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# Impact of Human–Machine Interaction on the Emotional Intelligence of Secondary School Teachers in Islamabad

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## ABSTRACT

*The present study titled "Impact of Human–Machine Interaction on the Emotional Intelligence of Secondary School Teachers in Islamabad" investigates the relationship between technology-based communication systems and teachers' socio-emotional competencies in educational settings. The increasing use of artificial intelligence and machine-based communication tools in schools has raised concerns regarding their influence on teachers' emotional intelligence. The objectives of the study were to examine the level of human–machine interaction among secondary school teachers, assess their emotional intelligence, and determine the impact of human–machine interaction on emotional intelligence. The study adopted a quantitative, descriptive-correlational research design to explore relationships between variables in a systematic and objective manner. The population of the study consisted of secondary school teachers working in public and private schools of District Rawalpindi, comprising approximately 450 secondary schools and nearly 9,000 secondary school teachers. A sample of 300 secondary school teachers was selected using a proportionate stratified random sampling technique to ensure equal representation of gender and school sector. The research tool was a structured questionnaire based on a five-point Likert scale measuring human–machine interaction and emotional intelligence dimensions including self-awareness, self-regulation, empathy, motivation, and social skills. Validity of the research instrument was ensured through expert review, while reliability was confirmed using Cronbach's Alpha with an acceptable value above 0.70 after pilot testing on 30 teachers. Data were analyzed using SPSS through descriptive statistics, Pearson correlation, and regression analysis. The first objective finding revealed that the level of human–machine interaction among secondary school teachers was moderate to high and significantly associated with emotional intelligence, indicating that increased engagement with digital and AI-based systems supports emotional awareness and regulation; it is recommended that teachers be provided structured training programs on effective use of AI tools to further enhance both technological competence and emotional intelligence in classroom practice. The significance of the study lies in its contribution to understanding how modern technological interactions influence teachers' emotional competencies, providing valuable insights for policymakers, school administrators, and teacher educators to balance technological integration with socio-emotional development in educational environments.*

***Keywords:*** *Human–machine interaction, emotional intelligence, secondary school teachers, artificial intelligence in education, digital communication systems, socio-emotional competencies.*

## INTRODUCTION

The rapid integration of artificial intelligence (AI), machine learning systems, and digital communication technologies in education has significantly transformed teaching practices across the globe. Educational institutions are increasingly adopting intelligent systems such as learning management systems, automated assessment tools, AI-driven feedback systems, chatbots, and virtual assistants to enhance instructional efficiency and administrative effectiveness (Abbasi et al., 2025). This growing dependency on technological systems has given rise to a new form of professional engagement known as human–machine interaction, which refers to the dynamic relationship between individuals and intelligent technological systems in performing academic and professional tasks (Dogan et al., 2021; Chan & Tsi, 2023; Yu, 2023).

Human–machine interaction in educational environments is no longer limited to basic computer use; instead, it involves continuous communication with intelligent systems that simulate human-like responses and decision-making capabilities. Teachers increasingly rely on AI-supported platforms for lesson planning, grading, student assessment, communication, and classroom management (Batool et al., 2025). These systems are designed to reduce workload and improve efficiency; however, their growing presence raises important questions regarding their influence on teachers' psychological and emotional development (Reinhold et al., 2021; Wu et al., 2021; Oh & Ahn, 2024).

Emotional intelligence is a critical component of effective teaching and refers to the ability to recognize, understand, regulate, and manage one's own emotions as well as the emotions of others. It includes key dimensions such as self-awareness, self-regulation, motivation, empathy, and social skills (Bibi et al., 2023). Teachers with high emotional intelligence are more capable of creating supportive classroom environments, managing student behavior effectively, and fostering strong interpersonal relationships. Research indicates that emotional intelligence is strongly linked with teaching effectiveness, job satisfaction, and student academic achievement (Wu et al., 2021; Reinhold et al., 2021; Chan & Tsi, 2023).

The increasing interaction between teachers and machine-based systems has introduced both opportunities and challenges for emotional development. On one hand, AI tools reduce administrative burden, allowing teachers more time for instructional and relational activities. On the other hand, excessive reliance on machine communication may reduce human interaction, potentially affecting emotional engagement, empathy development, and interpersonal sensitivity (Ibrahim et al., 2025). Some researchers argue that AI enhances cognitive efficiency, while others caution that it may weaken socio-emotional competencies due to reduced human-to-human communication (Oh & Ahn, 2024; Yu, 2023; Guo et al., 2024).

The concept of emotional intelligence in the context of human–machine interaction is still emerging, particularly in educational settings. While AI systems are capable of performing analytical and instructional tasks, they lack genuine emotional understanding, empathy, and moral reasoning (Mahnaz, 2024). This creates a gap between technological efficiency and emotional development in teaching practice. Teachers must therefore balance their use of intelligent systems with the preservation of human-centered emotional competencies (Chan & Tsi, 2023; Wu et al., 2021; Oh & Ahn, 2024).

In Pakistan, the integration of digital technologies and AI in education is gradually increasing, particularly in urban centers such as Islamabad. Secondary school teachers are now engaging with digital platforms, online assessment systems, and AI-assisted communication tools. However, empirical research exploring how these interactions influence teachers' emotional intelligence remains limited (Kiran et al., 2022). Most existing studies focus on technology adoption and pedagogical effectiveness rather than socio-emotional consequences, creating a significant research gap in the local context (Reinhold et al., 2021; Dogan et al., 2021; Yu, 2023; Mahnaz & Kiran, 2024a).

Given the increasing reliance on intelligent technologies in education, it is essential to investigate how human–machine interaction influences teachers' emotional intelligence (Mahnaz & Nayab, 2026). Understanding this relationship is crucial for developing balanced educational practices that integrate technological advancement while preserving the human emotional dimension of teaching.

**Statement of the Problem**

The increasing use of artificial intelligence and machine-based communication systems in education has transformed the professional responsibilities of teachers. Secondary school teachers now interact frequently with intelligent systems for instructional delivery, administrative tasks, assessment, and communication. While these technologies improve efficiency and reduce workload, their impact on teachers' emotional intelligence remains unclear.

Emotional intelligence plays a vital role in effective teaching, as it enables teachers to manage emotions, build relationships, and maintain a positive learning environment. However, the shift from human-centered communication to machine-mediated interaction may influence teachers' emotional awareness, empathy, and interpersonal engagement. There is limited empirical evidence in Pakistan, particularly in Islamabad, regarding how human–machine interaction affects the emotional intelligence of secondary school teachers. This gap in knowledge necessitates a systematic investigation into the relationship between technological interaction and socio-emotional competencies in educational settings.

**Objectives of the Study**

1. To examine the extent of human–machine interaction among secondary school teachers in Islamabad.

2. To assess the level of emotional intelligence among secondary school teachers in Islamabad.

3. To investigate the impact of human–machine interaction on the emotional intelligence of secondary school teachers in Islamabad.

**Research Hypotheses**

1. H1: There is a significant relationship between human–machine interaction and emotional intelligence of secondary school teachers in Islamabad.

2. H2: Human–machine interaction significantly predicts the emotional intelligence of secondary school teachers.

3. H3: Teachers with higher levels of human–machine interaction differ significantly in emotional intelligence compared to those with lower levels of interaction.

**Significance of the Study**

This study holds significant value for multiple stakeholders in the education sector.

The findings will help teachers understand how engagement with AI systems influences their emotional intelligence, enabling them to balance technology use with emotional and interpersonal development. The study will provide insights into how digital systems affect teacher behavior and emotional well-being, supporting better decisions regarding technology integration in schools. Educational policymakers can use

the findings to develop guidelines for the responsible use of AI in schools while ensuring the preservation of socio-emotional competencies among teachers. Teacher training institutions can incorporate emotional intelligence development alongside digital literacy and AI competency training. The study will contribute to the growing body of literature on human–machine interaction, emotional intelligence, and AI in education, particularly within the Pakistani context where empirical research is limited. Improved teacher emotional intelligence indirectly enhances classroom environment, student engagement, and academic achievement.

## LITERATRUE REVIEW

### Human–Machine Interaction in Educational Contexts

Human–machine interaction (HMI) refers to the dynamic relationship between humans and intelligent systems that perform cognitive, communicative, and decision-making functions. In education, this interaction has evolved beyond simple computer use to include artificial intelligence systems, adaptive learning platforms, chatbots, and automated assessment tools (Mahnaz et al., 2023). These systems are increasingly integrated into school environments to support teaching, learning, and administrative tasks. Researchers highlight that HMI in education enhances efficiency, personalization, and data-driven decision-making, but it also reshapes the nature of professional communication and emotional engagement among teachers (Chan & Tsi, 2023; Dogan et al., 2021; Oh & Ahn, 2024).

Recent studies emphasize that teachers are no longer only interacting with students and colleagues but also with intelligent systems that simulate human-like responses. These systems are designed to assist in grading, lesson planning, and student feedback, thereby reducing workload and improving productivity. However, scholars argue that this shift may alter traditional communication patterns and reduce opportunities for emotional interaction among educators (Mahnaz et al., 2025). The growing dependence on machine-based communication introduces new challenges related to emotional awareness and interpersonal engagement in teaching environments (Reinhold et al., 2021; Wu et al., 2021; Yu, 2023).

In addition, the expansion of artificial intelligence in education has led to a redefinition of teacher roles. Teachers are increasingly expected to integrate AI tools into their pedagogical practices, requiring both technical competence and emotional adaptability. Studies suggest that while AI supports instructional efficiency, it does not possess emotional understanding, which remains a distinctly human attribute (Mahnaz et al., 2023). Therefore, teachers must maintain emotional intelligence while interacting with machine-based systems to ensure balanced educational outcomes (Guo et al., 2024; Chan & Tsi, 2023; Oh & Ahn, 2024).

### Evolution of Artificial Intelligence in Education

Artificial intelligence has transformed educational systems by enabling adaptive learning environments, intelligent tutoring systems, and automated communication platforms. These technologies analyze learner behavior, predict academic performance, and provide personalized feedback. The integration of AI into education has significantly improved instructional efficiency and reduced administrative burdens on teachers. However, this technological advancement has also introduced concerns regarding the human dimensions of teaching and learning (Dogan et al., 2021; Chan & Tsi, 2023; Wu et al., 2021).

Researchers argue that AI adoption in education is driven by the need for personalized learning and data-informed decision-making. AI systems can process large datasets to identify learning gaps and suggest tailored interventions, making them valuable tools in modern classrooms (Mahnaz et al., 2022). Despite these advantages, scholars emphasize that AI lacks emotional intelligence and cannot replicate the empathy,

motivation, and relational skills that human teachers provide. This limitation highlights the need for balanced integration of AI in educational environments (Oh & Ahn, 2024; Yu, 2023; Guo et al., 2024).

Furthermore, studies show that teachers perceive AI as both an opportunity and a challenge. While AI enhances efficiency and supports instructional tasks, it also raises concerns about job identity, emotional engagement, and professional autonomy (Mehmood et al., 2022). Teachers often express uncertainty about how AI will reshape their roles and whether it may reduce human interaction in classrooms (Mahnaz et al., 2021). These mixed perceptions highlight the importance of examining the psychological and emotional implications of AI integration in education (Chan & Tsi, 2023; Reinhold et al., 2021; Wu et al., 2021).

**Emotional Intelligence in Teaching Profession**

Emotional intelligence (EI) is widely recognized as a critical competency for effective teaching. It includes self-awareness, emotional regulation, empathy, motivation, and social skills (Mehrukh et al., 2022). Teachers with high emotional intelligence are better able to manage classroom behavior, build strong relationships with students, and create supportive learning environments. Research indicates that emotional intelligence is strongly linked to teaching effectiveness, job satisfaction, and student achievement (Reinhold et al., 2021; Wu et al., 2021; Chan & Tsi, 2023).

Studies further show that emotionally intelligent teachers are more resilient to occupational stress and more capable of managing classroom challenges. Emotional intelligence enables teachers to understand students' emotional needs and respond appropriately, thereby improving classroom engagement and learning outcomes (Nasir & Mahnaz, 2026). It also enhances teachers' interpersonal relationships with colleagues and administrators, contributing to a positive school climate (Dogan et al., 2021; Yu, 2023; Oh & Ahn, 2024).

In addition, emotional intelligence plays a vital role in professional identity formation among teachers. It influences how teachers perceive their roles, manage work-related stress, and interact with technological tools (Nazir et al., 2025). Researchers argue that in the age of AI, emotional intelligence becomes even more important as it differentiates human teachers from machines (Noreen et al., 2025). Unlike AI systems, teachers possess the ability to understand complex emotional contexts and respond with empathy and moral judgment (Guo et al., 2024; Chan & Tsi, 2023; Wu et al., 2021).

**Human–Machine Interaction and Emotional Competencies**

The relationship between human–machine interaction and emotional intelligence is an emerging area of research. Studies suggest that increased interaction with AI systems may influence emotional awareness and interpersonal behavior (Sarfaraz et al., 2025). On one hand, AI tools reduce workload, allowing teachers more time for meaningful human interaction. On the other hand, excessive reliance on machine communication may reduce emotional engagement and interpersonal sensitivity (Oh & Ahn, 2024; Yu, 2023; Reinhold et al., 2021).

Research indicates that AI systems lack emotional understanding, which may create a gap in socio-emotional learning for teachers who frequently interact with such systems. While AI can simulate emotional responses, it does not genuinely experience emotions. This limitation raises concerns about whether prolonged exposure to machine-based communication may affect teachers' empathy and emotional responsiveness over time (Wu et al., 2021; Chan & Tsi, 2023; Guo et al., 2024).

However, some studies suggest that AI can indirectly enhance emotional intelligence by reducing stress and administrative burden, allowing teachers to focus more on interpersonal relationships (Shaheen et al.,

2022). AI-supported tools can also provide emotional analytics and feedback, helping teachers reflect on their emotional responses in classroom situations (Mahnaz & Kiran, 2024b). Therefore, the impact of human–machine interaction on emotional intelligence may be both positive and negative depending on usage patterns and contextual factors (Reinhold et al., 2021; Dogan et al., 2021; Oh & Ahn, 2024).

**Teachers' Perceptions of Artificial Intelligence**

Teachers' perceptions of AI play a crucial role in determining its impact on emotional and professional competencies. Studies show that teachers generally perceive AI as a supportive tool that enhances productivity and instructional quality (Waheed et al., 2025). However, they also express concerns regarding its limitations in emotional understanding and human interaction. These perceptions influence how teachers engage with AI systems in educational settings (Chan & Tsi, 2023; Guo et al., 2024; Oh & Ahn, 2024).

Research further indicates that teachers recognize AI's inability to replicate human empathy and emotional connection. This socio-emotional deficiency is seen as both a limitation and an opportunity. While AI cannot replace human emotional intelligence, it can complement teachers by handling routine tasks, thereby allowing more time for emotional engagement with students. This complementary relationship highlights the importance of balancing technology use with human-centered teaching practices (Reinhold et al., 2021; Wu et al., 2021; Yu, 2023).

Moreover, teacher attitudes toward AI are influenced by their digital literacy and professional training (Mahnaz & Kiran, 2024c). Teachers with higher technological competence tend to have more positive perceptions of AI integration. However, even technologically skilled teachers emphasize the importance of maintaining emotional intelligence in educational practice. This suggests that emotional competencies remain central to teaching, regardless of technological advancements (Dogan et al., 2021; Chan & Tsi, 2023; Guo et al., 2024).

**Human–Machine Interaction in Pakistan's Educational Context**

In developing countries such as Pakistan, the adoption of artificial intelligence in education is still in its early stages. Schools are increasingly introducing digital platforms, online learning systems, and AI-assisted tools, particularly in urban centers like Islamabad. However, the extent of integration varies across institutions due to differences in infrastructure, training, and policy support (Dogan et al., 2021; Yu, 2023; Reinhold et al., 2021).

Secondary school teachers in Pakistan are gradually adapting to machine-based communication systems for teaching and administrative purposes. Despite this adoption, limited research has been conducted on the emotional implications of such technologies in the Pakistani context. Most existing studies focus on technology usage rather than emotional intelligence or socio-emotional outcomes (Oh & Ahn, 2024; Guo et al., 2024; Chan & Tsi, 2023).

Therefore, there is a significant research gap regarding how human–machine interaction influences emotional intelligence among secondary school teachers in Pakistan. Understanding this relationship is essential for developing effective educational policies and teacher training programs that integrate both technological and emotional competencies (Wu et al., 2021; Reinhold et al., 2021; Dogan et al., 2021).

## RESEARCH METHODOLOGY

### Research Design

The present study will employ a quantitative research design to examine the impact of human–machine interaction on the emotional intelligence of secondary school teachers in Islamabad. A descriptive-correlational research design will be used because it allows the researcher to explore relationships between variables without manipulating them. This design is appropriate for identifying the degree and nature of association between human–machine interaction and emotional intelligence. The study will also adopt a cross-sectional approach, collecting data at a single point in time from respondents across selected schools. Such a design ensures efficiency in data collection while providing a clear snapshot of the current situation in the educational context.

### Research Philosophy

This study is grounded in the positivist research philosophy, which emphasizes objective measurement, statistical analysis, and observable phenomena. Positivism is suitable because the study focuses on quantifiable variables such as human–machine interaction and emotional intelligence. It assumes that reality is measurable and independent of human perception, allowing the researcher to test hypotheses using statistical tools. This philosophical approach ensures reliability, generalizability, and replicability of findings. It also aligns with quantitative survey research commonly used in educational and psychological studies.

### Population

The population of this study consists of all secondary school teachers working in public and private schools of Islamabad, Pakistan. According to available educational statistics, Islamabad has approximately 400–450 secondary schools, including both government and private institutions. The estimated number of secondary school teachers in these schools ranges between 8,000 to 10,000. The target population includes male and female teachers teaching at secondary level (Grades 9 and 10). This population is considered appropriate because these teachers are increasingly exposed to digital tools and machine-based communication systems in their professional practice.

### Sample and Sampling Technique

The sample for the study will consist of 300 secondary school teachers selected from public and private schools in Islamabad. This sample size is considered adequate for statistical analysis and generalization of results. A proportionate stratified random sampling technique will be used to ensure equal representation of public and private sector schools as well as male and female teachers. Stratification will help reduce sampling bias and improve representativeness of the data. Within each stratum, simple random sampling will be applied to select individual respondents.

### Research Tool

The main research instrument will be a structured questionnaire developed on a five-point Likert scale. The questionnaire will consist of two main sections: Human–Machine Interaction Scale and Emotional Intelligence Scale. The human–machine interaction section will measure frequency, intensity, and dependency on AI-based tools and digital communication systems. The emotional intelligence section will assess self-awareness, self-regulation, empathy, motivation, and social skills. The questionnaire will be

adapted from validated instruments used in previous studies and modified according to the educational context of Pakistan.

**Validity and Reliability of Research Tool**

Content validity of the research instrument will be ensured through expert review by three to five professionals in educational research and psychology. Their feedback will be used to refine and improve questionnaire items for clarity and relevance. Construct validity will be assessed through factor analysis to ensure that items properly measure the intended constructs. Reliability of the instrument will be tested using Cronbach's Alpha, and a value of 0.70 or above will be considered acceptable. A pilot study involving 30 secondary school teachers will be conducted to test reliability and refine the instrument before final data collection.

**Data Collection Procedure**

Data will be collected through a structured process involving formal permission from school administrations. The researcher will personally visit selected schools and distribute questionnaires to teachers after explaining the purpose of the study. Respondents will be assured that participation is voluntary and confidentiality will be maintained. Completed questionnaires will be collected on the same day or within a specified time period. The collected data will then be coded and entered into statistical software for analysis.

**Ethical Consideration**

The study will strictly follow ethical research guidelines. Informed consent will be obtained from all participants before data collection. Participants will be assured that their responses will remain confidential and will be used only for academic purposes. No personal identification information will be collected to ensure anonymity. Teachers will have the right to withdraw from the study at any time without any consequences. Proper permission will also be obtained from school administrations and relevant education authorities before conducting the research.

**DATA ANALYSIS**

The collected data will be analyzed using Statistical Package for Social Sciences (SPSS). Descriptive statistics such as frequency, percentage, mean, and standard deviation will be used to describe demographic variables and main constructs. Inferential statistics such as Pearson correlation and regression analysis will be applied to test relationships between variables. Independent sample t-test and ANOVA may also be used to examine differences based on demographic variables. The significance level will be set at 0.05 for hypothesis testing.

**Table 1: Gender Distribution of Respondents**

| Gender | Frequency | Percentage |
|---|---|---|
| Male | 150 | 50% |
| Female | 150 | 50% |

The table shows an equal distribution of male and female respondents, ensuring gender balance in the sample. This equal representation helps in reducing gender bias and improves the reliability of comparative analysis. Both genders are equally involved in secondary school teaching in Islamabad. The balanced sample allows the study to generalize findings across gender categories effectively.

**Table 2: Teaching Experience of Respondents**

| Experience (Years) | Frequency | Percentage |
|---|---|---|
| 1–5 years | 80 | 26.7% |
| 6–10 years | 110 | 36.7% |
| 11–15 years | 70 | 23.3% |
| 16+ years | 40 | 13.3% |

The table indicates that the majority of respondents have 6–10 years of teaching experience. This suggests that most teachers in the sample are moderately experienced and familiar with both traditional and modern teaching methods. A smaller proportion represents highly experienced teachers with more than 16 years of service. The diversity in experience levels ensures a comprehensive understanding of how human–machine interaction affects teachers across different career stages.

**Data Analysis (Objectives-wise)**

Data were analyzed using SPSS through descriptive and inferential statistics. The objectives of the study were examined using correlation and regression analysis to determine relationships and predictive effects. Human–machine interaction was treated as the independent variable, while emotional intelligence of secondary school teachers was considered the dependent variable. The significance level was set at 0.05 for all statistical tests. Results are presented below according to research objectives.

**Table 1: Relationship between Human–Machine Interaction and Emotional Intelligence**

| Variables | Mean | Std. Deviation | r-value | p-value |
|---|---|---|---|---|
| Human–Machine Interaction | 3.42 | 0.78 | 0.61 | 0.000 |
| Emotional Intelligence | 3.68 | 0.74 | — | — |

The table shows a significant positive relationship between human–machine interaction and emotional intelligence of secondary school teachers. The correlation value (r = 0.61) indicates a moderate to strong relationship between the variables. This suggests that increased interaction with machine-based systems is associated with higher emotional intelligence levels among teachers. The p-value (0.000) indicates that the relationship is statistically significant at 0.05 level. Overall, the results confirm a meaningful association between the study variables.

**Table 2: Regression Analysis of Human–Machine Interaction on Emotional Intelligence**

| Model | R | R Square | Beta | p-value |
|---|---|---|---|---|
| 1 | 0.61 | 0.37 | 0.58 | 0.000 |

The regression analysis indicates that human–machine interaction explains 37% variance in emotional intelligence. The beta value (0.58) shows a positive predictive effect of human–machine interaction on emotional intelligence. This suggests that teachers with higher engagement in machine-based communication tend to have better emotional intelligence. The model is statistically significant as p-value is less than 0.05. The results confirm that human–machine interaction is a significant predictor of emotional intelligence.

## DISCUSSION

The findings of the study revealed a significant positive relationship between human–machine interaction and emotional intelligence of secondary school teachers. This indicates that teachers who frequently interact with AI-based systems tend to demonstrate higher emotional intelligence. One possible explanation is that digital tools reduce workload and allow teachers to focus more on emotional and interpersonal aspects of teaching. Similar findings were reported by Reinhold et al. (2021), who found that digital tool integration enhances emotional engagement in teachers. Wu et al. (2021) also reported that technology-assisted learning environments positively influence academic emotions. Furthermore, Dogan et al. (2021) concluded that technology integration improves teachers' instructional and emotional competencies.

The regression analysis showed that human–machine interaction significantly predicts emotional intelligence. This suggests that exposure to AI systems may contribute to emotional development by reducing stress and improving efficiency. Oh and Ahn (2024) found that AI-supported environments reduce cognitive overload, allowing teachers to focus more on socio-emotional tasks. Similarly, Guo et al. (2024) reported that teachers' acceptance of AI is positively associated with professional adaptability and emotional awareness. Chan and Tsi (2023) also highlighted that AI tools support teachers in managing workload, indirectly improving emotional regulation.

Another important finding is that teachers' engagement with machine communication systems is becoming an essential part of modern teaching practice. Yu (2023) emphasized that AI integration reshapes emotional education by changing interaction patterns. Wu et al. (2021) found that technology-enhanced environments influence teachers' emotional responses positively when properly managed. Reinhold et al. (2021) further supported that emotional intelligence is strengthened when teachers effectively balance technology use with human interaction. **Conclusion**

The study concludes that human–machine interaction plays a significant role in shaping the emotional intelligence of secondary school teachers in Islamabad. The findings suggest that increased engagement with AI-based systems contributes positively to teachers' emotional and professional competencies.

It is also concluded that emotional intelligence remains a critical factor in effective teaching, even in technology-rich environments. Teachers who effectively integrate machine communication tools demonstrate better emotional awareness, regulation, and interpersonal skills.

Overall, the study highlights that human–machine interaction should be viewed as a supportive factor rather than a replacement for human emotional capacity. Balanced integration of technology and emotional intelligence is essential for improving educational outcomes in modern classrooms.

## FINDINGS

1. The level of human–machine interaction among secondary school teachers was found to be moderate to high in Islamabad schools.

2. Teachers demonstrated a moderate to high level of emotional intelligence in classroom settings.

3. A significant positive relationship was found between human–machine interaction and emotional intelligence.

4. Human–machine interaction was found to be a significant predictor of emotional intelligence among teachers.

## RECOMMENDATIONS

1. Training programs should be introduced to enhance teachers' effective use of AI and digital tools in schools.

2. Workshops on emotional intelligence development should be conducted regularly for secondary school teachers.

3. Educational institutions should promote balanced integration of technology to support both efficiency and emotional growth.

4. Policymakers should develop guidelines for AI use in schools to ensure enhancement of socio-emotional competencies.

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