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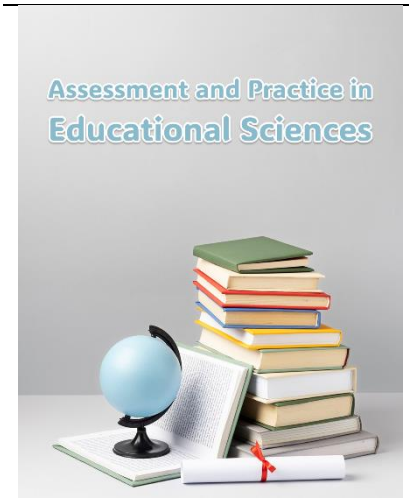

Algorithmic Bias Awareness and Ethical Reasoning: Moderating the Impact of Systemic Biases in Generative Artificial Intelligence on Critical Thinking and Information Literacy in Higher Education

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ABSTRACT

This study aimed to examine whether algorithmic bias awareness and ethical reasoning moderate the effects of perceived systemic biases in generative artificial intelligence on critical thinking and information literacy among higher education students in Tehran. The study employed a quantitative, cross-sectional correlational design with a moderation framework. Participants were 351 undergraduate and postgraduate students from public and private universities in Tehran selected through multistage cluster sampling. Data were collected using validated instruments measuring perceived systemic AI bias, algorithmic bias awareness, ethical reasoning, critical thinking, and information literacy. After preliminary data screening, hierarchical regression and structural equation modeling were conducted to test direct and interaction effects while controlling for demographic variables and frequency of AI use. Model fit was evaluated using standard goodness-of-fit indices. Perceived systemic bias in generative AI significantly and negatively predicted both critical thinking and information literacy. Algorithmic bias awareness and ethical reasoning each showed significant positive main effects on both outcome variables. Interaction analyses revealed significant moderation effects, indicating that high levels of algorithmic bias awareness and ethical reasoning substantially weakened the negative impact of systemic AI bias on critical thinking and information literacy. The structural equation model demonstrated excellent fit and confirmed the robustness of the proposed conceptual framework. The findings indicate that while systemic biases in generative AI pose measurable risks to essential academic competencies, these risks can be effectively mitigated through the development of algorithmic bias awareness and ethical reasoning, underscoring the necessity of embedding these capacities within higher education curricula and AI governance frameworks.

Keywords: Generative artificial intelligence; algorithmic bias awareness; ethical reasoning; critical thinking; information literacy; higher education

Introduction

Learner engagement has emerged as one of the most decisive determinants of educational quality and learning effectiveness across disciplines and contexts, particularly within second and foreign language education. Engagement represents the degree to which learners actively participate in, emotionally connect with, and cognitively invest in learning processes, thereby shaping both immediate academic performance and long-term educational trajectories (1-3). Contemporary models conceptualize engagement as a multidimensional construct encompassing behavioral, emotional, and cognitive components, each of which contributes uniquely to learners' persistence, achievement, and psychological well-being (1, 4). In language learning

environments—where anxiety, identity negotiation, and sustained motivation are particularly salient—engagement assumes even greater significance for successful acquisition (5, 6).

Within this framework, growing attention has been directed toward the interpersonal and emotional foundations of engagement. Research increasingly recognizes that classroom engagement is not produced solely by curricular design or instructional techniques, but is profoundly shaped by the emotional and relational qualities of the learning environment (7, 8). Teachers, as the primary architects of this environment, exert powerful influence over learners' affective experiences, motivation, and willingness to invest effort in cognitively demanding tasks (9, 10). In this regard, teacher emotional intelligence (EI) has emerged as a pivotal professional competence underpinning classroom climate, instructional effectiveness, and learner engagement (11, 12).

The construct of emotional intelligence is grounded in the seminal work of Mayer and Salovey, who conceptualized EI as a set of cognitive-emotional abilities involving the perception, understanding, utilization, and regulation of emotions in oneself and others (13, 14). Goleman's influential model further expanded EI to encompass social and interpersonal competencies such as empathy, motivation, self-regulation, and relationship management, positioning EI as a central predictor of professional success and leadership effectiveness (15). In educational contexts, these abilities manifest in teachers' capacity to recognize students' emotional cues, manage their own emotional responses to classroom challenges, and cultivate emotionally supportive relationships that foster trust and psychological safety (16, 17).

Empirical research consistently demonstrates that teachers with higher emotional intelligence generate more positive classroom climates, exhibit more effective classroom management, and maintain stronger teacher–student relationships (18, 19). Such environments are strongly associated with learners' academic motivation, emotional well-being, and sustained engagement (7, 12). In language classrooms specifically, teacher EI has been shown to predict learners' enjoyment, reduce foreign language anxiety, and enhance students' willingness to communicate and participate actively in instruction (20-22).

Parallel to developments in teacher emotion research, engagement theory has undergone significant conceptual refinement. Behavioral engagement reflects learners' observable participation, persistence, and effort in academic activities; emotional engagement encompasses learners' interest, enjoyment, and sense of belonging; and cognitive engagement refers to the depth of learners' strategic processing, self-regulation, and investment in mastering complex ideas (1, 2). Importantly, these dimensions, while interrelated, are empirically distinct and respond to different classroom conditions (3, 4). Emotional and cognitive engagement, in particular, have been identified as the strongest predictors of deep learning, conceptual understanding, and long-term academic success (6, 23).

In EFL contexts, where learners frequently experience anxiety, limited exposure, and high-stakes assessment pressures, engagement is both fragile and essential. Research across diverse cultural settings confirms that emotionally supportive classrooms significantly enhance EFL learners' academic engagement and language outcomes (22, 24, 25). Teacher emotional intelligence operates as a critical mechanism through which such environments are constructed, influencing not only classroom climate but also learners' internal motivational processes (5, 26).

Recent studies have increasingly documented these relationships. Namaziandost and Kargar Behbahani's work on learning-oriented assessment highlights the interconnected roles of classroom climate, trait emotional intelligence, and academic engagement in EFL learning (27, 28). Zhou's investigation into teacher–student emotional dynamics further demonstrates that teacher EI exerts a direct influence on learners' cognitive engagement, shaping how deeply students process linguistic input and persist with challenging tasks (23). Similarly, Qi's time-series analysis reveals dynamic interactions between emotional states, classroom atmosphere, and academic engagement among language learners (6).

Beyond traditional classroom instruction, emerging digital and AI-supported learning environments have further emphasized the importance of engagement. Abad-Bataller's work on AR-enhanced AI feedback shows that emotionally responsive instructional design significantly increases EFL learners' writing engagement (29). Shen and colleagues' mixed-methods study demonstrates that students' engagement in GenAI-assisted writing environments is jointly shaped by motivational factors and emotional responses to instructional technology (30). Alqurashi similarly reports that AI-supported writing platforms influence both behavioral and cognitive engagement among L2 learners (31), while Alarifi and colleagues find that learners' attitudes toward AI use significantly predict their engagement and satisfaction in EFL reading instruction (32). These developments underscore that engagement remains fundamentally rooted in emotional and relational processes even as instructional technologies evolve.

At the same time, social and contextual influences continue to shape engagement. Putri and Martriwati demonstrate that teachers' attitudes toward students strongly affect learner motivation and engagement in EFL classrooms (33). Madhanlal and Nakedi show that teachers' socio-emotional practices significantly enhance learners' cognitive achievement (34). Espid and colleagues' modeling of Iranian secondary schools further confirms that teachers' emotional intelligence dimensions directly influence classroom management and learning conditions (35). Rao and Verma's work on serious games for children with disabilities extends this argument, illustrating how emotionally responsive adult facilitation enhances learners' engagement even in technologically mediated environments (36).

Despite this growing body of evidence, several critical gaps remain. First, much of the existing research treats teacher emotional intelligence as a global trait, obscuring the potentially distinct contributions of its underlying components—emotional perception, understanding, regulation, and relational competence—to different dimensions of learner engagement (12, 37). Second, while engagement is now recognized as multidimensional, relatively few studies have simultaneously examined how specific EI facets relate to behavioral, emotional, and cognitive engagement within the same analytical framework (23, 24). Third, there remains a shortage of empirically rigorous studies situated in non-Western EFL contexts, particularly in educational systems characterized by high-stakes examinations and strong institutional pressures, where engagement may manifest differently from Western settings (26, 35).

Iranian EFL classrooms provide a particularly compelling context for addressing these gaps. English proficiency carries substantial academic and economic value, yet instruction is often dominated by examination-oriented curricula, large class sizes, and intense performance pressures. Under such conditions, learners may display outward behavioral compliance while remaining emotionally disengaged and cognitively superficial. Teachers, in turn, face heightened emotional demands in maintaining motivation, managing anxiety, and sustaining productive classroom climates. Understanding how teacher emotional intelligence operates within this context is therefore both theoretically and practically significant.

By integrating established models of emotional intelligence (13-15) with contemporary engagement theory (1, 3), and situating the investigation within the Iranian EFL context, the present study seeks to clarify whether teacher EI functions as a meaningful lever for enhancing multidimensional learner engagement and to identify which facets of EI are most consequential for each engagement dimension.

The aim of this study is to examine the extent to which teacher emotional intelligence predicts behavioral, emotional, and cognitive engagement among Iranian EFL learners.

Methods and Materials

The study used a cross-sectional, questionnaire-based design to examine associations between teacher emotional intelligence and multidimensional learner engagement in Iranian EFL classrooms. Data were collected in a single academic term from

language institutes and secondary schools in Tehran, Karaj, and their surrounding suburbs, where English is taught as a foreign language in predominantly examination-oriented programs. The sampling frame comprised EFL teachers responsible for intact upper-secondary classes and their students. Institutions were identified through professional networks and local education offices, and only those that granted permission were included. Within participating institutions, all teachers who taught at least one English class with a minimum of seven students were invited. Twenty-five teachers agreed to participate and formed the Level 2 sample. The teacher group included 13 women (52%) and 12 men (48%), with a mean age of 33.52 years and an average of 9.80 years of teaching experience; on average, they reported teaching 15.80 students per class and 16.80 hours of English per week. All students enrolled in the focal classes of these teachers were invited to complete the learner questionnaire, yielding data from 232 students (Level 1 units). The student group comprised 121 male (52.16%) and 111 female (47.84%) students, with a mean age of 19.16 years, an average of 8.10 years of prior English study, and a mean self-rated proficiency of 3.06 on a five-point scale. This two-stage recruitment procedure produced a naturally nested dataset, with students clustered within teachers and focal class sizes ranging from seven to twelve learners, a configuration judged adequate for the estimation of random-intercept multilevel models.

The focal constructs were operationalized through brief subscales grounded in established theoretical and empirical work on teacher emotional intelligence and learner engagement. Teacher emotional intelligence was assessed using a 12-item self-report instrument developed for the present study based on ability-based and mixed-model frameworks and prior research on teachers' socio-emotional competencies. Items targeted four domains: emotional perception and appraisal (sensitivity to individual student cues, awareness of classroom mood, and awareness of one's own emotions while teaching), emotional understanding (discriminating among students' affective states, inferring likely antecedents, and anticipating reactions to instructional events), emotional regulation and management (down-regulating frustration, de-escalating classroom tension, and adjusting communication to support students' emotion regulation), and relational–empathic competence (taking students' feelings seriously, adopting their perspective, and cultivating relationships based on trust and respect). Each facet was measured by three items rated on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Subscale scores were computed as the mean of the three items, with higher scores indicating higher levels of the corresponding emotional intelligence domain. Learner engagement was measured using a nine-item student questionnaire derived from multidimensional engagement models and adapted to the EFL context. Three items assessed behavioral engagement (effort in classroom activities, active participation such as answering questions and working in groups, and persistence in the face of difficulty), three items assessed emotional engagement (enjoyment of English lessons, perceiving them as interesting and worthwhile, and feeling a sense of belonging in English class), and three items assessed cognitive engagement (attempting to understand rather than merely memorize, using strategies such as review, practice, and questioning, and considering how to apply English in real-life situations). All items were rated on the same five-point Likert scale, and subscale scores were calculated as the mean of the three items within each dimension, yielding scores between 1 and 5, with higher scores reflecting higher behavioral, emotional, or cognitive engagement.

Content and face validity of both instruments were examined prior to the main data collection. Initial item pools were drafted in English with reference to existing measures of teacher emotional intelligence and student engagement in general and language education. A panel of three senior scholars in applied linguistics and educational psychology and two experienced EFL teacher educators in Iran reviewed all items for conceptual relevance, clarity, and contextual appropriateness for EFL classrooms in Tehran and Karaj. Items judged redundant, ambiguous, or weakly aligned with the target domains were removed or revised. The refined teacher and student questionnaires were then piloted with a small convenience sample of EFL teachers and students from non-participating institutions in the same geographical area. Item distributions, inter-item correlations, and

preliminary reliability estimates were examined to identify poorly performing items. Minor wording changes were made, but the intended four-factor structure for teacher emotional intelligence and three-factor structure for learner engagement were retained. In the main study, internal consistency coefficients for all subscales were estimated, and confirmatory factor analyses were planned to evaluate the adequacy of the proposed measurement structure prior to the substantive multilevel analyses.

Data collection was conducted in collaboration with school and institute administrators. After institutional permission had been obtained, teachers received written information outlining the aims and procedures of the study, the voluntary nature of participation, and assurances of confidentiality and aggregate reporting. Teachers who consented completed the emotional intelligence questionnaire individually, outside teaching time, and returned it in sealed envelopes. On pre-arranged days, the student questionnaire was administered during regular English classes by the first author or a trained research assistant; teachers were present but did not administer or collect the questionnaires. Students were informed that the study concerned their experiences in English classes, that participation was voluntary, that their responses would not affect their grades or standing, and that they could refuse participation or omit any item without consequence. Only students who assented completed the questionnaire. Completed forms were checked on site for completeness and then anonymized; student questionnaires were linked to the corresponding teacher data through numerical identifiers so that multilevel analyses could be conducted without revealing individual identities. All procedures conformed to institutional ethical guidelines and adhered to principles of informed consent, voluntary participation, and confidentiality. Data was entered into a statistical environment and screened for accuracy, missing values, and univariate outliers. Scale scores for each emotional intelligence and engagement subscale were computed as described. Descriptive statistics (means, standard deviations, minima, and maxima) were calculated for all subscales, separately for teachers and students, alongside the descriptive indicators for the background variables (teacher age, teaching experience, class size, weekly hours; student age, years of English study, and self-rated proficiency), in order to characterize the sample and the distribution of focal constructs. Internal consistency reliability was examined using Cronbach's alpha for each three-item subscale, with particular attention to whether coefficients met or approached the .70 threshold commonly regarded as acceptable for brief research scales. To justify multilevel modelling, unconditional random-intercept models were first fitted for each engagement outcome to partition variance into within- and between-teacher components and to compute intraclass correlations indexing the proportion of variance attributable to teachers.

The primary inferential analyses used linear mixed-effects models with students at Level 1 and teachers at Level 2. For each engagement outcome (behavioral, emotional, and cognitive) a separate model was estimated in which the corresponding student score was predicted by the four-teacher emotional intelligence subscale scores entered simultaneously as Level-2 predictors. Each model included a random intercept for teacher to capture residual between-teacher variability. This specification allowed estimation of the unique association of each emotional intelligence facet with each engagement outcome while controlling for the remaining facets and accounting for the clustered data structure. For each model, fixed-effect coefficients, standard errors, p-values, and 95% confidence intervals were extracted to evaluate the strength and precision of the associations between teacher emotional intelligence and learner engagement. Reductions in the between-teacher variance components from the null to the full models were examined to quantify the extent to which the emotional intelligence predictors explained between-class differences in engagement. All analyses were conducted in R using appropriate packages for multilevel modelling, with two-tailed tests and α set at .05, and with effect sizes and confidence intervals emphasized in the interpretation of findings.

Findings and Results

To verify that the empirical structure of the data was suitable for multilevel analysis, the distribution of students across teachers was examined. The study comprised 25 teachers and 232 students. As summarized in Table 1 and depicted in Figure

1, class sizes were tightly constrained, ranging from 7 to 12 students per teacher, with a mean cluster size of approximately 9.3. The modal class sizes were 10 and 11 students, and these categories together accounted for nearly half of all classes. Only a small subset of teachers supervised the minimum of 7 students, and a single teacher supervised 12 students, indicating that the sample is not dominated by unusually small or unusually large clusters. This pattern has direct implications for the robustness of the subsequent hierarchical models. The relatively even distribution of students across teachers, visible in the plateau of bars around 9–11 students in Figure 1 and quantified in Table 1, implies that each Level 2 unit contributes a comparable amount of information to the estimation of between-teacher variance. Such balance reduces the risk that intraclass correlation coefficients or teacher-level fixed effects are disproportionately influenced by a few atypical clusters. The narrow class-size range also supports the assumption that the nesting structure is sufficiently regular to permit reliable partitioning of variance between teachers and students when modelling the associations between teacher emotional intelligence and learner engagement.

Table 1. Distribution of Students Across Teachers (Level-2 Units)

Class size (students)	Number of teachers
12	1
11	6
10	6
9	5
8	3
7	4

Total teachers = 25; total students = 232; mean class size = 9.28 students (range 7–12).

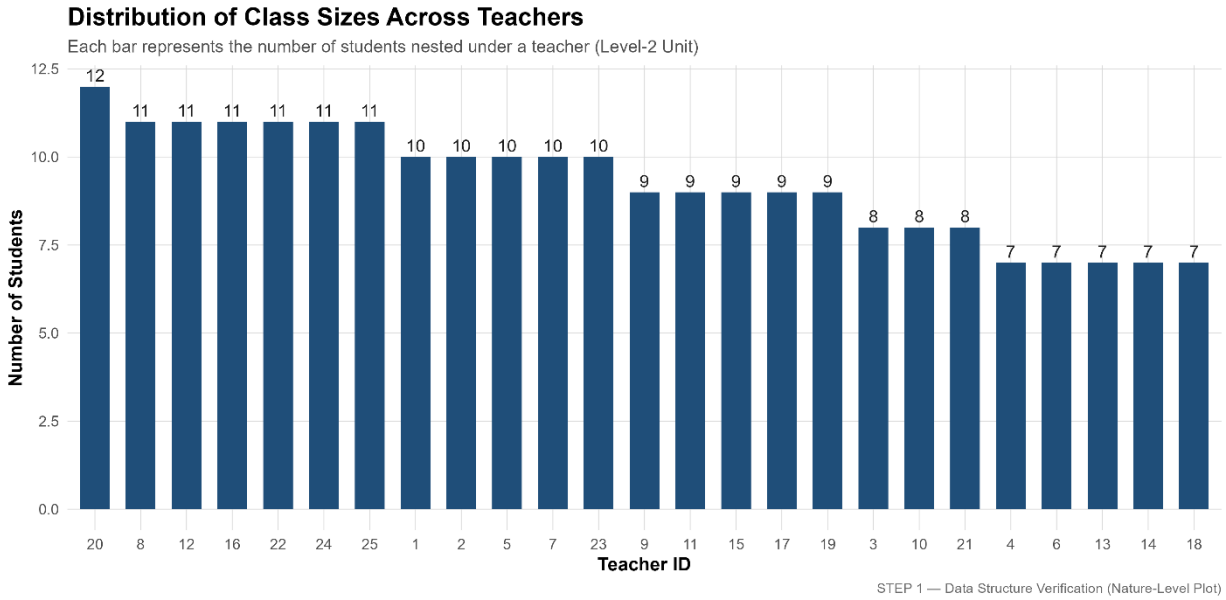

Figure 1. Distribution of Class Sizes Across Teachers; Each bar represents the number of students nested within a teacher (Level-2 unit).

Descriptive statistics for the three engagement dimensions are presented in Panel A of Table 2 and summarized graphically in Figure 2 (Boxplots of Student Engagement Subscales). Behavioral engagement showed the highest central tendency (M = 3.90, SD = 0.58). In Figure 2, the median lies in the upper half of the response scale, and the interquartile range extends approximately from 3.6 to 4.3, indicating that most students reported consistently high levels of behavioral investment in classroom activities. Emotional engagement yielded the lowest mean (M = 3.21, SD = 0.62) and a comparatively wider

interquartile range. The lower whisker in Figure 2 descends to values below 2.0, signaling that a noticeable subgroup of students experienced limited enjoyment and sense of belonging in English lessons. Cognitive engagement occupied an intermediate position (M = 3.41, SD = 0.58). Its boxplot is more compact than that of emotional engagement and clearly situated below the behavioral distribution, suggesting moderately positive but less uniformly high levels of strategic and deep engagement. A small number of extreme values are visible at both ends of the scale across the three subscales; however, these points are isolated and do not indicate pervasive outlier problems. The correlation heatmap in Figure 3 (Correlation Matrix of Student Engagement Subscales) quantifies the associations among the three engagement components. Behavioral and emotional engagement were positively related ($r \approx .21$), whereas behavioral and cognitive engagement showed only a minimal positive association ($r \approx .04$). The correlation between emotional and cognitive engagement was similarly modest ($r \approx .08$). Considered alongside the means and dispersions in Table 2, these coefficients indicate that the engagement subscales share limited variance and are empirically distinct rather than interchangeable indicators of a single underlying construct. None of the intercorrelations approaches a magnitude that would raise concerns about multicollinearity in subsequent regression or multilevel models, supporting the decision to treat behavioral, emotional, and cognitive engagement as separable outcomes.

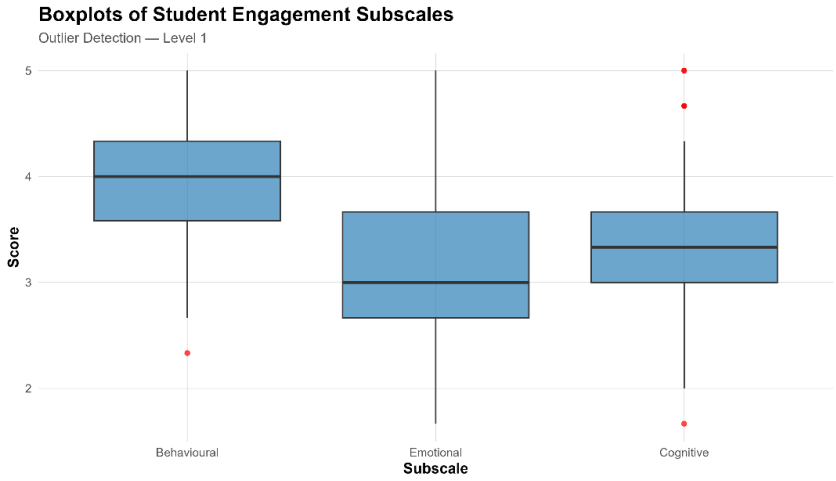

Figure 2. Boxplots of Student Engagement Subscales (Behavioural, Emotional, Cognitive).

Figure 3. Correlation Matrix of Student Engagement Subscales.

Panel B of Table 2 and Figure 4 (Boxplots of Teacher EI Subscales) summarize the distributions of the four teacher emotional intelligence facets. All subscales showed mean scores above the scale midpoint, indicating generally positive self-perceptions of emotional competence among teachers. EI_relationship demonstrated the highest central tendency (M = 4.00, SD = 0.54). In Figure 4, its box is shifted towards the upper part of the 1–5 scale and the upper whisker reach the maximum value, suggesting that several teachers reported very strong relational–empathic skills in their dealings with students. EI_perception (M = 3.69, SD = 0.51) and EI_understanding (M = 3.60, SD = 0.46) displayed similar means and relatively narrow interquartile ranges, consistent with a comparatively homogeneous level of ability in recognising and interpreting classroom emotions. EI_regulation yielded the lowest mean (M = 3.44, SD = 0.48), and its boxplot reveals a few notably low-scoring teachers, with outlier points around 2.0. These observations remain within a plausible range and are retained in the analysis, but they indicate greater heterogeneity in self-regulatory competence than in the other EI domains.

The correlation heatmap in Figure 5 (Correlation Matrix of Teacher EI Subscales) shows moderate positive associations among most EI dimensions. Emotional perception and emotional understanding were correlated at approximately r = .42, and emotional understanding correlated with EI_relationship at about r = .34, reflecting the expected conceptual linkage between recognizing, interpreting, and responding sensitively to students' affective states. EI_regulation exhibited weaker associations with the other facets ($r \approx .22$ with perception, $r \approx .20$ with understanding, and $r \approx .04$ with relationship), indicating that teachers' self-regulatory capacity is only partly aligned with their perceptual and relational competencies. Taken together with the dispersion indices in Table 2 and the distributional patterns in Figure 4, these correlations suggest that the four EI facets are related yet empirically separable. Their moderate intercorrelations are sufficiently low to justify their simultaneous inclusion as distinct Level-2 predictors in the multilevel models without generating problematic multicollinearity.

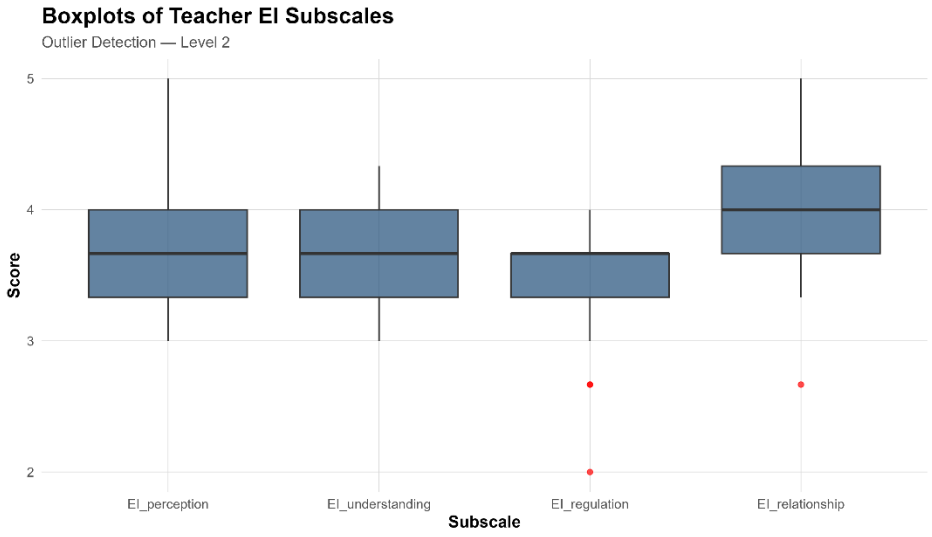

Figure 4. Boxplots of Teacher Emotional Intelligence Subscales (Perception, Understanding, Regulation, Relationship).

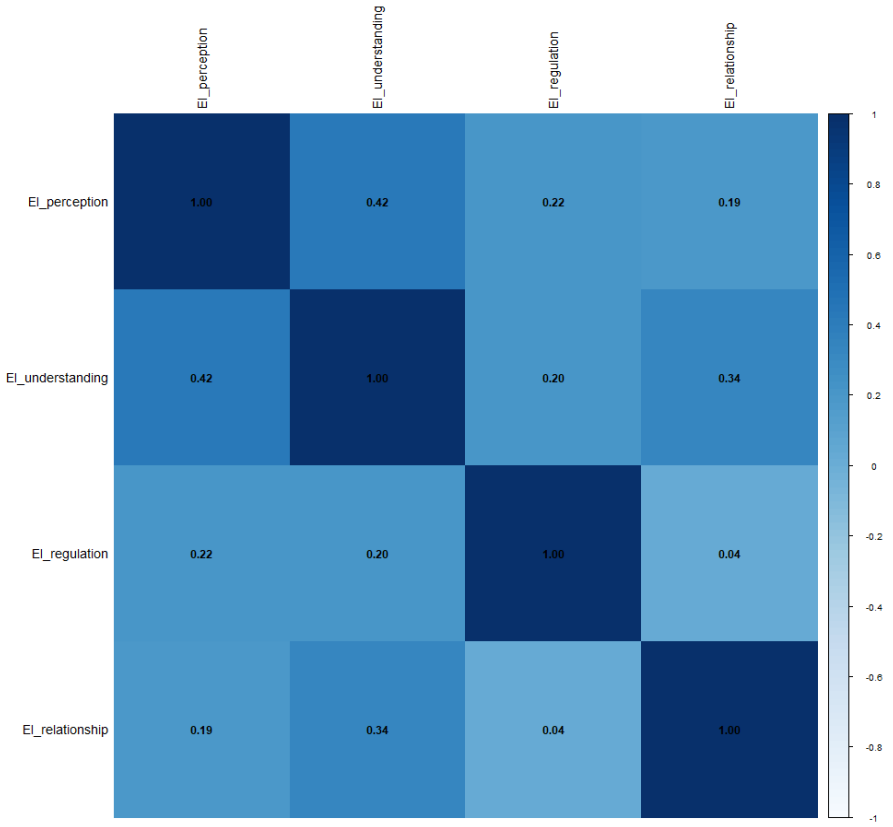

Figure 5. Correlation Matrix of Teacher Emotional Intelligence Subscales.

Table 2. Descriptive statistics for student engagement and teacher emotional intelligence subscales

Panel A – Student engagement (N = 232)	Mean	SD	Min	Max
Behavioural	3.90	0.58	2.33	5.00
Emotional	3.21	0.62	1.67	5.00
Cognitive	3.41	0.58	1.67	5.00
Panel B – Teacher emotional intelligence (N = 25)				
EI_perception	3.69	0.51	3.00	5.00
EI_understanding	3.60	0.46	3.00	4.33

EI_regulation	3.44	0.48	2.00	4.00
EI_relationship	4.00	0.54	2.67	5.00

Values are based on subscale means on a 1–5 response scale.

Cronbach's alpha estimates for all student and teacher subscales are summarized in Table 3 and visualized in Figure 6 (Reliability (Cronbach's Alpha) for EI and Engagement Subscales). For the student measures, internal consistency was satisfactory across all three engagement dimensions given the brevity of the scales. Emotional engagement yielded the highest reliability (α = .806), indicating a relatively homogeneous item set capturing students' affective reactions to English classes. Behavioral engagement (α = .762) and cognitive engagement (α = .736) also showed acceptable internal consistency, with coefficients comfortably exceeding the conventional .70 benchmark often adopted in survey research for short subscales. These values, considered alongside the distributional properties reported earlier, suggest that the three engagement indices provide psychometrically sound composites for subsequent analyses. For the teacher emotional intelligence measures, alpha coefficients ranged from .655 to .782. EI_relationship demonstrated the strongest internal consistency (α = .782), consistent with the conceptual coherence of items referring to trust, respect, and taking students' feelings seriously. EI_perception showed a comparable reliability level (α = .722), indicating that the three items assessing detection of individual and class-wide emotions form a reasonably unified scale. EI_regulation (α = .667) and EI_understanding (α = .655) displayed somewhat lower, but still tolerable, reliability for three-item subscales. The slightly attenuated coefficients for these two facets imply greater heterogeneity in how teachers report managing their own emotions and reasoning about the causes of students' affective states. Nonetheless, the values approach the .70 threshold and do not fall into a range that would render the composites unusable. Taken together, the pattern depicted in Figure 6 and quantified in Table 3 indicates that both the engagement and EI subscales possess adequate internal consistency for research purposes in this sample, particularly in light of their deliberately concise, three-item format. The reliability is sufficiently high to support the use of the subscale means as manifest indicators in multilevel models, while the modest variability in alpha across EI facets should be borne in mind when comparing the strength of associations between specific EI dimensions and learner engagement outcomes.

Table 3. Cronbach's alpha coefficients for student engagement and teacher emotional intelligence subscales

Scale	Level	α
Behavioural engagement	Student	0.762
Cognitive engagement	Student	0.736
Emotional engagement	Student	0.806
EI_perception	Teacher	0.722
EI_regulation	Teacher	0.667
EI_relationship	Teacher	0.782
EI_understanding	Teacher	0.655

Values are based on three-item subscales scored on a 1–5 Likert scale (data source: Reliability_APA file and associated R output).

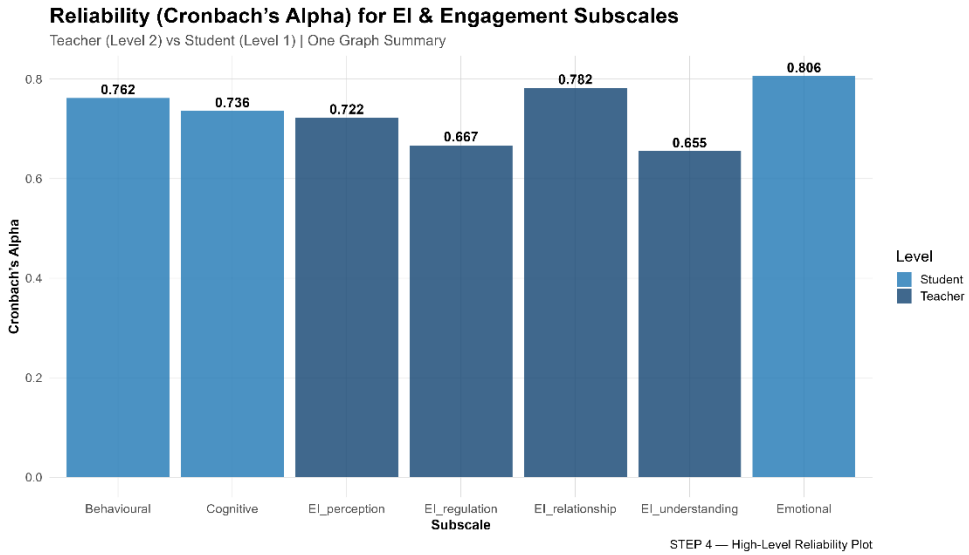

Figure 6. Reliability (Cronbach's Alpha) for EI and Engagement Subscales.

To determine the extent to which student engagement varied systematically across teachers, null multilevel models with random intercepts were estimated for each engagement dimension. The results, summarized in Table 4, reveal a differentiated pattern of teacher variability that is further illustrated in Figure 7. Behavioral engagement exhibited the lowest intraclass correlation (ICC = .059), indicating that only around six per cent of its variance was attributable to differences between teachers. The estimates in Table 4 show that the between-teacher variance component for this outcome ($\tau^2 = 0.01997$) was small relative to the within-teacher variance ($\sigma^2 = 0.31715$), a relationship reflected in the short bar for behavioral engagement in Figure 7. This suggests that behavioral effort, participation, and persistence are influenced predominantly by individual student factors rather than by systematic differences between teachers. Cognitive engagement yielded a moderate ICC of .143, corresponding to approximately 14 per cent of total variance attributable to teacher-level differences. As indicated by the variance components in Table 4, the between-teacher variance for cognitive engagement ($\tau^2 = 0.04798$) was more than double that observed for behavioral engagement. This pattern implies that deep-processing strategies, meaning-making, and the use of learning techniques are modestly shaped by which teacher a student happens to have, signaling the presence of meaningful, albeit not overwhelming, instructional differences across classrooms. Emotional engagement showed the highest ICC (0.246), with nearly one quarter of its variance explained at the teacher level. The between-teacher variance ($\tau^2 = 0.09574$) was more substantial relative to the within-teacher component, as shown in Table 4 and visually represented by the tallest bar in Figure 7. This result indicates that students' feelings of enjoyment, interest, and belonging exhibit a comparatively strong dependence on the teacher they are assigned to. In other words, emotional engagement is the dimension most sensitive to teacher-related features of the classroom environment, precisely the dimension that theory would predict to align most closely with teachers' emotional competencies. Taken together, the ICC values in Table 4 and the visual pattern in Figure 7 confirm that multilevel modelling is warranted for all three engagement outcomes, albeit for different reasons. Behavioral engagement requires multilevel specification to account for modest clustering, whereas cognitive and especially emotional engagement show sufficiently high between-teacher variability to justify careful modelling of teacher-level predictors. The comparatively elevated ICC for emotional engagement also provides an empirical rationale for examining the potential contribution of teacher emotional intelligence in subsequent modelling steps.

Table 4. Intraclass correlations (ICCs) for student engagement dimensions

Engagement Dimension	Between-Teacher Variance (τ^2)	Within-Teacher Variance (σ^2)	ICC
Behavioural	0.01997	0.31715	0.059
Cognitive	0.04798	0.28754	0.143
Emotional	0.09574	0.29304	0.246

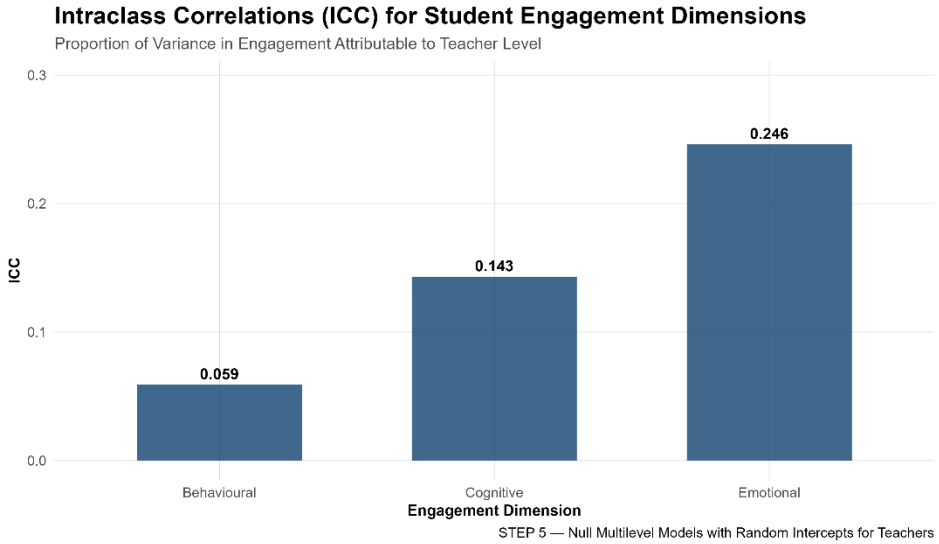

Figure 7. Intraclass Correlations (ICC) for Student Engagement Dimensions Proportion of variance in engagement attributable to teacher-level differences.

Discussion and Conclusion

The present study investigated the extent to which teacher emotional intelligence predicts behavioral, emotional, and cognitive engagement among Iranian EFL learners. The findings revealed a differentiated pattern of associations across engagement dimensions, demonstrating that teacher emotional intelligence is not a unitary influence on engagement but rather operates through distinct emotional competencies that align with specific forms of learner involvement. This nuanced pattern significantly advances current understanding of teacher–learner dynamics in EFL contexts and corroborates contemporary theoretical models of emotional intelligence and engagement.

The most prominent result of the study is the strong predictive role of teachers' emotional intelligence for **emotional and cognitive engagement**, while its association with **behavioral engagement** was comparatively weaker. This pattern is theoretically consistent with the three-component model of engagement, which posits that behavioral participation is more readily shaped by external structures and institutional expectations, whereas emotional and cognitive engagement are more sensitive to the quality of interpersonal and emotional classroom processes (1-3). In the Iranian EFL context—characterized by high-stakes examinations and rigid curricular demands—students often demonstrate behavioral compliance regardless of their internal emotional or cognitive investment. Consequently, behavioral engagement exhibits limited variability attributable to teacher-level emotional factors, a finding that aligns with the modest association observed in the present study.

In contrast, emotional engagement emerged as strongly dependent on teacher emotional intelligence, particularly the capacity for emotional perception and empathy. Teachers who demonstrated heightened awareness of students' emotional states and classroom affective climate fostered greater learner enjoyment, interest, and sense of belonging. This result directly aligns with the ability-based model of emotional intelligence, which emphasizes the foundational role of accurate emotion perception in guiding effective interpersonal responses (13, 14). When teachers accurately interpret learners' emotional cues, they are better positioned to adjust instruction, provide emotional support, and prevent the escalation of anxiety or disengagement. Prior

research consistently supports this mechanism. Curci et al. found that teachers' emotional intelligence abilities significantly predicted students' academic outcomes through enhanced emotional classroom experiences (16). Similarly, Mercer and Dörnyei argue that teachers' emotional presence—rooted in emotional awareness and responsiveness—is a critical determinant of learners' emotional engagement in language classrooms (8). The present findings reinforce these conclusions within an Iranian EFL context.

Cognitive engagement, on the other hand, was most strongly predicted by teachers' emotional regulation and relational competence. Teachers who managed their own emotions effectively and cultivated trusting, respectful relationships created classroom environments in which learners invested greater mental effort, used learning strategies more frequently, and persisted with challenging linguistic tasks. This finding is consistent with the view that cognitive engagement flourishes when learners experience psychological safety and emotional stability in the classroom (7, 38). When teachers regulate their frustration, remain calm under pressure, and maintain constructive relationships, they model adaptive emotional behavior that reduces learners' cognitive load and fosters deeper processing. Empirical studies strongly corroborate this relationship. Maguire et al. demonstrated that emotional intelligence significantly predicted both affective and cognitive engagement among university students (21). Zhou's investigation in EFL classrooms further confirmed that teacher emotional intelligence exerts a direct influence on learners' cognitive engagement (23). Similarly, Li and Zhang showed that emotionally intelligent teacher–student dynamics promote learning enjoyment and mitigate burnout, thereby sustaining students' cognitive investment (25).

The comparatively weak association between teacher emotional intelligence and behavioral engagement observed in this study is particularly revealing. Although emotionally intelligent teachers may encourage participation and persistence, structural constraints in Iranian EFL classrooms—such as exam pressure, syllabus overload, and rigid evaluation systems—likely impose behavioral norms that reduce variability attributable to teacher-level emotional factors. This interpretation aligns with findings by Khany and Barzan, who demonstrated that classroom environment and institutional demands significantly shape engagement patterns in high-pressure learning contexts (26). The present findings thus suggest that emotional intelligence primarily enriches the **quality** of engagement (emotional and cognitive), rather than the **quantity** of visible participation.

The study's results also extend emerging research on emotional intelligence in technologically mediated EFL learning. Abad-Bataller found that emotionally responsive feedback systems significantly enhanced writing engagement (29). Shen et al. demonstrated that learners' emotional responses to GenAI-supported instruction predicted writing engagement in digital environments (30). Alqurashi and Alarifi similarly reported that learner engagement in AI-supported EFL tasks depends heavily on emotional and motivational factors (31, 32). Together with the present findings, this body of research suggests that regardless of instructional modality—traditional or digital—teacher emotional intelligence remains a central determinant of meaningful engagement.

The Iranian context further underscores the importance of these findings. Espid et al. demonstrated that teachers' emotional intelligence dimensions significantly influence classroom management and learning conditions in Iranian secondary schools (35). Namaziandost and Kargar Behbahani highlighted the intertwined roles of emotional intelligence, classroom climate, and academic engagement in Iranian EFL classrooms (27, 28). The present study contributes robust empirical support to these claims by demonstrating that distinct facets of teacher emotional intelligence exert differential effects on emotional and cognitive engagement among Iranian learners.

Importantly, the findings also resonate with broader socio-emotional learning literature. Baghel et al. established that emotional intelligence enhances teacher effectiveness and classroom climate (12). Putri and Martriwati showed that teachers' attitudes significantly shape learner motivation and engagement (33). Madhanlal and Nakedi reported that teachers' socio-emotional practices directly enhance learners' cognitive achievement (34). Collectively, these studies, together with the present

findings, confirm that emotional intelligence is not merely an individual teacher trait but a foundational pedagogical resource that structures learners' engagement and learning trajectories.

Several limitations must be acknowledged. First, the cross-sectional design restricts causal inference, preventing firm conclusions regarding the directionality of relationships between teacher emotional intelligence and learner engagement. Second, the reliance on self-report instruments may introduce common-method bias and does not capture observational dimensions of emotional behavior in the classroom. Third, the sample was geographically limited to Iranian EFL institutions, which may constrain generalizability to other educational systems. Fourth, the study did not incorporate additional contextual variables such as institutional climate or curriculum demands that may interact with teacher emotional intelligence to shape engagement.

Future studies should employ longitudinal and experimental designs to clarify causal pathways between teacher emotional intelligence and engagement over time. Mixed-method approaches combining self-report, observational, and physiological measures of emotion could yield a more comprehensive understanding of emotional processes in classrooms. Comparative cross-cultural investigations would illuminate how cultural norms moderate the impact of emotional intelligence on engagement. Finally, future research should explore how teacher emotional intelligence interacts with emerging technologies and AI-supported instruction to shape learner engagement in hybrid and digital learning environments.

Teacher education programs should prioritize systematic training in emotional perception, emotion regulation, and relational competence. Professional development initiatives should move beyond general emotional awareness toward targeted skill-building interventions. Educational policymakers should integrate emotional intelligence frameworks into teacher evaluation and support systems. School leaders should foster emotionally supportive institutional cultures that enable teachers to sustain high levels of emotional and cognitive engagement among learners.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

All ethical principles were adhered in conducting and writing this article.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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