EMOTIONAL INTELLIGENCE CHARACTERISTICS AMONG STUDENTS FROM THE NATIONAL SPORTS ACADEMY "VASSIL LEVSKI"

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ABSTRACT
Background: Emotional intelligence (EI) is a key determinant of students' academic achievement, interpersonal relationships, and professional adaptability. Despite its recognized importance, limited research has examined the latent group-based structures of EI among students in sports education using probabilistic modeling techniques.
Objective: This cross-sectional exploratory study aimed to assess emotional intelligence levels among students from the National Sports Academy "Vassil Levski" and to identify underlying subgroups.
Methods: The study involved 156 participants (79 males and 77 females) from the Faculties of Pedagogy and Sport. Emotional intelligence was measured with the Bulgarian adaptation of the Schutte Self-Report Emotional Intelligence Test (SSEIT). Descriptive statistics, the Mann-Whitney U-test, and clustering via Gaussian Mixture Models (GMM) were applied. Model selection criteria included the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), and the sample average negative log-likelihood.
Results: Both male and female students demonstrated moderate to high levels of EI with mean scores of 131.99 and 132.47 and no statistically significant gender differences (p=0.901). However, probabilistic clustering revealed three latent subgroups among male students and four among females, corresponding to low, medium, and high EI profiles. Transitional overlap zones between clusters illustrated the interrelated nature of EI.
Conclusion: The integration of Gaussian Mixture Models and density estimation methods offers a more refined understanding of emotional intelligence variability compared to traditional descriptive statistics and hypothesis tests. These findings underscore the potential of data-driven approaches to support educational training that fosters emotional competences among particular student cohorts in higher education and sports contexts.

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INTRODUCTION

Emotional intelligence (EI) is one of the key global factors determining the quality of life in modern society. Emotional intelligence (EI) evolved from the broader study of cognitive and social intelligence, first conceptualized by Galton (1869), Cattell (1906), and Thorndike (1920), who emphasized the cognitive, affective, and social dimensions of human adaptability. Building on these foundations, Salovey and Mayer (1990) introduced EI as the ability to perceive, understand, and manage emotions, while Goleman (1998, 2011) expanded the model to include its role in personal and professional effectiveness. Later, Peterson and Seligman (2004) further integrated the cognitive and emotional domains through a framework of character strengths – wisdom, courage, humanity, justice, temperance, and transcendence, underscoring their joint contribution to self-regulation and moral growth.

In Bulgaria, Stoyanova (2008) validated tools for assessing perceived EI, while Iancheva and Prodanov (2022) adapted the Schutte Self-Report Emotional Intelligence Test (SSEIT) for sports contexts. Research shows that EI enhances coaching effectiveness (Tasheva, 2021), athletic performance (Iancheva & Prodanov, 2018), and professional fulfillment in sport management (Ilieva & Marinov, 2023).

Overall, the concept of emotional intelligence continues to evolve through extensive cross-cultural and interdisciplinary studies. The predominance of multidimensional models highlights the complex, layered structure of emotional intelligence (Dzhalev, 2024). Advanced analytical approaches, primarily dimensionality reduction methods (e.g., Factor analysis), are applied to uncover its latent structure (Dzhalev, 2024). However, an equally broad range of unsupervised machine learning methods, designed to uncover latent classes among surveyed participants, remains largely underutilized in research on emotional intelligence.

Aim and objectives

This study aims to explore the structure and gender differences in emotional intelligence among students from the Faculty of Pedagogy and the Faculty of Sports at the National Sports Academy "Vassil Levski," with the intention of improving teaching methods and educational outcomes.

1. To assess the overall level of emotional intelligence among a cohort of students using the Bulgarian adaptation of the Schutte Self-Report Emotional Intelligence Test (SSEIT).
2. To examine potential gender differences in EI scores between male and female students using non-parametric statistical analysis.
3. To identify latent subgroups with different EI profiles through Gaussian Mixture Model (GMM) clustering.
4. To interpret the derived clusters in terms of psychological meaning and their potential implications for the pedagogical development of educational practices.

METHODS

A total of 156 students from the National Sports Academy "Vassil Levski" were studied, comprising 79 males and 77 females from the Faculties of Pedagogy and the Faculty of Sport. Participation was voluntary and anonymous. All participants provided their consent after being informed that their results would be used for research purposes and published in a scientific report. Emotional intelligence was measured using the Schutte Self-Report Emotional Intelligence Test (SSEIT), adapted for use in Bulgaria (Stoyanova, 2008). The test consists of 33 items, and responses are rated using a 5-point Likert scale, ranging from 1 ("Strongly Disagree") to 5 ("Strongly Agree"). Exploratory data analysis on the estimated students' scores was performed based on descriptive statistics (mean and standard deviation). In addition, the Mann-Whitney U test was applied to compare male and female scores, testing the following null hypothesis:

H_0: *There is no significant difference between male and female students in their median values for the EI score.*

For grouping students based on similarities in their emotional intelligence scores, cluster analysis was performed using the Gaussian Mixture Model (GMM), which is a probabilistic clustering technique that assumes the data arise from a mixture of Gaussian distributions, each representing a distinct latent subgroup within the population. (Dempster et al., 1977; Bishop, 2006). Unlike partitioning methods such as K-Means, which assign each observation to a single cluster, GMM estimates the probability of membership in multiple clusters, allowing a more flexible representation of psychological constructs like emotional intelligence. This approach enables the identification of latent EI profiles and a nuanced understanding of individual differences across gender groups. Although the SSEIT scale produces discrete values, its broad scoring range allows for an approximate Gaussian distribution, which is suitable for empirical modeling.

Mathematically, the GMM parameters are estimated using the Expectation-Maximization (EM) algorithm. This iterative procedure alternates between computing the posterior probabilities of cluster memberships (E-step) and updating the Gaussian parameters to maximize the likelihood of the observed data (*M*-step) (Bishop, 2006). A significant advantage of GMM is that it captures both cluster shapes and variances, enabling clusters to differ in size and density. The optimal number of clusters (k) was determined by comparing different models based on their goodness-of-fit and model complexity. The sample average negative log-likelihood (<u>*NLL*</u>), Bayesian Information Criterion (*BIC*), Akaike Information Criterion (*AIC*) were used as performance metrics. Each of the three criteria is estimated in the following manner:

$$\underline{NLL} = -\frac{1}{n}\sum_{i=1}^{n} \log \log p(x_i|\theta) \quad (1) \quad AIC = 2k - 2 \log \log L \quad (2) \quad BIC = kn - 2 \log \log L \quad (3) \quad \log \log L = -n.\underline{NLL} \quad (4)$$

where $\rho(\theta)$ – model's predicted probability (density) for each data point; n – sample size; k – number of model parameters (depends on number of sample features and number of predefined clusters); θ – model parameters (means, variances, mixture weights in GMM);

log log L – maximized log-likelihood of the model. Essentially, the lower the value for the NLL, the better the goodness-of-fit. At the same time, lower values for BIC and AIC indicate a better balance between goodness-of-fit and model complexity. Hence, the proposed methodology follows a deductive approach, aiming to identify the specific subgroups (clusters) within the studied student cohort and to reveal the structural characteristics that differentiate them. Kernel Density Estimation (KDE) with a Gaussian kernel was applied to visualize the distribution of emotional intelligence scores, providing a smooth, continuous approximation of the underlying data solely for illustrating the overlapping areas between the defined subgroups (Bishop, 2006). All computations required for applying the described methods were conducted in Python 3.12.3 (Python Software Foundation, n.d.) and standard statistical and data science libraries (Pandas, n.d.; Scikit-learn, n.d.; Scipy, n.d.). All illustrations were generated via Matplotlib (Matplotlib, n.d.) and Seaborn (Seaborn, n.d.).

RESULTS

The internal consistency of SSEIT was evaluated using Cronbach's alpha. The reliability coefficient was estimated to be α=.73, which is considered acceptable for exploratory analyses. Results from the descriptive analysis showed that all students demonstrate a moderate-to-high level of emotional intelligence (Table 1). While female participants are generally expected to have a higher EI score, the level of emotional intelligence of the studied male students can be considered above average. Hence, the observed difference in the values of the individual emotional intelligence factors between male and female students was not statistically significant after applying the Mann-Whitney U-test to the sample medians (p = .901).

Table 1. *Emotional intelligence level of the surveyed students (Male and Female)*

Emotional intelligence (EI)	Male – 79		Female – 77		*Mean* difference	M-W U-test *p*-value
	Mean	*SD*	*Mean*	*SD*		
Total SSEIT Score	131.99	11.50	132.47	9.56	0.48	.901

Figure 1 illustrates the KDEs for male and female students' scores, highlighting the similarities in the central tendency between the two groups. Moreover, the derived male and female mean scores (The Schutte Self-Report Emotional Intelligence Test, n.d.) were provided for reference. It is noticeable that for both groups, there are individual male and female students with lower scores on the emotional intelligence factor; however, these outliers do not significantly influence the overall assessment.

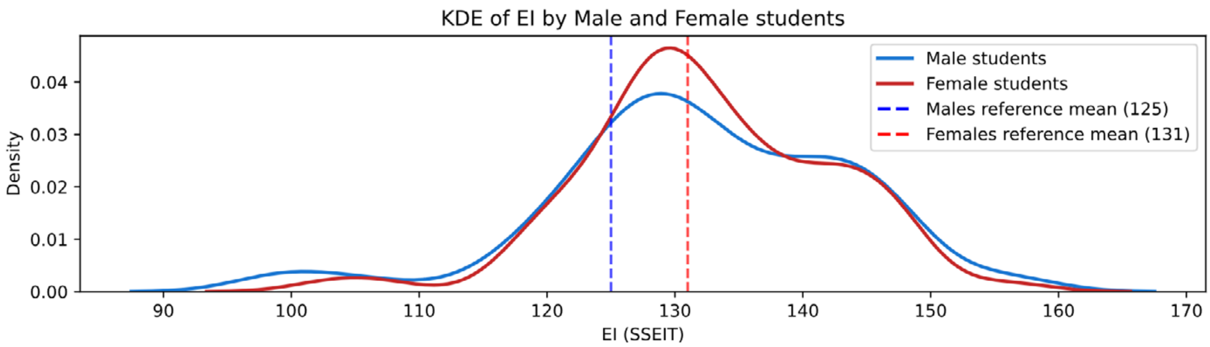

Figure 1. *Emotional intelligence levels of the studied male and female students*

Both distributions indicate an inherent bimodality of the studied groups. Hence, GMM served as a tool to identify the latent subgroups within each gender group.

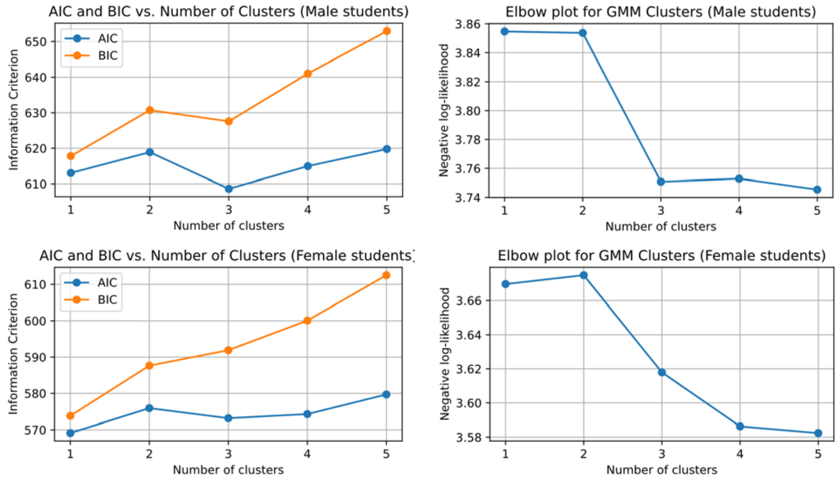

Figure 2. *Model selection criteria (AIC, BIC, and sample average negative log-likelihood) for determining the optimal number of male and female GMM clusters*

The results shown in Figure 2 were obtained by experimenting with different cluster numbers (k), ranging from 1 (baseline model) to 5. It was determined that the male students should be divided into three clusters (latent groups), based on the local minimum values of , BIC and AIC. However, a total of four clusters were adopted for the female students, despite the increased BIC and AIC values (resulting from the increased model complexity, given the smaller female sample size). The key characteristics of the male and female clusters are outlined in Table 2.

Table 2. *Emotional intelligence level of the surveyed student subgroups (clusters)*

Emotional intelligence clusters	Male Students			Female Students		
	Mean	*SD*	*N*	*Mean*	*SD*	*N*
Cluster 1	143.30	5.08	30	144.43	3.92	21
Cluster 2	127.11	4.80	45	131.86	3.02	35
Cluster 3	102.00	3.83	4	123.56	3.16	19
Cluster 4		–		105.00	2.83	2

Note: All cluster labels represent different subgroups for male and female students and should not be interpreted as equivalent across genders.

The standard deviations of all clusters are relatively low, indicating a high degree of homogeneity within the identified subgroups. As discussed, two outlier clusters with notably low EI scores were identified (male cluster 1 and female cluster 1). Hence, these clusters represent students with considerably lower emotional intelligence levels compared to their peers and may benefit from additional support. Figure 3 presents the characteristics of the derived male clusters in comparison with the SSEIT mean score and reference lines that separate emotional intelligence levels (low, medium, high).

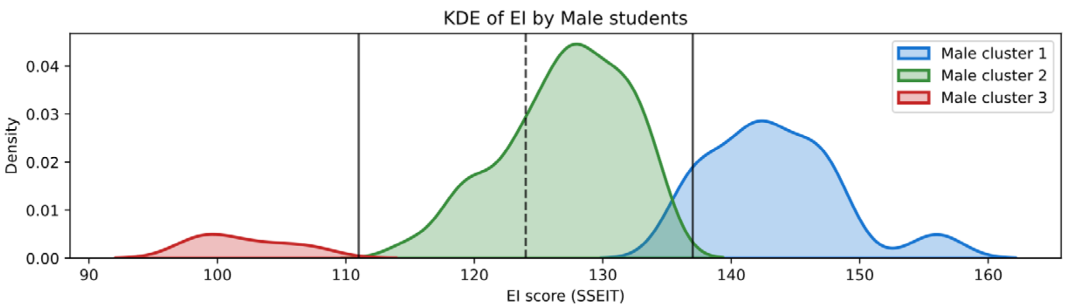

Figure 3. *Emotional intelligence levels of the identified subgroups of male students*

It can be observed that all three male clusters strongly correspond to the intervals derived from the SSEIT, indicating that the clustering effectively reflects distinct levels of emotional intelligence among male students with low, medium, and high EI profiles. Moreover, the overlapping areas between the KDEs of the empirical EI data illustrate the shared cluster membership derived from GMM for EI levels between 130 and 140. This suggests that some male individuals exhibit traits corresponding to both high and low EI levels.

A similar approach was applied to the surveyed females, who were divided into four clusters (Figure 4).

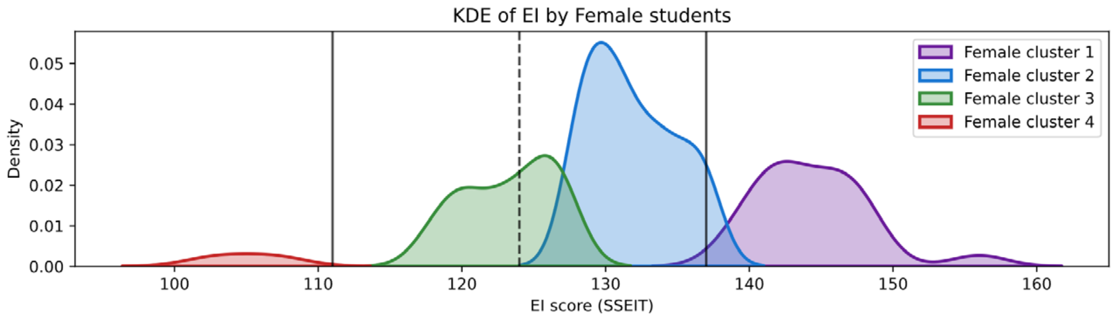

Figure 4. *Emotional intelligence levels of the identified subgroups of female students*

Similarly, the transition areas between the outward and middle clusters align with the SSEIT scores' boundary zones between EI levels. In addition, among female students, the medium EI group shows internal variation and could be further divided into two subgroups with slightly different emotional intelligence levels, suggesting greater emotional diversity in females.

DISCUSSION AND FUTURE WORK

The Gaussian Mixture Model (GMM) revealed distinct latent subgroups representing low, medium, and high EI levels, as well as transitional profiles, emphasizing that EI is a dynamic construct shaped by experience, training, and individual predispositions. The findings confirm that students from the National Sports Academy "Vassil Levski" demonstrate moderate to high levels of emotional intelligence (EI), consistent with previous studies that link physical and social activity to emotional awareness, self-regulation, and interpersonal competence (Iancheva & Prodanov, 2018; Ilieva & Marinov, 2023). However, this methodological approach highlights how probabilistic clustering can uncover subtle intra-group differences that conventional statistical tests often overlook. From a pedagogical perspective, the identified clusters can be used to enhance emotional awareness, regulation, and communication skills among targeted groups of students who are lagging behind their peers. Additionally, students with higher EI levels could be engaged as peer mentors or group facilitators, thereby fostering emotionally supportive learning environments. Such initiatives would strengthen both personal and collective development, reinforcing the pedagogical value of emotional intelligence in higher education and sports training.

A limitation of the study lies in its modest sample size, which affected the precision of model selection, particularly for the female cohort. Hence, a crucial consideration before applying GMM is the aimed practical results – generalizability and inferential reasoning, or partitioning the students' cohort into semi-homogeneous groups for practical reasons and the provision of adapted support.

Future research should integrate clustering with dimensionality reduction methods and adopt longitudinal designs to explore the stability and development of emotional intelligence over time, providing deeper insight into its structural and functional determinants.

CONCLUSIONS

The application of the Gaussian Mixture Model (GMM) provided a deeper and more precise understanding of the variability and internal structure of emotional intelligence (EI) among students from the National Sports Academy "Vassil Levski". Beyond confirming that both male and female students generally possess moderate to high EI levels, the probabilistic nature of GMM revealed distinct latent subgroups and transitional profiles that traditional statistical approaches could not capture. These results suggest that emotional intelligence is not a static psychological trait. Gender-specific nuances were also not initially evident. Despite the lack of statistically significant gender differences based on the Mann-Whitney U-test, the greater internal variability within the medium EI range among female students indicates a more diversified emotional intelligence structure.

Finally, the findings underscore the potential for curricular integration of emotional development programs, focused on the particular level of the students. Thus, the integration of machine learning models, such as GMM, into emotional intelligence research not only enhances scientific precision but also opens new possibilities for developing adaptive, data-driven educational programs tailored to the specific study cohort, thereby fostering improved emotional and social competencies among future professionals.

REFERENCES

Bishop, C. M. (2006). *Pattern recognition and machine learning.* New York, NY: Springer.

Cattell, J. (1906). A statistical study of American men of science: The selection of a group of one thousand men. *Science, 24*(621), 658–665.

Dempster, A. P., Laird, N. M., & Rubin, D. B. (1977). Maximum likelihood from incomplete data via the EM algorithm. Journal o*f the Royal Statistical Society: Series B (Methodological), 39*(1), 1–38.

Dzhalev, L. (2024). *Emotsionalnata inteligentnost [*Emotional intelligence*].*

Galton, F. (1869). *Hereditary genius: An inquiry into its laws and consequences* (1st ed.). London: Macmillan.

Goleman, D. (1998). *Working with emotional intelligence.* New York: Bantam Books.

Goleman, D. (2011). *Emotsionalnata inteligentnost* [Emotional intelligence]. Iztok-Zapad.

Iancheva, T., & Prodanov, G. (2018). Influence of emotional intelligence on coaching efficacy expectations among football coaches. *Journal of Applied Sports Sciences, 2,* 59–72.

Iancheva, T., & Prodanov, G. (2022). Adaptatsia na testa za otsenka na emotsionalnata inteligentnost (The Schutte Self-Report Emotional Intelligence Test, Schutte et al., 1998) [Adaptation of the test for assessment of emotional intelligence (The Schutte Self-Report Emotional Intelligence Test, Schutte et al., 1998)]. *Godishnik na Natsionalna Sportna Akademia „Vasil Levski", 129–137.*

Ilieva, D., Marinov, T. (2023). Influence of emotional intelligence on the professional fulfilment of students specializing in sport management. *Trakia Journal of Sciences, 21(*Suppl. 1), 365–371.

Matplotlib. (n.d.). *Matplotlib documentation.* Retrieved July 30, 2025, from https://matplotlib.org/

Pandas development team. (n.d.). *Pandas documentation.* Retrieved July 30, 2025, from https://pandas.pydata.org/

Peterson, C., Seligman, M. (2004). *Character strengths and virtues.* Washington, DC: American Psychological Association.

Python Software Foundation. (n.d.). *Python documentation.* Retrieved July 30, 2025, from https://www.python.org/

Salovey, P., Mayer, J. D. (1990). Emotional intelligence. *Imagination, Cognition and Personality, 9*(3), 185–211.

Schutte, N., Malouff, J., Hall, L., Haggerty, D., Cooper, J., Golden, C., & Dornheim, L. (1998). Development and validation of a measure of emotional intelligence. *Personality and Individual Differences, 25,* 167–177.

Scikit-learn. (n.d.). *Scikit-learn documentation.* Retrieved July 30, 2025, from *https:*//scikit-learn.org/stable/

SciPy. (n.d.). *SciPy documentation*. Retrieved July 30, 2025, from https://scipy.org/

Seaborn. (n.d.). *Seaborn: Statistical data visualization.* Retrieved July 30, 2025, from https://seaborn.pydata.org/

Stoyanova, S. (2008). Aprobirane na test za emotsionalna inteligentnost [Validation of an emotional intelligence test]. *Prilozhna psikhologia i sotsialna praktika,* 223–233.

Tasheva, G. (2021). Vliyanie na emotsionalnata inteligentnost varhu trenyorskata efektivnost pri trenyori ot razlichni vidove sport v Bulgaria [The influence of emotional intelligence on coaching effectiveness among coaches from different sports in Bulgaria]. *Lichnost, motivatsia, sport, 25*, 50–57.

Thorndike, E. L. (1920). Intelligence and its uses. *Harper's Magazine, 140*, 227–235.

Veritas ITC. (n.d.). *The Schutte Self-Report Emotional Intelligence Test.* Retrieved July 30, 2025, from https://www.veritas-itc.com/wp-content/uploads/2020/12/The-Schutte-Self-Report-Emotional-Intelligence-Test.pdf

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