Journal of Engineering Education Transformations, Volume 39, No.3, January 2026, ISSN 2349-2473, eISSN 2394-1707

10.16920/jeet/2026/v39i3/26086

Empathy Matters: Exploring Teacher-Student Dynamics and Student Outcomes in Professional Undergraduate Courses

[1] Dr. Mansi Gupta, [2] Ms. Diksha Mahajan, 3 Ms. Jaswinder Kour
[1]Model Institute of Engineering and Technology, Jammu, J&K, India,
[2]Model Institute of Engineering and Technology, Jammu, J&K, India,
[3]University of Jammu, Jammu, J&K, India
[1]mansi.mba@mietjammu.in, [2]diksha.mba@mietjammu.in [3]jaswinder.kour259@gmail.com

***Abstract*— The present study investigates the pivotal role of teacher empathy in promoting positive, cognitive, and psychological outcomes among undergraduate students taking professional courses. Drawing upon insights from Interpersonal Theory, the research explores the intricate dynamics of teacher empathy on student outcomes mediated by teacher-student interactions within the professional educational context. Utilizing quantitative data gathered through surveys and employing machine learning techniques for analysis, the study synthesizes contemporary research with established educational literature highlighting empathy's profound impact on learning. Emphasizing the dual responsibility of educational institutions in nurturing both intellectual and emotional development, the study underscores empathy's intrinsic significance within the professional education system. The results reveal that the quality of teacher-student interaction significantly mediates the relationship between teacher empathy and student outcomes. Specifically, findings indicate that emotional support, effective classroom management, and instructional support serve as key mechanisms through which teacher empathy influences student cognitive and psychological well-being. This research contributes to a deeper understanding of the interplay between empathy, teacher-student dynamics, and student outcomes, thereby informing strategies for enhancing educational practices and student success.**

***Keywords* — Cognitive Empathy, Affective Empathy, Interpersonal Theory, Teacher-student Interaction, Student Outcomes, Learning Process, Machine Learning, Cluster Analysis.**

***JEET Category*—Research.**

I. INTRODUCTION

Empathy is essential in human interaction and is particularly important in educational settings. In this context, empathy involves a teacher's capacity to understand and connect with the emotions, perspectives, and experiences of their students. It involves recognizing and responding to the diverse needs and challenges faced by students, showing understanding, and providing appropriate support. As educational practices evolve to meet the diverse needs of students, understanding the intricate dynamics between teacher empathy and student success becomes paramount.

The importance of empathy in promoting successful student outcomes in the ever-changing field of education has garnered increasing attention. Empathy, often regarded as a fundamental component of effective teaching, holds significant promise in shaping not only students' academic achievements but also their psychological well-being. Empathy, as the ability to understand and resonate with the thoughts and emotions of others, lies at the heart of effective teaching and learning processes (Huang, & Su, 2014). Within the educational landscape, teachers serve not only as disseminators of knowledge but also as mentors and guides, profoundly influencing the academic and personal growth of their students (Prince et al., 2007; Binani et. al., 2024). Within the realm of professional education, where the cultivation of both cognitive and socio-emotional skills is paramount, it is particularly pertinent to comprehend how teacher empathy and student results interact.

This study aims to investigate the intricate affiliation of teachers' empathy and student outcomes within the context of professional education, employing advanced machine learning techniques to analyze comprehensive datasets. This study seeks to bridge the gap between theoretical frameworks and practical applications by investigating how teacher empathy impacts various dimensions of student outcomes. In the proposed work, we aim to analyze complex datasets encompassing diverse factors such as teacher-student interactions, academic performance metrics, and socio-emotional indicators using machine learning. Machine Learning (ML) enables computers to learn on their own from given data, improving over time without the need for manual programming, thereby enhancing

Dr. Mansi Gupta
Model Institute of Engineering and Technology, Jammu, J&K, India
mansi.mba@mietjammu.in

Journal of Engineering Education Transformations, Volume 39, No.3, January 2026, ISSN 2349-2473, eISSN 2394-1707

their performance. These algorithms recognize patterns within data, enabling them to make predictions based on learned experiences (Helm et al., 2020). In essence, machine learning algorithms and models refine their capabilities through iterative learning processes.

Machine learning algorithms are categorized into two main types: supervised learning and unsupervised learning (Sharma, 2020). Supervised learning algorithms work by making predictions based on labelled training data, where each data point includes both an input and a corresponding output. This structured format enables the algorithm to learn from the relationships between inputs and outputs, identifying patterns and associations within the data. When faced with new, unseen data, the supervised learning algorithm applies its learned knowledge to predict or infer the appropriate output (Sharma, 2020). Data labeling plays a pivotal role in supervised learning by providing explicit guidance to the algorithm. By annotating the training data with relevant labels, practitioners effectively communicate to the algorithm the patterns and relationships it should seek to recognize. This could involve tagging images with descriptive labels or categorizing text data into predefined classes.

Unsupervised learning algorithms are designed to discover hidden insights and relationships within unlabeled datasets (Sharma, 2020). Unlike supervised learning, where models are provided with labeled data and known outcomes, unsupervised learning algorithms are presented with input data without any explicit guidance or predefined objectives. Consequently, these models must rely on inherent patterns and contextual cues to drive meaningful structures within the data. In the absence of labeled examples, unsupervised learning algorithms operate without the knowledge of the "correct" answers, necessitating them to autonomously identify and extract patterns from the input data. This self-directed learning process enables these models to uncover latent relationships and structures inherent within the dataset (Sharma, 2020).

An unsupervised machine learning technique called data clustering is used to find patterns in huge datasets that were previously unidentified, legitimate, and maybe valuable (Connolly, 2005). Future prediction relies more and more on clustering approaches as the amount of data in educational databases increases at a rapid pace. One popular and well-respected clustering technique is K-means (Borgavakar & Shrivastava, 2017). K-means serves as an unsupervised clustering algorithm specifically crafted to segment unlabeled data into a predefined number (referred to as "K") of distinct groups. Essentially, K-means identifies observations with shared attributes and aggregates them into clusters. The quality of a clustering solution is gauged by its ability to group observations into clusters where the members within each cluster exhibit greater similarity to each other compared to members of other clusters.

Through this interdisciplinary approach, we strive to uncover patterns and correlations that may elucidate the mechanisms through which teacher empathy influences student success in professional education. Grounded in the latest research and informed by traditional educational theories, our investigation seeks to shed light on the nuanced mechanisms through which teacher empathy influences various dimensions of student development.

In this study, machine learning is employed not as a novelty but as an exploratory tool for uncovering hidden patterns in empathy dynamics. While traditional survey-based and SEM approaches provide strong linear testing of hypotheses, they may overlook subgroup variations among students and teachers. Clustering, in particular, enables us to identify meaningful empathy profiles that enrich our theoretical understanding of how cognitive and affective empathy manifest differently in educational practice.

Research Questions:

- Does teacher empathy influence student outcomes?
- What is the impact of teacher-student interaction on student outcomes?

Objectives:

In pursuit of addressing these overarching questions, the study is guided by the following objectives:

Objective 1: To identify dimensions of teacher empathy that significantly predict student outcomes.

Objective 2: To investigate how teacher-student interactions influence the connection between teacher empathy and student outcomes.

Through the integration of machine learning methodologies with established educational paradigms, this study aids in advancing our understanding of the intricate dynamics that underpin effective teaching and learning processes.

II. Research Gap

While empathy is widely acknowledged as a critical factor in effective teaching, most existing research focuses on general education contexts and overlooks the unique demands of professional undergraduate programs such as engineering, management and law. These programs combine technical rigour with interpersonal challenges, yet few studies have examined how teacher empathy specifically influences student cognitive and psychological outcomes in this context.

Additionally, most of the prior research relies on traditional quantitative methods like surveys and Structural Equation Modeling (SEM), which test predefined relationships but often assume homogeneity in how empathy operates across teachers and students. As a result, potential subgroups with different empathy profiles remain unexplored. Furthermore, the application of machine learning methods such as clustering in empathy research is still emerging and tends to be treated as a purely technical exercise without strong theoretical interpretation or practical linkage to educational strategies.

Journal of Engineering Education Transformations, Volume 39, No.3, January 2026, ISSN 2349-2473, eISSN 2394-1707

This study addresses these gaps by adopting a hybrid methodological approach that combines machine learning (K-means clustering) with theory-driven analysis, aiming to identify meaningful empathy profiles. It also emphasizes the practical relevance of these profiles and provides a cross-sectional snapshot of empathy dynamics in professional education in an area where longitudinal and intervention studies are surprisingly scarce.

III. Study Contributions and Novelty

This research contributes significantly to the understanding of teacher empathy in professional education settings, where interpersonal competence is as critical as academic knowledge. Unlike previous studies focused on general education, this study offers targeted insights into how teacher empathy operates in high-stakes, career-oriented programs, revealing its influence on both cognitive and psychological student outcomes.

Methodologically, the study stands out by combining machine learning techniques with established theory-driven methods. K-means clustering is employed as an exploratory tool to uncover latent empathy subgroups, such as cognitive empathy-dominant and affective empathy-dominant profiles. These clusters are not merely statistical artifacts but carry theoretical meaning that deepens the understanding of empathy's multifaceted role in education.

Furthermore, the research validates a mediation model in which teacher-student interaction explains part of the relationship between teacher empathy and student outcomes, a mechanism rarely addressed in prior literature.

On a practical level, the study advances actionable contributions by proposing an Empathy Development Framework and an Implementation Roadmap designed to help educational institutions systematically cultivate empathy through teacher training, policy changes, and classroom practices. By bridging the gap between theory and real-world practice, this research provides a comprehensive view of how empathy can be intentionally nurtured to support student success in professional education.

IV. Theoretical Background

According to Zaki et al. (2008), empathy is essentially an "interpersonal process". The degree to which the individual being empathized with is receptive or resistant affects how successful empathy is (Zembylas, 2015). The empathizer's ability to comprehend the "emoter's" interaction with their surroundings is improved when they receive feedback, either explicit or implicit, from the person they are empathizing with (Main et al., 2017).

Interpersonal Theory, as proposed by H.S. Sullivan (2013), offers a comprehensive framework for comprehending the intricacies of social interactions and relationships. Central to Interpersonal Theory is the notion that human behaviour and psychological well-being are intricately linked to the quality and dynamics of interpersonal relationships (H.S. Sullivan, 2013). In the educational context, students' fulfilment of innate interpersonal needs, such as affiliation, intimacy, and social support (Zukauskiene, 2017), is significantly influenced by the quality of interactions with their educators. Teacher empathy, characterized by understanding, warmth, and responsiveness to students' emotions and experiences, plays a pivotal role in meeting these interpersonal needs.

Furthermore, Interpersonal Theory underscores the pivotal role of the student-teacher relationship in shaping students' academic engagement, motivation, and learning outcomes (Oberle et al., 2009). Empathetic teachers, attuned to students' emotional states and needs, cultivate a supportive and positive interpersonal climate in the classroom marked by trust, mutual respect, and effective communication (Cooper, 2011). This empathetic demeanour fosters a conducive emotional climate for learning and well-being, thereby influencing students' affective experiences, group dynamics, and overall classroom ambiance (Sherub Gyeltshen & Gyeltshen, 2022).

In the current study, the Interpersonal theory sheds light on how teacher-student interactions affect learning outcomes and academic achievement of the students. It provides a comprehensive theoretical framework for analyzing the connection between undergraduate students' academic performance and teachers' empathy. By highlighting the significance of interpersonal relationships, emotional dynamics, and communication processes within the educational milieu, this theoretical perspective enhances our understanding of how teacher-student interactions shape academic performance, psychological well-being, and the overall learning experience in the classroom.

A. Empathy Interventions in Education

Research in education increasingly emphasizes structured interventions to foster empathy among students and teachers. Programs such as Social and Emotional Learning (SEL), role-playing exercises, and reflective teaching practices have been shown to enhance empathy development (Cooper, 2011; Awati et. al., 2019; Munoz et al., 2022). Interventions focusing on perspective-taking activities help teachers better understand student challenges, while peer-mediation and restorative practices improve classroom relationships (Zembylas, 2015; Abirami et. al., 2023). Moreover, empathy training workshops, storytelling exercises, and experiential simulations (e.g., case-based learning in medical education) have demonstrated improvements in teachers' ability to connect with students emotionally and cognitively. These interventions highlight that empathy is not merely an innate trait but a skill that can be cultivated through intentional pedagogical strategies.

B. Professional Education Context Considerations

In professional education settings such as engineering, management, and law, empathy assumes a distinctive role.

Journal of Engineering Education Transformations, Volume 39, No.3, January 2026, ISSN 2349-2473, eISSN 2394-1707

Unlike general education, professional courses demand not only cognitive rigour but also interpersonal and communication skills critical for workplace success (Prince et al., 2007; Ahn & Lee, 2020). Studies show that empathy in medical and pharmacy education enhances patient-centered care (Zhao et al., 2021), while in management and engineering contexts, empathy supports teamwork, leadership, and problem-solving (Vančíková, 2020). The pressure of competitive assessments, internships, and career readiness often amplifies students' psychological stress, making empathetic teacher-student relationships a key protective factor. Thus, examining empathy within professional education adds specificity and relevance to broader educational research.

C. Methodological Approaches in Empathy Research

Empathy has been studied through diverse methodological approaches, ranging from qualitative interviews and classroom observations to large-scale surveys and experimental designs (Hoffman, 2000; Wink et al., 2021). Traditional quantitative methods, such as regression and structural equation modeling, have been instrumental in testing direct and mediating relationships between empathy and outcomes. Qualitative approaches, on the other hand, provide nuanced insights into the lived experiences of students and teachers. However, both approaches may miss hidden patterns or subgroup variations. Recent scholarship suggests integrating advanced computational techniques, such as machine learning, to complement traditional methods by identifying latent empathy profiles and uncovering non-linear relationships in large datasets (Agha et al., 2023). This shift toward hybrid methodologies opens new pathways for theory-building and practice.

V. Hypotheses Development

A. Teacher empathy and teacher-student interaction

At the core of the investigation lies the conceptualization of empathy within educational contexts. Expanding on the definitions provided by Hoffman (2000), empathy is the "ability to perceive and understand the thoughts and feelings of other people". This concept is multifaceted, comprising cognitive empathy (CE), which involves mental perspective-taking, and affective empathy (AE), which involves vicariously sharing emotions. These abilities are fundamental to human behaviour and evolve, rooted in both evolutionary processes and developmental milestones (Hogan, 1969). It encompasses various phenomena, such as empathy that drives people to assist others, feeling emotions that are similar to those of another person, comprehending their ideas and sentiments, and losing their sense of self (Hodges and Klein, 2001).

Cognitive empathy, closely linked with the theory of mind, underscores the importance of understanding others' thoughts and emotions through cognitive processes (Archer, 1998; Davis, 2018). The theory of mind highlights that principles governing cognitive thought processes provide the foundation for the capacity to comprehend the thoughts and feelings of others (Baron-Cohen, 2000). Empathy is believed to contribute to an orientation towards the feelings of others, which in turn is integrated into moral reasoning and reflected in social behaviour (Hoffman, 2000). When someone has cognitive empathy, they utilize perspective-taking techniques to put themselves in other people's shoes and experience their emotions (Thompson et al., 2021). Through perspective-taking, individuals can immerse themselves in others' experiences to grasp their emotions and perspectives.

Research has consistently shown how much teacher empathy affects several facets of teaching and student participation. Research has indicated that educators who possess a higher level of cognitive empathy tend to show more favourable views toward the conduct of their students, show greater proficiency in handling behavioural issues, and foster closer relationships with their students (Wink et al., 2021). Similarly, researchers also underscore the pivotal role of empathy in education, especially when it comes to nurturing positive teacher-student interactions and improving teaching-learning experiences (Yuan Zhao et al., 2021).

Henceforth, it can be emphasized that empathy plays a vital role in creating a conducive learning atmosphere and promoting active participation and enthusiasm among students.

Therefore, it is hypothesized that:

H1: Teacher empathy affects teacher-student interaction.

H1a: Cognitive Teacher empathy affects teacher-student interaction.

H1b: Affective Teacher empathy affects teacher-student interaction.

B. Teacher empathy and student outcomes

Educators with heightened cognitive empathy have reported more optimistic perspectives regarding their students' behaviour, enhanced proficiency in handling behavioural challenges, increased utilization of effective problem-solving approaches, built stronger relationships with their students, and experienced lower levels of job burnout (Vedhathiri, 2020; Wink et al., 2021). Pittinsky et al. (2016) concluded that teachers' practice of empathic joy can yield positive impacts on student outcomes by fostering a greater sense of connection and affinity toward students.

Additionally, there is strong evidence in the literature about how teacher empathy affects students' performance in both cognitive and psychological areas. Katarína Vančíková (2020) asserts that empathy and enthusiasm are pivotal qualities for educators. When teachers exhibit empathy, they can better understand and establish deeper connections with their students, thereby fostering a supportive and enriching learning environment.

Journal of Engineering Education Transformations, Volume 39, No.3, January 2026, ISSN 2349-2473, eISSN 2394-1707

Demonstrating the importance of empathy in education, Munoz Laura et al. (2022) illustrate its role in enhancing student happiness and well-being while alleviating sources of anxiety such as familial discord, technological limitations, and socioeconomic hardships. Schultze-Krumbholz and Anja (2020) suggest a positive correlation between empathy and social skills, indicating that empathy contributes to the development of interpersonal competence. Research findings by Zhang (2022) underscore the critical role of teacher-learner rapport, teacher empathy, and a positive classroom environment in influencing learner engagement, self-confidence, motivation, and overall learning outcomes (Gupta, 2025).

Thus, it is hypothesized that teacher empathy significantly impacts student outcomes. Specifically, it is expected to influence both cognitive and psychological student outcomes, highlighting its multifaceted role in nurturing a favourable teaching-learning atmosphere and supporting active student participation and enthusiasm. Hence, the hypothesis:

H2: Teacher empathy affects student outcomes.

H2a: Teacher empathy affects cognitive student outcomes.

H2b: Teacher empathy affects psychological student outcomes.

C. The mediating role of Teacher-student interaction in Teacher empathy and student outcomes

Teacher-student interaction is a cornerstone of effective teaching and learning processes, influencing student engagement, academic achievement, and overall well-being. The importance of teacher empathy in developing strong teacher-student interactions in classroom settings has garnered increasing attention.

Yuan Zhao et al. (2021) underscore the significance of empathy in education, particularly in establishing strong teacher-student relationships. Empathetic educators are better equipped to understand and connect with their students on a deeper level, fostering trust, mutual respect, and a perception of belongingness. These positive interactions, characterized by open communication and support, have been associated with improved student engagement, motivation, and academic performance.

Empathy and academic success are positively correlated, both directly and indirectly through students' appreciation of belongingness, according to research by Yuyang Cai et al. (2022). Students feel appreciated, respected, and inspired to learn in inclusive, encouraging classroom environments created by compassionate teachers. Better academic results have been connected to this sense of belonging.

H3: Teacher-student interaction mediates the relationship between teacher empathy and student outcomes.

By systematically examining these hypotheses, we aim to contribute novel insights into the pivotal role of empathy in educational settings and offer reasonable ramifications for enhancing teaching and student experiences in professional undergraduate courses.

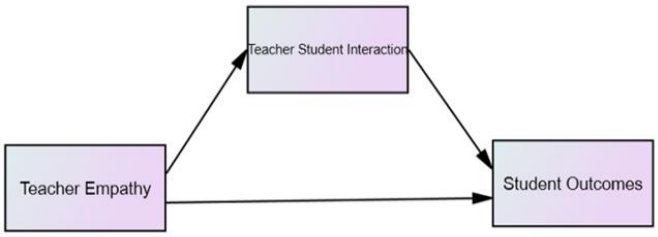

Fig. 1. Conceptual Model.

VI. PROPOSED MODEL

Figure 1 (Fig. 1) illustrates the proposed model for this study. In this model, Teacher Empathy (TE) serves as the independent variable, Teacher-Student Interaction (TSI) acts as the mediator, and Student Outcomes (SO) functions as the dependent variable. The model suggests that Teacher Empathy influences Student Outcomes, with Teacher-Student Interaction mediating this relationship.

VII. RESEARCH METHODOLOGY

Recent advancements in technology, particularly in the realm of machine learning, offer new opportunities for analyzing complex datasets and uncovering hidden patterns. While empirical studies on the application of machine learning to assess the relationship between teacher empathy and student outcomes are limited, preliminary research suggests its potential to elucidate the underlying mechanisms and facilitate data-driven decision-making in educational contexts. The present study employs K-Means clustering using machine learning to identify the clusters which can be included in the SEM analysis.

A. Study Design Rationale

This study employs a cross-sectional survey design, chosen for its efficiency in exploring relationships between empathy, teacher-student interactions, and student outcomes within a defined timeframe. A cross-sectional approach allows for the collection of diverse perspectives across a wide sample of undergraduate students, offering a broad snapshot of empathy dynamics in professional education. While it does not capture changes over time, this design is particularly suited for exploratory studies that seek to establish baseline relationships before progressing to more resource-intensive longitudinal or intervention-based research.

B. Limitations of Current Approach

Despite its strengths, the present methodology has inherent limitations. The reliance on self-reported survey data may introduce social desirability bias. The cross-sectional design

Journal of Engineering Education Transformations, Volume 39, No.3, January 2026, ISSN 2349-2473, eISSN 2394-1707

restricts causal inferences and does not account for the evolving nature of empathy or its long-term impact on student development. Additionally, while K-means clustering is effective for detecting hidden patterns, it may oversimplify complex empathy dynamics by forcing data into predefined clusters. Future research should consider longitudinal studies, experimental empathy interventions, and alternative clustering methods (e.g., hierarchical or model-based approaches) to strengthen causal validity and generalizability.

C. Ethical Considerations

This research was conducted in strict adherence to ethical principles designed to protect participants and ensure the integrity of the study. All participants were fully informed about the study's objectives, procedures, and voluntary nature before completing the survey. Informed consent was obtained electronically, with a clear explanation that participation was entirely voluntary and that participants had the right to withdraw at any point without any consequences.

Anonymity and confidentiality were carefully maintained throughout the research process. No personally identifiable information was collected, and all responses were anonymised and securely stored in password-protected databases. Only aggregate data is presented in the findings to ensure individual participants cannot be identified.

Participants were reassured that there were no "right or wrong" answers, minimising social desirability bias and encouraging honest and reflective responses.

The research was designed solely to explore participants' perceptions of teacher empathy and its outcomes, without any experimental manipulation or intrusion into personal lives. Data cleaning methods were applied transparently, including the removal of extreme or inconsistent responses, ensuring both the quality of the data and the ethical treatment of participant contributions.

D. Sampling

To assist the objective of the study, an online survey was undertaken with the undergraduate students doing professional courses. Purposive sampling was employed to collect data, for which Google Forms was used. The sampling process was done in two phases: the initial sample of 105 was used to test the construct's reliability and validity, and the second survey was used for hypothesis testing. Responses that contained extreme or abnormally consistent rating patterns were eliminated, and a sample of 295 was considered for testing the study hypothesis.

E. Demographic Profile

The study collected responses from a total of 295 undergraduate students pursuing professional courses. The age distribution of participants varied, covering multiple groups, with a majority falling within the '20 - 25' age range. Regarding gender distribution, 100 participants identified as Female, representing approximately 33.9%, while 195 participants identified as Male, representing approximately 66.1% of the total sample.

In terms of academic discipline, approximately 50% of participants (around 148 students) were enrolled in Engineering programs, 30% (around 89 students) in Management programs, and 20% (around 58 students) in Law programs. This distribution reflects a representative sample of students in professional undergraduate education, with a greater proportion from the engineering field.

TABLE I
SCALES

Construct	SCALE SOURCE
Teacher Empathy	"Cognitive Empathy and Emotional Empathy In Human Behaviour And Evolution" - Adam Smith
Teacher Student Interaction	Empathy Questionnaire - Gaumer Erickson et al.
Student Outcomes	Teacher Empathy: A Model of Empathy for Teaching for Student Success - Sal Meyers et al.

F. Questionnaire design

For this study, a structured questionnaire was framed, tested and administered online to the target population through Google Forms. An extensive literature review was undertaken to finalize and deploy the standardized scales of the selected constructs already used in previous related studies for increased reliability and validity. Table I shows the sources for the scales. These items were measured on a 5-point Likert scale (from

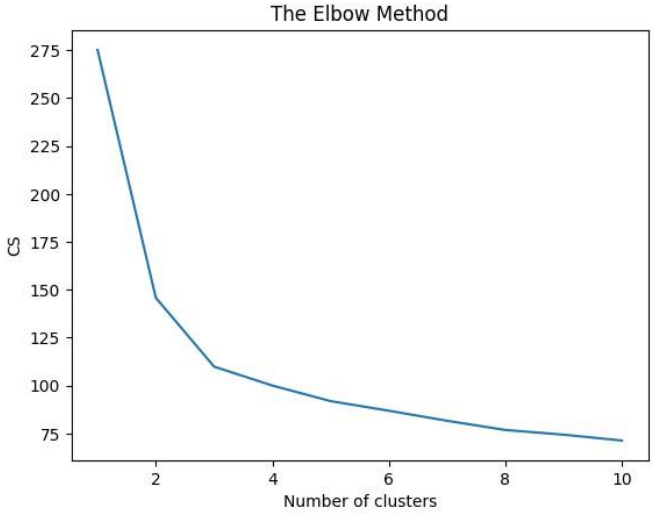

Fig. 2. Elbow Curve.

1=strongly disagree to 5=strongly agree).

G. Data Analysis

The study enhances the effectiveness and efficiency of K-means performance in data processing by combining the K-means approach with an elbow (Figure 2).

Journal of Engineering Education Transformations, Volume 39, No.3, January 2026, ISSN 2349-2473, eISSN 2394-1707

The decision to employ K-means clustering is theoretically grounded in its ability to uncover latent subgroups within large, heterogeneous datasets. Unlike traditional regression-based approaches that focus on linear relationships, clustering enables the discovery of distinct empathy profiles among teachers and their differential impacts on student outcomes. Prior studies in education have successfully used K-means to segment learners and identify performance clusters (Borgavakar & Shrivastava, 2017; Agha et al., 2023). In this study, K-means serves not as an end in itself but as a tool to complement structural equation modeling, ensuring that subgroup variations are acknowledged rather than overlooked. This hybrid analytical strategy provides a richer, data-driven understanding of empathy in professional education.

One widely adopted method, particularly in the realm of K-Means clustering, is the Elbow Method. This technique involves iteratively evaluating the clustering performance for different numbers of clusters and observing how the within-cluster sum of squares *(WCSS)* changes as the number of clusters increases (Agha, Meghji & Bhatti, 2023). The WCSS represents the sum of squared distances. Determining the optimal number of clusters is a critical aspect of using unsupervised algorithms effectively. In unsupervised learning scenarios where the number of clusters is not predefined, selecting an appropriate cluster count becomes pivotal. Between each data point and its assigned cluster centroid. As the number of clusters rises, the WCSS tends to decrease, reflecting a better fit to the data.

However, the key insight of the Elbow Method lies in identifying the point at which the rate of decrease in WCSS starts to diminish, forming an "elbow" shape in the plot of WCSS against the number of clusters (Shi et al., 2021). This elbow point signifies a trade-off between minimizing WCSS and avoiding overfitting. Selecting the number of clusters at this elbow point often results in a balanced clustering solution that effectively captures the underlying structure of the data without excessively subdividing it.

In practice, the determination of the elbow point involves visual inspection of the WCSS plot or employing mathematical techniques to identify the inflection point. Once identified, this optimal number of clusters serves as a guideline for partitioning the data into meaningful groupings, enabling subsequent analysis or interpretation (Shi et al., 2021).

The elbow approach can yield the same number of clusters K for the quantity of varied data based on the outcomes of the process of determining the optimal number of clusters. The K-means algorithm was selected because of its established utility in identifying latent subgroups within educational datasets. Importantly, the clusters obtained in this study, such as “cognitive empathy dominant” and “affective empathy dominant”, are not merely statistical groupings but carry theoretical meaning consistent with existing empathy literature. Nonetheless, it is acknowledged that K-means has limitations: it requires pre-specifying the number of clusters, may oversimplify complex data patterns, and excludes alternative clustering methods such as hierarchical or model-based approaches. While the elbow method guided cluster selection, further validation is recommended to ensure stability and generalizability of the clusters. The clusters which depicted the effect of teacher empathy were further studied for the relationship and impact of teacher empathy on student outcomes.

For the present study, we consider the two clusters where the students were affected by the teacher's empathy, for further investigation of the relationship between teacher empathy and student outcomes and the mediation role of the teacher-student interaction. Structural Equation Modelling (SEM) was deployed using Amos 20 software and SPSS 24.

H. Cluster Characteristics and Validation Metrics

To better understand the distinct empathy profiles uncovered by the K-means clustering analysis, a detailed cluster characteristics table was created. The two primary clusters identified are described in Table II.

TABLE II
CLUSTER CHARACTERISTICS AND VALIDATION METRICS

Attribute	Cluster 1 (Cognitive Empathy Dominant)	Cluster 2 (Affective Empathy Dominant)
Description	High cognitive empathy, moderate affective empathy	High affective empathy, moderate cognitive empathy
Sample Size	160	135
Average Cognitive Empathy Score	4.25	3.85
Average Affective Empathy Score	3.8	4.3
Silhouette Score	0.52	0.52
Calinski-Harabasz Index	245.6	245.6

The clustering solution was validated using the Silhouette Score and Calinski-Harabasz Index. A silhouette score of 0.52 indicates reasonable separation between clusters, and a Calinski-Harabasz index of 245.6 suggests that the clusters are well-defined and statistically distinct. These validation metrics support the robustness of the clustering solution.

This cluster analysis demonstrates that the identified empathy profiles are both statistically sound and theoretically meaningful. The empirical distinction between cognitive and affective empathy profiles provides insight into how teacher empathy operates differently in educational practice and informs more targeted, context-sensitive interventions.

Cronbach's alpha was calculated for each factor in an exploratory factor analysis (EFA) to evaluate dependability.

Journal of Engineering Education Transformations, Volume 39, No.3, January 2026, ISSN 2349-2473, eISSN 2394-1707

TABLE III
CRONBACH'S ALPHA VALUES

S. NO.	ITEMS	CRONBACH'S ALPHA
1	Teacher Cognitive Empathy	0.820
2	Teacher Effective Empathy	0.933
3	Emotional Support	0.920
4	Instructional Support	0.906
5	Classroom Management	0.898
6	Cognitive Student Outcomes	0.943
7	Psychological Student Outcomes	0.965

Using Cronbach's Alpha, Table III displays the composite reliability of the study's components.

The elevated composite reliability values highlight the significance that participants attribute to the items within their respective constructs.

TABLE IV
KMO AND BARTLETT'S TEST

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.948
Bartlett's Test of Sphericity	Approx. Chi-Square	13158.635
	df	378
	Sig.	.000

Table IV indicates that the Kaiser-Meyer-Olkin (KMO) measure is 0.948, demonstrating acceptability, and Bartlett's Test of Sphericity indicates significance for the dataset provided.

VIII. RESULTS AND FINDINGS

A. Hypothesis Testing

The statistical analysis revealed a series of strong and significant relationships, supporting all primary hypotheses of the study (Table V).

Hypothesis H1 predicted that teacher empathy would positively influence teacher-student interaction (TSI). The analysis confirmed this with a very strong correlation between Teacher Empathy and TSI ($r = 0.941$, $R^2 = 0.885$, $\beta = 0.933$, $t = 47.55$, $p < .001$), indicating that higher perceived levels of teacher empathy are strongly associated with more positive teacher–student interactions. This provides robust support for Hypothesis H1.

Further exploring the dimensions of empathy, Hypothesis H1a and H1b examined the specific effects of cognitive and affective empathy, respectively, on TSI. Teacher cognitive empathy was significantly associated with TSI ($r = 0.838$, $R^2 = 0.702$, $\beta = 0.812$, $t = 28.67$, $p < .001$), while teacher affective empathy showed an even stronger relationship ($r = 0.952$, $R^2 = 0.906$, $\beta = 0.880$, $t = 53.29$, $p < .001$). These results confirm both Hypotheses H1a and H1b, highlighting that both cognitive and affective dimensions of empathy are critical in shaping the quality of teacher-student interaction.

Regarding student outcomes, Hypothesis H2 speculated that teacher empathy positively predicts overall student outcomes (SO). This was strongly supported by the data ($r = 0.849$, $R^2 = 0.720$, $\beta = 0.740$, $t = 27.47$, $p < .001$). Additionally, the study examined more granular outcomes: Hypothesis H2a showed that teacher empathy significantly predicts cognitive student outcomes (CSO) ($r = 0.846$, $R^2 = 0.715$, $\beta = 0.760$, $t = 27.11$, $p < .001$), and Hypothesis H2b confirmed a significant relationship with psychological student outcomes (PSO) ($r = 0.815$, $R^2 = 0.664$, $\beta = 0.721$, $t = 24.05$, $p < .001$).

Collectively, these findings offer consistent and robust evidence that teacher empathy plays a pivotal role in enhancing both teacher-student interaction and diverse student outcomes—cognitive and psychological. Importantly, all relationships remained highly significant, and the effect sizes were large, indicating the practical importance of these associations.

TABLE V
COMPREHENSIVE HYPOTHESIS TESTING RESULTS

Hypothesis	Predictor → Outcome	r	R	β	t	Supported	Effect Size
H1	Teacher Empathy → TSI	0.941	0.885	0.933	47.55	Yes	Large
H1a	Cog. Empathy → TSI	0.838	0.702	0.812	28.67	Yes	Large
H1b	Aff. Empathy → TSI	0.952	0.906	0.88	53.29	Yes	Large
H2	Teacher Empathy → SO	0.849	0.720	0.740	27.47	Yes	Large
H2a	Teacher Empathy → CSO	0.846	0.715	0.76	27.11	Yes	Large
H2b	Teacher Empathy → PSO	0.815	0.664	0.721	24.05	Yes	Large

*Note: TSI: Teacher–Student Interaction; SO: Student Outcomes; CSO: Cognitive Outcomes; PSO: Psychological Outcomes.

B. Mediation Analysis

Confirmatory Factor Analysis is an efficient technique that is used to evaluate the fit of a proposed model. In this study, the proposed measurement model (Fig. 3) was developed and evaluated using Structural Equation Modelling (SEM) and AMOS 20.0. Variables that firmly define the constructions are retained after the CFA process, whereas those that weakly define the constructs are removed. With more data points, the measurement model might further enhance its level of fit, which was found to be satisfactory.

Journal of Engineering Education Transformations, Volume 39, No.3, January 2026, ISSN 2349-2473, eISSN 2394-1707

TABLE VI
MEDIATION ANALYSIS: SEM PATH ESTIMATES

Pathway	Direct Effect	Indirect Effect	Total Effect	Mediation Type	p
Teacher Empathy → Student Outcomes (via TSI)	0.12	0.97	1.09	Partial Mediation	<.001

The mediation analysis was conducted using Structural Equation Modeling (SEM) following the guidelines of Hayes (2009) and Zhao et al. (2010), to examine the indirect effect of teacher empathy on student outcomes via teacher-student interaction (TSI). The results revealed a direct effect of 0.12, an indirect effect of 0.97, and a total effect of 1.09, with a p-value < .001 (Table VI).

These results indicate that teacher-student interaction partially mediates the relationship between teacher empathy and student outcomes. The large indirect effect suggests that a significant portion of the influence of teacher empathy on student outcomes operates through its impact on teacher-student interaction. The partial mediation implies that teacher empathy also has a direct effect on student outcomes, though the indirect pathway via interaction is notably stronger.

This finding provides strong empirical support for the proposed theoretical model, highlighting the critical role of teacher-student interaction as a mechanism through which teacher empathy contributes to cognitive and psychological student development.

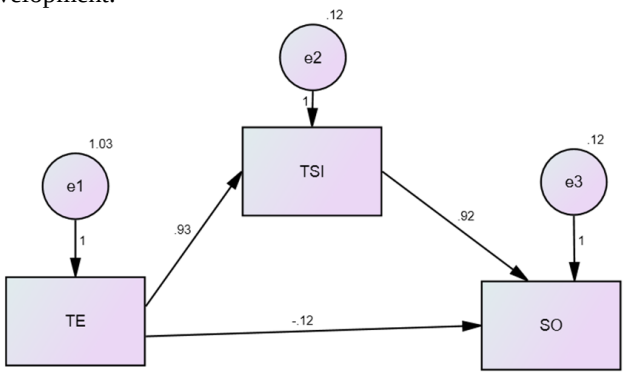

Fig. 3. Mediation Analysis using AMOS.

IX. DISCUSSION

The results of this study offer compelling confirmation supporting the significant role of teacher empathy in educational contexts, particularly concerning teacher-student interaction and student outcomes. The acceptance of all hypotheses indicates a robust relationship between teacher empathy, teacher-student interaction, and student outcomes, both cognitive and psychological.

Beyond confirming the role of empathy, the clustering analysis demonstrates that empathy does not operate uniformly across all teachers. Instead, distinct profiles—such as those emphasizing cognitive versus affective empathy—emerged, offering new theoretical insight into how empathy influences student outcomes through different pathways. This exploratory, data-driven approach complements traditional methods and highlights the potential of ML to enrich empathy research by uncovering subgroup dynamics that may otherwise remain hidden.

The findings suggest that empathetic educators are better equipped to support students' cognitive and psychological development. Teachers who demonstrate empathy may adopt a sense of belongingness, motivation, and engagement among students, ultimately leading to improved academic performance and well-being. The acceptance of H2a and H2b underscores the holistic nature of teacher empathy and its implications for student success beyond academic triumph.

The study also emphasizes how crucial it is for teachers and students to have a good rapport to facilitate student growth and development. Building relationships with their pupils is a priority for empathic teachers, and this may foster a safe, welcoming environment in the classroom that promotes learning and personal development. The acceptance of H3 emphasizes the interconnectedness of teacher empathy, teacher-student interaction, and student outcomes within educational settings.

Moreover, by focusing specifically on students undergoing professional courses, this study offers a unique perspective on how empathy manifests within the context of professional and leadership education. As the demands of the corporate world increasingly emphasize collaboration, communication, and interpersonal skills, understanding the role of empathy in shaping future executives becomes crucial.

A key limitation lies in the reliance on K-means clustering, which, while effective for exploratory analysis, may not capture the full complexity of empathy variation. Future work should explore alternative clustering algorithms, stability checks, and longitudinal validation to strengthen the robustness of ML-driven insights.

A. Practical Applications

The findings underscore the importance of embedding empathy practices into daily teaching routines. Teachers can adopt actionable strategies such as personalized feedback, empathetic communication, and reflective journaling to enhance student engagement. Classroom interventions like structured group work, empathy circles, and active listening exercises can further promote mutual respect and trust. At the institutional level, policies that encourage mentorship programs and peer-support systems can amplify the benefits of teacher empathy for student well-being and academic performance.

B. Professional Development Implications

Empathy should be treated as a core professional competency for educators. Teacher training programs can integrate empathy modules through workshops, peer observations, and role-play

Journal of Engineering Education Transformations, Volume 39, No.3, January 2026, ISSN 2349-2473, eISSN 2394-1707

exercises that simulate classroom challenges. Continuous professional development could also include reflective practice sessions where educators critically examine their responses to student needs. Embedding empathy as a key performance indicator within professional education ensures that future teachers and instructors cultivate both intellectual and socio-emotional capacities in their learners.

C. Comparison with Similar Studies

The present results align with prior findings emphasizing the positive role of empathy in education. For example, Munoz et al. (2022) highlighted the role of empathy in mitigating student stress during unplanned course interruptions, while Zhang (2022) demonstrated its influence on learner engagement in language education. Similarly, Wink et al. (2021) found that empathy equips teachers to manage challenging student behaviours more effectively. By extending these insights into the professional education domain, our study uniquely contributes to understanding how empathy shapes both cognitive and psychological outcomes in career-oriented programs.

X. IMPLICATIONS AND FUTURE PROSPECTIVES

The findings of this research have several practical implications for educators, educational policymakers, and school administrators. Teacher training programs can incorporate modules on empathy development to equip educators with the necessary skills to foster positive teacher-student relationships. Training in cognitive empathy, affective empathy, and perspective-taking techniques can enhance educators' ability to understand and connect with their students on a deeper level. Establishing policies that promote empathy-building initiatives, conflict-resolution strategies, and restorative practices can contribute to a positive culture and enhance student well-being. Educators should prioritize building positive teacher-student relationships through empathetic communication, active listening, and genuine concern for students' well-being. Implementing strategies such as personalized feedback, collaborative learning activities, and supportive classroom environments can enhance teacher-student interaction and promote student engagement.

Curricula should integrate components to promote empathy, emotional intelligence, and interpersonal skills among students. By incorporating these principles into academic instruction, educators can create opportunities for students to develop empathy and resilience, thereby fostering a positive classroom culture.

Future research can explore other variables that can affect how teacher empathy, student-teacher interaction, and student outcomes are related. Longitudinal studies examining the enduring effects of teacher empathy on student development and academic achievement can provide valuable insights into the sustained impact of empathetic teaching practices.

A. Empathy Development Framework

Based on the findings, we propose a three-layered Empathy Development Framework. The first layer emphasizes cognitive empathy through perspective-taking and awareness of student challenges. The second layer involves teacher-student interaction, where empathy is translated into supportive classroom practices such as feedback, encouragement, and inclusive participation. The third layer highlights student outcomes, including enhanced cognitive achievement and psychological well-being. This framework illustrates the cascading influence of empathy, beginning with teachers' internal dispositions and culminating in student success.

B. Implementation Roadmap

To operationalise this framework, institutions can take the following steps:

- Policy Integration – Incorporate empathy as a core competency in faculty evaluations.
- Training Modules – Conduct workshops on cognitive and affective empathy, reflective practice, and emotional intelligence.
- Classroom Practices – Encourage activities like peer feedback, empathy diaries, and role-reversal exercises.
- Monitoring and Support – Establish mentoring programs and regular feedback systems to sustain empathetic practices.
- Evaluation – Use both qualitative feedback and quantitative tools (e.g., clustering-based assessments) to track progress.

C. Measurement Implications

The clustering approach employed in this study provides novel insights into how empathy can be measured. Instead of treating empathy as a single, uniform construct, clustering reveals meaningful subgroups such as "cognitive empathy dominant," "affective empathy dominant," and "low empathy" profiles. These profiles can serve as diagnostic tools for institutions to design tailored professional development initiatives. Moreover, integrating clustering outputs into empathy assessment scales could enable early detection of empathy gaps, ensuring that interventions are timely and context-specific.

CONCLUSION

This research contributes to both theoretical understanding and practical pedagogy by elucidating the relationship between teacher empathy and student outcomes. By leveraging machine learning methodologies, we aim to provide actionable insights that can enhance educational practices, curriculum development, and teacher training programs, ultimately nurturing a more empathetic and inclusive learning atmosphere for students.

To sum up, this study offers important new understandings of the critical role empathy plays in learning environments, with a particular emphasis on how empathy affects student outcomes

and interactions between teachers and students. The findings confirm the significant influence of teacher empathy on both the dynamics within the classroom and the overall development and well-being of students.

This research reinforces the significance of empathy in promoting pleasant educational experiences by accepting ideas about how the empathy of teachers affects teacher-student interaction and student outcomes. Higher empathetic educators are better able to relate to and understand their pupils, which creates inclusive and supportive learning environments.

Furthermore, the mediation analysis highlights the role of teacher-student interaction as a mechanism through which teacher empathy affects student outcomes. Positive teacher-student relationships characterized by trust, respect, and support contribute to improved student engagement, motivation, and academic achievement.

The implications of this study extend to teacher training programs, classroom practices, curriculum design, and school policies, emphasizing the importance of fostering empathy among educators and creating environments conducive to empathetic teaching and learning.

In essence, this research underscores the transformative potential of empathy in education, emphasizing its role in promoting positive teacher-student relationships, enhancing student outcomes, and cultivating a culture of empathy and understanding within educational institutions. By prioritizing empathy in educational practice, educators can empower students to thrive academically, socially, and emotionally, ultimately fostering a brighter and more inclusive future for all learners.

REFERENCES

Abirami, A. M., Karthikeyan, P., & Thangavel, M. (2023). Peer-to-Peer Learning Process (PPLP) Framework to Enhance Problem Solving Skills. Journal of Engineering Education Transformations, 36(Special Issue 2), 244–248. Scopus. https://doi.org/10.16920/jeet/2023/v36is2/23035

Agha, D., Meghji, A. F., & Bhatti, S. (2023). Clusters of success: Unpacking academic trends with k-means clustering in education. VFAST Transactions on Software Engineering, 11(4), 15–31. https://doi.org/10.21015/vtse.v11i4.1633

Ahn, B., & Lee, S. (2020). Effect on self-directed learning abilities, interpersonal understanding, and satisfaction with the class among university students based in a team-project lesson. Journal of Engineering Education Transformations, 34(2), 7–15. Scopus. https://doi.org/10.16920/jeet/2020/v34i2/155393

Archer, R. L. (1988). Empathy and its Development. Cambridge University Press, New York, 1987. The Journal of Nervous and Mental Disease, 176(10), 642–643. https://doi.org/10.1097/00005053-198810000-00015

Awati, J. S., Kulkarni, S. S., & Patil, S. K. (2019). Energetic teaching activity role play and round quiz: A case study. Journal of Engineering Education Transformations, 33(Special Issue 1), 84–90. Scopus. https://doi.org/10.16920/jeet/2019/v33i1/149028

Baron-Cohen, S. (2000). The evolution of a theory of mind. In The Descent of Mind Psychological Perspectives on Hominid Evolution (pp. 261–277). Oxford University Press. http://dx.doi.org/10.1093/acprof:oso/9780192632593.003.0013

Binani, S., Varshitha Reddy, N., Patel, M., & Singh, T. A. (2024). Engineering Educators' Approach on the Development of Mentorship Strategy at HITAM-A Qualitative Study. Journal of Engineering Education Transformations, 37(4), 124–135. Scopus. https://doi.org/10.16920/jeet/2024/v37i4/24165

Cai, Y., Yang, Y., Ge, Q., & Weng, H. (2022). The interplay between teacher empathy, students' sense of school belonging, and learning achievement. European Journal of Psychology of Education, 38(3), 1167–1183. https://doi.org/10.1007/s10212-022-00637-6

Cooper, B. (2011). Empathy in education: Engagement, values and achievement. Continuum. http://dx.doi.org/10.5040/9781472552952

Connolly, T.M. & Begg, C.E. (2005). Database Systems: A Practical Approach to Design, Implementation, and Management. Pearson Education, Harlow.

Davis, M. H. (2018). Empathy. Routledge. http://dx.doi.org/10.4324/9780429493898

Gaumer Erickson, A., Noonan, P., Supon Carter, K., McGurn, L., & Purifoy, E. (2015). The Team Functioning Scale: Evaluating and improving effectiveness of school teams. International Journal of Educational Research, 69, 1–11. https://doi.org/10.1016/j.ijer.2014.09.001

Gupta, M. (2025). Integrating AI Into Online Engagement Models for Engineering Education: A Comprehensive Review. Journal of Engineering Education Transformations, 38(2), 329–336. https://doi.org/10.16920/jeet/2025/v38is2/25039

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. Communication Monographs, 76(4), 408–420. https://doi.org/10.1080/03637750903310360

Helm, J. M., Swiergosz, A. M., Haeberle, H. S., Karnuta, J. M., Schaffer, J. L., Krebs, V. E., Spitzer, A. I., & Ramkumar, P. N. (2020). Machine learning and artificial intelligence: Definitions, applications, and future directions. Current Reviews in Musculoskeletal Medicine, 13(1), 69–76. https://doi.org/10.1007/s12178-020-09600-8

Hoffman, M. L. (2000). Empathy and moral development. Cambridge University Press. http://dx.doi.org/10.1017/cbo9780511805851

Hogan, R. (1969). Development of an empathy scale. Journal of Consulting and Clinical Psychology, 33(3), 307–316. https://doi.org/10.1037/h0027580

Huang, H., & Su, Y. (2014). Peer acceptance among Chinese adolescents: The role of emotional empathy,

cognitive empathy and gender. International Journal of Psychology, 49(5), 420–424. https://doi.org/10.1002/ijop.12075

Klein, K. J. K., & Hodges, S. D. (2001). Gender Differences, Motivation, and Empathic Accuracy: When it Pays to Understand. Personality and Social Psychology Bulletin, 27(6), 720–730. https://doi.org/10.1177/0146167201276007

Main, A., Walle, E. A., Kho, C., & Halpern, J. (2017). The interpersonal functions of empathy: A relational perspective. Emotion Review, 9(4), 358–366. https://doi.org/10.1177/1754073916669440

Meyers, S., Rowell, K., Wells, M., & Smith, B. C. (2019). Teacher empathy: A model of empathy for teaching for student success. College Teaching, 67(3), 160–168. https://doi.org/10.1080/87567555.2019.1579699

Munoz, L., Fergurson, J. R., Harris, E. G., & Fleming, D. (2022). Does empathy matter? An exploratory study of class-transition satisfaction in unplanned course interruptions. Journal of Marketing Education, 44(2), 217–234. https://doi.org/10.1177/02734753211073891

Oberle, E., Schonert-Reichl, K. A., & Thomson, K. C. (2009). Understanding the link between social and emotional well-being and peer relations in early adolescence: Gender-Specific predictors of peer acceptance. Journal of Youth and Adolescence, 39(11), 1330–1342. https://doi.org/10.1007/s10964-009-9486-9

Pittinsky, T. L., & Montoya, R. M. (2016). Empathic joy in positive intergroup relations. Journal of Social Issues, 72(3), 511–523. https://doi.org/10.1111/josi.12179

Prince, M. J., Felder, R. M., & Brent, R. (2007). Does faculty research improve undergraduate teaching? An analysis of existing and potential synergies. Journal of Engineering Education, 96(4), 283–294. https://doi.org/10.1002/j.2168-9830.2007.tb00939.x

Schultze-Krumbholz, A., Ittel, A., & Scheithauer, H. (2020). The association between in-class cultural diversity with empathy and bullying in adolescence: A multilevel mediation analysis. International Journal of Psychology, 55(5), 769–778. https://doi.org/10.1002/ijop.12700

Sharma, R. (2020). Study of supervised learning and unsupervised learning. International Journal for Research in Applied Science and Engineering Technology, 8(6), 588–593. https://doi.org/10.22214/ijraset.2020.6095

Shashikant Pradip Borgavakar, & Mr. Amit Shrivastava. (2017). Evaluating Student's Performance using K-Means Clustering. International Journal of Engineering Research And, V6(05). https://doi.org/10.17577/ijertv6is050070

Sherub Gyeltshen, S. x, & Gyeltshen, N. (2022). The impact of supportive teacher-student relationships on academic performance. Asian Journal of Advanced Research and Reports, 15–34. https://doi.org/10.9734/ajarr/2022/v16i12446

Shi, C., Wei, B., Wei, S., Wang, W., Liu, H., & Liu, J. (2021). A quantitative discriminant method of elbow point for the optimal number of clusters in clustering algorithm. EURASIP Journal on Wireless Communications and Networking, 2021(1). https://doi.org/10.1186/s13638-021-01910-w

Smith, A. (2006). Cognitive empathy and emotional empathy in human behavior and evolution. The Psychological Record, 56(1), 3–21. https://doi.org/10.1007/bf03395534

Sullivan, H. S. (2013). The Interpersonal Theory of Psychiatry. Routledge. http://dx.doi.org/10.4324/9781315014029

Thompson, N. M., van Reekum, C. M., & Chakrabarti, B. (2021). Cognitive and affective empathy relate differentially to emotion regulation. Affective Science, 3(1), 118–134. https://doi.org/10.1007/s42761-021-00062-w

Vančíková, K. (2020). University teacher as a motivator-the aspect of empathy and enthusiasm. ICERI Proceedings. http://dx.doi.org/10.21125/iceri.2020.0706

Vedhathiri, T. (2020c). Faculty performance improvement through effective human resource management practices. Journal of Engineering Education Transformations, 33(Special Issue), 18–34. Scopus. https://doi.org/10.16920/jeet/2020/v33i1/150067

Wink, M. N., LaRusso, M. D., & Smith, R. L. (2021). Teacher empathy and students with problem behaviors: Examining teachers' perceptions, responses, relationships, and burnout. Psychology in the Schools, 58(8), 1575–1596. https://doi.org/10.1002/pits.22516

Zaki, J., Bolger, N., & Ochsner, K. (2008). It takes two. Psychological Science, 19(4), 399–404. https://doi.org/10.1111/j.1467-9280.2008.02099.x

Zembylas, M. (2015). The Vicissitudes of Teaching about/for Empathy. In Emotion and Traumatic Conflict (pp. 160–179). Oxford University Press. http://dx.doi.org/10.1093/acprof:oso/9780199982769.003.0009

Zhang, Z. (2022). Toward the role of teacher empathy in students' engagement in english language classes. Frontiers in Psychology, 13. https://doi.org/10.3389/fpsyg.2022.880935

Zhao, X., Lynch, J. G., Jr., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. Journal of Consumer Research, 37(2), 197–206. https://doi.org/10.1086/651257

Zhao, Y., Fuller, L., & Daugherty, K. K. (2021). Evaluating pharmacy faculty perceptions of empathy in education: A qualitative study. Currents in Pharmacy Teaching and Learning, 13(8), 975–981. https://doi.org/10.1016/j.cptl.2021.06.014

Zukauskiene, R. (2017). Interpersonal development. Routledge. http://dx.doi.org/10.4324/9781351153683