Manufacturing Science and Education 2025

ACTA TECHNICA NAPOCENSIS

Series: Applied Mathematics, Mechanics, and Engineering
Vol. 68, Issue Special III, August, 2025

EMBEDDING SOFT SKILLS INTO ENGINEERING EDUCATION: A PEDAGOGICAL SHIFT FOR INDUSTRY 4.0 DEMANDS

Valentin GRECU

Abstract: *This paper investigates the role of theatrical pedagogy in fostering transversal competencies (soft skills) among engineering students and graduates. While technical skills are traditionally emphasized in engineering education, the modern professional landscape increasingly demands strong interpersonal and intrapersonal abilities. Through a quantitative study utilizing a questionnaire, this research explores the current state of soft skill development among engineers, the methods through which these skills are acquired, and their perceived importance for personal and professional success. The findings suggest that theatrical pedagogy offers a valuable, yet underutilized, approach to cultivating these essential competencies, complementing formal technical education. Recommendations for integrating theatrical methods into both academic curricula and organizational training programs are provided.*
Keywords: *Engineering education; transversal competencies; theatrical pedagogies; curriculum integration*

1. INTRODUCTION

Education, fundamentally, involves the discovery, assimilation, and application of knowledge, leading to the acquisition of diverse competencies [1,2]. In the context of engineering, while technical proficiency remains paramount, the evolving demands of the 21st-century workforce highlight the critical importance of transversal competencies, often referred to as "soft skills" [3,4]. These include abilities such as communication, teamwork, problem-solving, emotional intelligence, and adaptability.

The theatrical arts, often perceived as distinct from technical fields, offer a unique pedagogical approach that can significantly contribute to the development of these crucial soft skills. Theater courses, through carefully selected games and exercises, aim not to create professional actors, but to cultivate a range of aptitudes vital for personal and societal engagement [5,6]. These include teamwork, imagination, spontaneity, concentration, emotion management, memory improvement, observation skills, and freedom of public expression [7,8]. Communication, in particular, is a foundational skill fostered by theatrical pedagogy, serving as a starting point for artistic creativity and effective human connection [9–11].

Theatrical pedagogy, commonly associated with the arts, offers a unique, experience-based approach to skill development. It facilitates emotional expression, social interaction, and reflective thinking through activities like improvisation, role-playing, and collaborative performances. This study investigates the integration of theatrical methods into engineering education to address soft skill deficits and better prepare graduates for professional environments.

2. THEORETICAL FRAMEWORK

2.1 Theatrical Pedagogy

Theatrical pedagogy represents a dynamic and interdisciplinary approach that combines aesthetic expression with personal and social development. Rooted in historical and philosophical perspectives on education, this method is increasingly recognized for its

capacity to foster critical transversal competencies. According to Perțea [12], theatrical pedagogy is not about producing professional actors but about using artistic experiences as tools for shaping individuals' capacities to adapt, communicate, and collaborate. Through structured improvisation, role-playing, and dramatization, students engage in experiential learning that promotes emotional intelligence, critical reflection, and social interaction.

This approach is grounded in theories of constructivist and experiential learning. Dewey [13] emphasized the importance of learning through experience, positing that education should prepare individuals to actively participate in society. Similarly, Skinner [14] highlighted that what remains after formal education is often what truly contributes to long-term success—precisely the kind of skills theatrical pedagogy seeks to develop. The activities involved in theatrical learning—games, improvisation, and scene creation—stimulate imagination, spontaneity, memory, and emotional regulation [6].

In academic settings, especially within technical fields like engineering, theatrical pedagogy remains underutilized. However, recent studies suggest it can significantly enhance competencies such as public speaking, collaboration, and conflict resolution [5]. In one study at the Faculty of Engineering in Sibiu, students who participated in theatrical workshops exhibited improved reflection, emotional control, and teamwork abilities, showcasing the method's relevance in shaping well-rounded professionals.

2.2 Transversal Competencies

Transversal competencies, often referred to as soft or non-cognitive skills, include critical thinking, collaboration, communication, time management, adaptability, and emotional intelligence. These are increasingly viewed as essential for success in modern, fast-changing work environments. As defined in the literature, a competence represents the integration of knowledge, skills, and attitudes applied in real-world problem-solving [15,16].

Educational institutions and employers alike acknowledge the importance of these skills for economic productivity and social cohesion. Zamora-Polo et al. [3] argue that transversal competencies enhance workforce adaptability, promote empathy, and enable interdisciplinary collaboration. Yet, traditional educational models, particularly in STEM disciplines, often fail to adequately support their development. [17]

European educational policies and institutions advocate for reforms that integrate these competencies into formal learning. However, in many systems, including Romania's, soft skills remain undervalued compared to technical expertise.[15] This imbalance creates a gap between academic preparation and labor market expectations, necessitating innovative, integrative pedagogies such as those found in the theatrical arts.

2.3 Theatrical Pedagogy and Soft Skills

The link between theatrical pedagogy and transversal competencies is well documented. Theatrical methods provide immersive, feedback-rich environments where students explore self-expression, emotional awareness, and interpersonal dynamics. These exercises serve as catalysts for building self-confidence, cooperation, and adaptability [9].

Theater also cultivates empathy and social perspective-taking—skills that are critical for leadership and teamwork. As Miranda-Calderón [6] notes, theater's emphasis on exploring reality and expressing human emotion allows individuals to better understand themselves and others. Participation in drama activities enables students to safely confront and process conflict, thereby enhancing resilience and communication under pressure.

Globally, educational initiatives integrating theater into curricula have shown promising results. In India, the National Thermal Energy Corporation employs a four-month theater-based training module for engineers to build confidence in public speaking and interpersonal engagement. In Australia, Brainstorm Productions has used theatrical techniques to address social issues such as aggression and bullying in schools [18].

Research shows that such programs are well-received by students, who appreciate their practical, engaging format and recognize their relevance to future workplace scenarios. Importantly, theatrical education nurtures transferable skills across academic, civic, and professional domains, reinforcing its interdisciplinary value.

2.4 Transversal Competencies and Professional Success

In today's professional landscape, the ability to manage emotions, communicate effectively, and navigate social dynamics is considered as critical as technical proficiency. Employers consistently report dissatisfaction with graduates who possess strong academic backgrounds but lack interpersonal and intrapersonal skills [19].

Studies by organizations such as Adecco USA reveal that poorly developed transversal skills lead to reduced productivity and financial losses. Consequently, many employers now prioritize candidates who demonstrate emotional intelligence, conflict resolution abilities, and teamwork, even when their technical skills are still developing. Human resource professionals often prefer hiring individuals with strong soft skills and investing in the development of their technical knowledge later [20].

This reorientation underscores the importance of incorporating comprehensive soft skill training into academic programs. Theatrical pedagogy provides a compelling solution. By fostering emotional literacy, adaptability, and self-regulation, it equips future professionals to meet workplace demands with confidence and resilience.[5] As such, it serves not only as an educational tool but as a strategic intervention to bridge the gap between education and employability.

3. METHODOLOGY

3.1 Research Objective

The study aimed to evaluate the development of transversal competencies among engineering students and graduates and examine how theatrical pedagogy contributes to this development.

3.2 Research Design

A quantitative survey was developed and distributed online using Google Forms. It included 11 sections: 10 sections assessed key transversal competencies via a 5-point Likert scale, and the final section collected demographic information and data on extracurricular participation.

3.3 Participants

The sample included 225 respondents from the Faculty of Engineering, comprising 123 females and 102 males. Of these, 64% were current students and 36% were graduates, representing a range of specializations.

3.4 Data Analysis

Responses were analyzed using Google Forms' built-in tools, with comparative assessments based on academic status, gender, and involvement in extracurricular or theatrical activities. Competency scores were averaged across respondent groups to identify trends.

3.5. Limitations of the Research

As with any research, this study was subject to certain limitations:

- **Data Collection Challenges:** Difficulty in collecting data due to a lack of involvement from some solicited individuals.
- **Respondent Sincerity:** As the research was conducted online, the sincerity of respondents' answers cannot be definitively guaranteed.
- **Subjectivity in Interpretation:** Potential for subjectivity in the interpretation of qualitative responses.

4. RESULTS AND DISCUSSION

The questionnaire assessed the presence of ten transversal competencies among engineering students and graduates, recognizing their importance for daily life, effective situation management, and career success. These competencies included: influence on others, active listening, self-management, problem-

solving, time management, decision-making, learning agility, goal setting, change management, and conflict management. Each of the first ten sections contained five statements, with respondents rating their frequency of engagement on a 5-point scale. An example of such an assessment is presented in figure 1

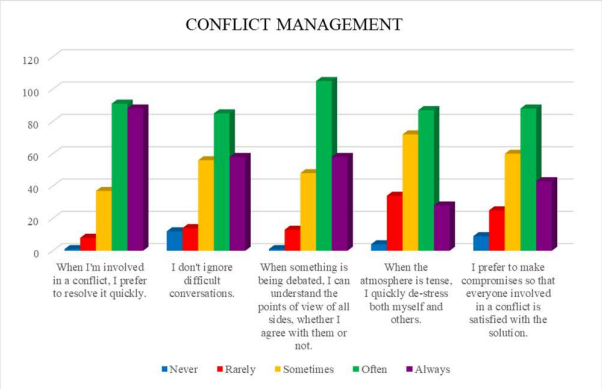


Fig. 1. Assessment of conflict management competencies

4.1. Individual Competency Assessment

The overall perceived presence of each of the ten transversal competencies was quantified by calculating the mean score and standard deviation for each competency. Figure 2 provides a summary of these statistical measures.

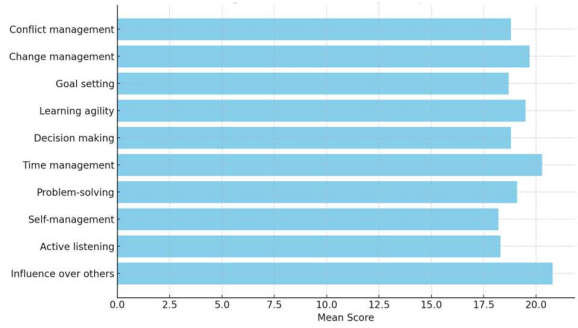


Fig. 2: Mean Scores for Assessed Transversal Competencies

4.2. Comparative Analysis of Competency Development

To further understand competency development, detailed analyses were performed by comparing average scores across different respondent categories.

While average scores were generally close or identical, graduates exhibited slightly more developed competencies in six out of ten cases (Table 1). This difference may be attributed to age, diverse life experiences, and workplace activities.

Table 1.

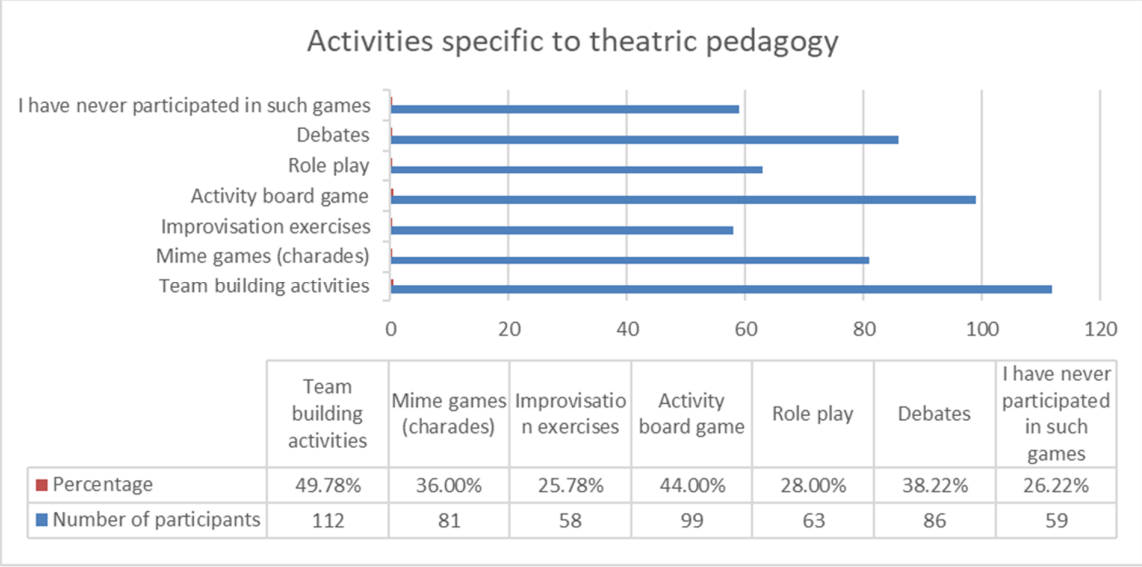
Comparative Analysis of Average Scores Across 10 Competencies

Competency	Student status		Gender		Extra-curricular activities	
	Students	Graduates	Female	Male	Participants	Non-Participants
Influence on Others	20.2	21.4	21	21	21	21
Active Listening	18.1	18.4	18	18	18	18
Self-Management	17.6	19.1	18	18	18	18
Problem-Solving	19.0	19.0	19	19	19	19
Time Management	19.7	21.0	21	20	20	21
Decision-Making	18.3	19.2	19	19	19	19
Learning Agility	18.9	19.7	19	19	20	20
Goal Setting	18.1	19.3	19	18	19	19
Change Management	19.5	20.0	20	20	20	19
Conflict Management	18.8	18.9	19	18	19	18

Average scores for male and female respondents were very similar, often identical. However, female respondents showed slightly higher averages in time management, goal setting, and conflict management.

Respondents who participated in extracurricular activities generally showed more developed skills, particularly in change management and conflict management. While overall averages were similar, participants more frequently achieved higher scores, including the maximum. Non-participants rarely achieved maximum scores, and when they did, it was in very limited numbers. This suggests that extracurricular engagement, including activities related to theatrical arts (e.g., improvisation, role-playing, mime games, team-building), plays a significant role in developing these skills.

The questionnaire also aimed to highlight the types of activities engineers or future engineers had engaged in that were intended to develop transversal skills. According to the results illustrated in Figure 3, the most commonly reported activity was participation in team-building exercises, with 112 respondents involved. This was followed by the game "Activity," played by 99 individuals. Debates and mime games ranked third and fourth, with 86 and 81 participants respectively, indicating a moderate level of engagement with these forms of collaborative communication training. However, activities directly linked to theatrical arts—such as role-playing and improvisation—were significantly less common, with only 28% and 25.8% of respondents, respectively, reporting involvement. Notably, about one-quarter of participants indicated they had not taken part in any such activities. A few respondents mentioned alternative methods, such as online games and stress-resilience challenges. One particularly insightful response came from Participant 132, who noted that all their experiences with activities like team-building, role-playing, and debates occurred in the workplace, rather than during university education—highlighting the current disconnect between formal training and practical skill development.



	Team building activities	Mime games (charades)	Improvisation exercises	Activity board game	Role play	Debates	I have never participated in such games
Percentage	49.78%	36.00%	25.78%	44.00%	28.00%	38.22%	26.22%
Number of participants	112	81	58	99	63	86	59

Fig. 3. Activities intended to develop transversal competencies

The final classification question assessed how important respondents considered transversal skills to be in the professional development of engineers. Using a linear scale from 1 (not important at all) to 10 (extremely important), the majority of participants (218 individuals) rated these skills between 7 and 10, with 43.1% assigning the maximum value of 10. Only six respondents viewed transversal competencies as moderately important (three

rated them 5, three rated them 6), and just one respondent dismissed their relevance entirely, assigning a score of 1. These findings underscore the widespread recognition of transversal skills as essential for professional success among current and future engineers.

4.3. Discussion of Hypotheses

The research findings support the formulated hypotheses. Hypothesis 1, which posited that activities specific to theatrical pedagogy contribute to the development of transversal (soft) skills, is confirmed by the participants' engagement in mime games, improvisation, role-playing, and debates—hallmarks of theatrical arts that effectively nurture human values and soft competencies. Hypotheses 2 and 3, concerning the limitations of formal education in cultivating these skills and the reliance on personal initiative for their development, are also supported. Survey results indicate that activities promoting soft skills, such as team-building and role-playing, primarily take place in professional environments rather than within the university curriculum, revealing a significant gap in formal training. Hypothesis 4, addressing employer dissatisfaction with technically proficient candidates who lack collaboration, communication, and situational management abilities, is likewise validated. Nearly half of respondents rated transversal skills as "extremely important" for professional success, echoing employer concerns about graduates' deficits in creativity, emotional regulation, and conflict resolution. Although many engineering students and graduates display strong emotional intelligence and soft skills, a substantial number still demonstrate weaknesses in this area. These findings highlight the pressing need for structured interventions—especially through theatrical pedagogy—to better integrate transversal skill development into both academic and non-academic educational contexts.

5. RECOMMENDATIONS

The research findings highlight that while engineers possess transversal competencies, their development largely stems from personal initiative and extracurricular engagement, rather than formal academic training. This indicates a significant opportunity for integrating practical, soft skill-focused methods into engineering education. Therefore, the following recommendations are proposed, focusing on leveraging theatrical arts as a didactic tool for personality development and stimulation among students and engineers:

5.1. Recommendations for Higher Education Institutions

University management, particularly within engineering faculties, should prioritize the establishment of training centers dedicated to developing students' emotional and transversal skills. These centers should utilize practical activities rooted in theatrical pedagogy, focusing on emotional intelligence to enhance interaction, communication, and self-confidence. An alternative approach could involve fostering partnerships between faculties and student associations, empowering these organizations to lead soft skill development programs. Such initiatives would facilitate smoother integration of graduates into the job market by complementing their technical expertise with essential interpersonal abilities.

5.2. Recommendations for Engineering Organizations

Companies in the engineering sector that prioritize employee development should invest in continuous training programs for transversal skills. As interpersonal skill development is an ongoing process, these programs, led by personal development specialists, would benefit both experienced employees and those early in their careers who may have had initial exposure to such training during their studies. By continuously improving interpersonal skills, organizations can foster greater harmony, collaboration, and ultimately, guaranteed success. This investment would address the growing employer demand for well-rounded professionals capable of effective communication, teamwork, and conflict resolution, leading to increased productivity and a more adaptable workforce.

6. CONCLUSION

This paper provides a comprehensive overview of theatrical pedagogy and its benefits as a formative and transformative tool. Its interdisciplinary methods, blending pedagogy and theater, create an environment conducive to self-knowledge and personal growth. Theatrical pedagogy focuses on developing universally applicable skills, relevant in both personal and professional spheres.

The study challenges the outdated notion that engineers, despite their intelligence, lack expressive abilities. It demonstrates that modern engineers are capable of transcending traditional disciplinary barriers through emotional intelligence and acquiring interpersonal and intrapersonal skills. These include enhanced listening and communication, improved attitude and behavior, effective interaction, and adept management of challenging situations.

The theoretical framework and empirical findings underscore theatrical pedagogy's essential role in developing transversal competencies in engineers, serving as a crucial practical complement to their technical training. While academic success is often measured by exam performance, professional success in the current job market increasingly depends on soft skills. Employers prioritize candidates who can collaborate and communicate effectively. Therefore, the research concludes that greater emphasis should be placed on developing transversal competencies through both university curricula and organizational training, recognizing their significant positive impact on personal and professional development.

7. REFERENCES

[1] Ausubel, D.P., The Acquisition and Retention of Knowledge: A Cognitive View, Springer Science & Business Media, ISBN 978-94-015-9454-7, Netherlands, 2012.

[2] Petruse, R.E., Grecu, V., Chiliban, M.-B., Tâlvan, E.-T., Comparative Analysis of Mixed Reality and PowerPoint in Education: Tailoring Learning Approaches to Cognitive Profiles, MDPI, ISSN 1424-8220, Switzerland, 2024.

[3] Zamora-Polo, F., Martínez Sánchez-Cortés, M., Reyes-Rodríguez, A.M., García Sanz-Calcedo, J., Developing Project Managers' Transversal Competences Using Building Information Modeling, MDPI, ISSN 2076-3417, Switzerland, 2019.

[4] Petruse, R.E., Grecu, V., Gakić, M., Gutierrez, J.M., Mara, D., Exploring the Efficacy of Mixed Reality versus Traditional Methods in Higher Education: A Comparative Study, MDPI, ISSN 2076-3417, Switzerland, 2024.

[5] Pertea, A., Grecu, V., Using Theatric Pedagogy To Develop Social And Emotional Skills In Order To Improve Employability Of Engineering Students, De Gruyter, ISSN 1583-199X, Romania, 2015.

[6] Miranda-Calderón, L.A., Theatrical Pedagogy and Exploration of Reality: An Expressive Approach That Causes Awareness in Teacher Training, Universidad de Costa Rica, ISSN 1409-4703, Costa Rica, 2020.

[7] Darie-Creţu, B., UNATC Junior-Proiect Pilot de Implementare a Artei Teatrului În Educaţie, UNATC, ISSN unknown, Romania, 2017.

[8] Vicovan, A., Jocurile Teatrale În Educaţia Specifică Studentului-Actor, UNATC, ISSN unknown, Romania, 2020.

[9] Geissler, G.L., Edison, S.W., Wayland, J.P., Improving Students' Critical Thinking, Creativity, and Communication Skills, Academic and Business Research Institute, ISSN 2327-5324, USA, 2012.

[10] Grecu, V., Investigating Critical Thinking Among Engineering Students in Romania, De Gruyter, ISSN 1583-199X, Romania, 2023.

[11] Grecu, V., Deneş, C., Developing Interpersonal, Communication and Critical Thinking Skills in Engineering Students, De Gruyter, ISSN 1583-199X, Romania, 2020.

[12] Perţea, A.-M., Teatrul ca Joc Şi Metodă de Formare, Editura Universităţii "Lucian Blaga", ISBN unknown, Romania, 2014.

[13] Dewey, J., Experience and Education, Taylor & Francis, ISSN 0013-1725, USA, 1986.

[14] Skinner, B., Education Is What Survives When What Has Been Learned Has Been Forgotten, New Scientist, ISSN 0262-4079, United Kingdom, 1964.
[15] Grecu, V., Denes, C., Developing Transversal Skills in Engineering Studies, FAIMA Business & Management Journal, ISSN unknown, Romania, 2023.
[16] Santos, S., Freire, C., Barbosa, I., Figueiredo, H., Costa, M., Assessing Transversal Competencies for the Future of Graduate Work: An Adaptation of the Multiple Mini-Interviews Method, in Proceedings of the Conference, Editor not listed (Ed.), pp. 4112–4122, 2020.
[17] Grecu, V., Deneș, C., Ipiña, N., Creative Teaching Methods for Educating Engineers, Trans Tech Publications, ISSN 1660-9336, Switzerland, 2013.
[18] Wooster, R., Contemporary Theatre in Education, Intellect Books, ISBN 1-84150-170-0, United Kingdom, 2007.
[19] Baltador, L.A., Grecu, V., Panța, N.D., Beju, A.M., Design Thinking in Education: Evaluating the Impact on Student Entrepreneurship Competencies, MDPI, ISSN 2227-7102, Switzerland, 2024.
[20] Jardim, J., Entrepreneurial Skills to Be Successful in the Global and Digital World: Proposal for a Frame of Reference for Entrepreneurial Education, MDPI, ISSN 2227-7102, Switzerland, 2021.

Integrarea competențelor transversale în educația inginerească: O schimbare pedagogică pentru cerințele Industriei 4.0

Această lucrare investighează rolul pedagogiei teatrale în dezvoltarea competențelor transversale în rândul studenților și absolvenților de inginerie. Deși în educația inginerească accentul este pus în mod tradițional pe abilitățile tehnice, peisajul profesional actual solicită tot mai mult abilități interpersonale și intrapersonale solide. Printr-un studiu cantitativ bazat pe un chestionar, cercetarea analizează stadiul actual al dezvoltării competențelor transversal în rândul inginerilor, metodele prin care acestea sunt dobândite și importanța percepută a acestora pentru succesul personal și profesional. Rezultatele sugerează că pedagogia teatrală oferă o abordare valoroasă, dar insuficient exploatată, pentru cultivarea acestor competențe esențiale, completând educația tehnică formală. Sunt oferite recomandări privind integrarea metodelor pedagogiei teatrale atât în curricula academică, cât și în programele de formare organizaționale.

Valentin GRECU, ș.l. dr. ing., Lucian Blaga University of Sibiu, Faculty of Engineering, Department of Industrial Engineering and Management, valentin.grecu@ulbsibiu.ro.