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Balancing Emotions and Science: Insights from the POEMS Project

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Abstract

The study is based on the POEMS project (Promoting Emotional Intelligence at School) and explores a new approach to integrating emotional engagement in science education. This addresses the challenge of balancing academic rigour with emotional impact. The project addresses this challenge by incorporating stories, hands-on learning, and emotional awareness into science teaching. Findings indicate that incorporating emotional elements enhances student motivation, engagement, understanding, and retention. The project approach reimagines science not just as a list of facts, but as an active, socially meaningful activity. According to the POEMS project, addressing students' emotional needs can make science classes more welcoming and inspiring places where students' natural curiosity grows and obstacles to learning are lowered. The article also considers future directions, including the potential for technological integration, such as AI, and ways to adapt traditional science teaching models to include Poems emotional strategies. Emphasizing emotional intelligence as integral to scientific literacy, the findings advocate for a change in science education - one that values emotional engagement as essential to fostering understanding and inspiring lifelong learning. Ultimately, the POEMS project highlights the critical role of emotions in cultivating scientifically literate, empathetic individuals capable of addressing complex societal challenges. This approach calls on educators and stakeholders to incorporate emotional considerations into teaching practices, transforming science education into a more engaging, effective, and human-centered experience.

Keywords: *Emotional intelligence, science, rigour, teaching practices*

1. Introduction

Science classrooms are often considered as detached, rational spaces focused on facts and objective standards, where there is no place for emotions. However, there are studies that state that feelings can be epistemic resources that help students observe, persist, investigate, analyze, test to make meaning in their learning [1, 2, 3, 4, 5, 6]. This would help students to move beyond memorization to deeper understanding and gain a sense of ownership, which makes them feel like real scientists and stimulates and maintains their curiosity and motivation [7, 8, 9]. Emotions help students connect new information to their prior experiences and understandings, thereby deepening comprehension and retention. When students feel emotionally connected to science, they are more motivated, curious, and willing to invest effort in understanding complex concepts. Moreover, addressing students' emotional needs helps create a more inclusive and equitable learning environment, where diverse learners feel valued and supported in their scientific journey [10].

Such studies highlight the role of emotions in the process of learning science, supporting the idea of embedding emotions into science learning [11, 12, 13, 14]. Emotions are not distractions as they are part of learning itself, managing attention, motivating careful observation, and encouraging investigation [5, 15]. This leads to more intense student engagement, which in turn feeds back into emotion (more care, interest, anticipation, joy and love for learning). Taking all these into consideration, science education has begun to embrace a more holistic approach which incorporates emotions in learning.

However, this change in science learning comes with a challenge: the tension between academic rigour and emotional engagement. This duality of rigour and emotion has generated discussions about whether integrating emotions would not compromise scientific rigour. Recent research suggests that humans function completely with both emotional and reasoning systems and rigor and emotion often interact, the combination of both creating richer, more effective learning experiences [16, 17, 18].

2. The POEMS Project

The POEMS project (Promoting Emotional Intelligence at School) offers an innovative response to this challenge. The POEMS project (2023-1-IT02-KA220-SCH-000157972) was funded by the European Commission under the Erasmus+ programme and implemented by the EuroED Foundation, Iasi, Romania, in a partnership of universities, schools, and NGOs from Italy, Latvia, Spain, Turkey and Romania [19]. The project aims to develop and enhance students' and teachers' ability to make use of emotional intelligence in science classes. By emphasizing Emotional Intelligence as a core component of science education, the POEMS project aims at reshaping the classroom as a space where scientific understanding is intertwined with emotional engagement. Through role-play, storytelling, experiential activities, and emotional awareness strategies, the project aims to transform science classes from mere presentation of facts into a socially meaningful and emotionally resonant activity. This paper explores the POEMS approach and examines the project's findings and future directions as seen from the participants themselves, teachers and students, to illustrate how embracing emotions can foster a more inclusive, inspiring, and student-centered science education.

3. Conceptual Framework

It is essential to clarify the key concepts of emotions, emotional intelligence and rigour used in this paper to understand the innovative approach of the POEMS project.

3.1 Emotional Intelligence

Emotional Intelligence (EI)**,** as used in this paper, defines students' ability to monitor one's own and others' feelings and emotions, to discriminate among them and to use this information to guide one's thinking and actions [20, p 190]. Salovey and Mayer recommend that "the term emotional intelligence be limited to abilities at the intersection between emotions and intelligence – specifically limited to the set of abilities involved in reasoning about emotions, and of using emotions to enhance reasoning" [21, p19]. Five areas of emotional intelligence have been identified: self-awareness, self-regulation, self-motivation, social awareness and social skills, which can be related to two large dimensions: personal skills and social skills. Emotional Intelligence acts as both an intrapersonal and interpersonal ability: as an intrapersonal ability it implies recognizing internal feelings, understanding one's strengths and weaknesses, and expressing one's feelings and thoughts clearly. As an interpersonal ability, it refers to being aware of others' emotions, feelings and needs, and having the potential to adjust behaviour to unpredictable, complex and unexpected situations [22]. EI helps one understand oneself better and connect well with others. The aim of developing emotional intelligence in science classrooms is to cultivate self-awareness, emotional regulation, and social skills, enabling students to manage the emotional dimensions of learning science - such as overcoming frustration and confusion or maintaining curiosity and embracing discovery - with flexibility, resilience and empathy (Mayer, Salovey & Caruso, 2008).

3.2 Emotions in Science Learning

Emotions are conscious mental reactions (such as anger or fear) subjectively experienced as strong feelings usually directed toward a specific object and typically accompanied by physiological and behavioral changes in the body, such as changes in breathing patterns, body temperature and/or feelings in specific parts of the body (Poems project). Feelings are emotional states or reactions. According to the APA Dictionary of Psychology [23], a feeling is "a self-contained phenomenal experience"; feelings are "subjective, evaluative, and independent of the sensations, thoughts, or images evoking them".
Research increasingly recognizes the central role of emotions in science education, influencing motivation and knowledge construction [24]. Epistemic emotions including curiosity and confusion are of particular significance. Curiosity stimulates students to explore and inquire, serving as a catalyst for

enhanced engagement and inquiry [25]. Moreover, confusion, when managed effectively, can serve as a springboard for critical thinking and conceptual change, encouraging learners to clarify misunderstandings and enhance their mental models [24].
Apart from epistemic emotions, other affective factors such as interest, enjoyment, anxiety, and frustration also influence students' science experiences [26]. It is well established that experiencing positive emotions increases student motivation in science classes [13]. What is more, students bring to their new learning thoughts and feelings associated with previous learning experiences, so students' past emotional experiences may influence task outcomes [27]. Studies have also shown that identity - how students see themselves as "science learners" can be shaped not only by recognition, competence and performance [28] but also by emotional responses to classroom activities [5, 7]. Zembylas (2004) states that emotions cannot be separated from science learning as they are interwoven into class science practices and impact how students participate in and interpret scientific activities. Emotions interact with students' scientific practices during classes and influence what students notice, pursue, and come to understand [5]. Recognizing and utilizing these emotions can thus enhance learning outcomes.

3.3 Defining "Rigour" in Teaching Science

In the context of the POEMS project, rigour refers to proficiency in scientific practices and conceptual understanding, the most important parts of scientific literacy. Scientific practices include skills such as observing, hypothesizing, experimenting, and analyzing - activities that represent the scientific method. Conceptual understanding involves comprehension of fundamental scientific principles and theories that explain natural phenomena.
As for rigour in teaching, there are different views depending on different understandings of what rigour refers to and of the qualities of rigour. Thus, when rigour applies to the qualities of scientific content delivered and received in a class (the curriculum), it means precision and accuracy, adequacy, and appropriateness. When applied to effective teaching, it involves clarifying abstract foundational concepts of science, discussing procedures clearly and accurately, identifying the adequacy in students' explanations and justifications, identifying and explaining connections among facts, conceptions and procedures [29].
To balance rigour with emotions, teachers need to design learning experiences that support high standards of scientific inquiry and comprehension while creating an emotionally supportive environment. This dual focus aims to produce students who are also emotionally motivated and scientifically competent - capable of critical thinking, creativity, and sustained interest in science.

4. Experiment Settings

The experiment involved 10 secondary school teachers from schools in Iasi Romania, who discussed two science lesson plans developed within the Poems project ("Exploring School and Community Life through Statistics" and "The Heart"), which they implemented with their students. The two lesson plans covered mathematics and biology and developed topics that students study in their mathematics and biology classes. The discussions explored how each lesson managed to strike a balance between emotional connection and academic rigour. We also collected students' testimonials related to the lessons they participated in.

5. Discussions

All participants agreed that teaching science is not merely about transmitting facts and theories; it involves fostering curiosity, critical thinking, and emotional engagement among students. Striking a balance between emotional connection and academic rigor enhances student learning and contributes to students' well-rounded development.

5.1 The "Exploring School and Community Life through Statistics," Lesson Plan

Thus, the teachers stated that the "Exploring School and Community Life Through Statistics" lesson plan managed to balance rigour and emotions by keeping a strong statistics core through its stages including introducing and clarifying concepts, applying them in calculations, interpretation and fallacy detection, while also using emotional intelligence (EI) activities to strengthen how students collaborate, question bias, and communicate responsibly about real-world data.

They noticed that the lesson plan maintains academic rigour by having a clear progression through three teaching units: students learn and apply mean, median, and mode with examples and practice tasks; they then analyze different data distributions (normal, skewed, bimodal, etc.) and locate mean, median and mode on distribution curves; finally, they develop critical statistical reasoning by identifying and fixing common statistical fallacies (sample bias, misleading axes, correlation vs causation, base-rate misunderstandings). These are high-value statistical competencies because they go beyond calculating and finding answers to interpreting and evaluating evidence.

The teachers highlighted that the lesson plan also uses the power of emotions in organizing student work. The lesson plan includes frequent pair or group work, group presentations, and class discussions, so students practice active listening, constructive disagreement, and respectful communication. These are all examples of EI skills and competences as explicitly named in the lesson plan. Reflection prompts after activities invite students to reflect on teamwork and how to improve collaboration, keeping emotions and relationships central to the learning experience without affecting, minimizing, or replacing mathematical content.

The participants agreed that the main “bridge” between rigour and emotions is visible in Unit 3, where statistical criticality is directly associated with self-awareness and emotion regulation. Students discuss how data can trigger emotional reactions (especially when it connects to social issues similar to those of their own communities). The lesson plan proposes activities to help students practice managing those reactions. Thus, they return to evidence and check assumptions to recognize biases. In other words, EI is used to help students think more clearly and supports better reasoning by slowing down impulsive interpretations and improving judgment when facts go against students’ views and beliefs.

Also, the assessment section combines rigour and emotions. For example, the exit tickets check students’ comprehension of statistical concepts, while teacher feedback evaluates collaboration strategies and students’ ability to communicate empathetically and responsibly. The optional adaptation for students with impairments (“mood bar graph”) is another example of balance: it keeps the statistics objective (mode, median and mean) while relying on emotionally meaningful and community-focused datasets.

Overall, teachers balance rigour and emotions by sequencing the lesson gradually as follows: teaching statistical tools, applying them to real-life contexts, critiquing misleading statistics, identifying and reflecting on biases, encouraging communication, and emotional responses to evidence. This approach ensures that emotions serve to develop critical thinking rather than weaken or compromise it.

5.2 The Heart Lesson Plan

The teachers also analyzed how “The Heart” lesson plan balances rigour and emotions by maintaining a clear biology “outline” (structure, function, and measurable heart rate) while using emotional learning activities as a bridge to apply and consolidate science learning - not as a distraction from it.

The participants agreed that the lesson preserves academic rigour by explicitly teaching essential circulatory system knowledge (the heart’s four chambers, arteries vs. veins, and the heart’s role in circulation) and by inviting students to engage with observable, measurable, and biological outcomes like resting vs. active heart rate. The lesson plan relies on scientific information, uses diagrams, models, and accurate explanations, and students’ learning is checked through a final questionnaire that covers both the structure of the heart and the connection between heart and emotions.

At the same time, the lesson intentionally incorporates emotions to make the science lesson personally meaningful: students discuss how emotions like stress, tension, excitement, and happiness manifest physically in the body (e.g., faster heart rate, sweating, blushing). This helps students connect abstract physiology to lived experience, which deepens both motivation and understanding.

The key balancing move is that emotions are taught through structured routines that help students think scientifically. For example, the Mindful Jar experiment makes emotional regulation a real observable thing: glitter swirling in water represents emotional “arousal,” and settling represents calming down. The lesson plan makes visible for students how emotional states can influence the heart and decision-making, then links it to strategies for managing stress (breathing, exercise, seeking support). This preserves rigour because students reason about how things happen and how their bodies react, but in a way that makes sense to them.

The second session builds on the first by having students analyze data and share and negotiate their opinions through the “emotion wheel” warm-up activity and the poster task. Students learn how to recognize emotions and describe physical cardiovascular changes. Then they create posters, compare how hearts respond to different emotions and suggest ways to calm down. Presentations are safe and inclusive, so emotional expression is supported, but the task remains academic because students must collect and organize information, justify arguments, and communicate clearly.
Overall, the teacher combines rigour and emotions by structuring the lesson plan as follows: introducing new biology concepts, connecting biology to emotions through evidence-based discussion and modeling, applying both by engaging students in group work and assessing understanding. Emotions are not treated as superfluous; rather, they are used to make science more understandable, memorable, and relevant while maintaining explicit educational objectives.

5.3 Students' Reactions when Blending Emotions with Academic Rigor

The two lesson plans were implemented with 30 lower secondary students. We asked them for their feedback to determine whether the way the lessons were organized, aroused their curiosity and interest in the topic, helped them understand the content, motivated them to further explore the subject, improved their communication with their peers, and increased their confidence in their scientific abilities.
Overall, their reactions were positive. Here are some typical reactions:
Twenty students stated that they became more interested in the subject matter because the content was connected to their life. They appreciated that the teacher started the lesson with a concrete example of the concept and by the end of the lesson they were also able to provide their own applications of the concept. Relating scientific concepts to personal experiences or community issues stirred their curiosity and motivated them to explore further. This also increased their awareness of the relevance of the materials they are expected to learn to their lives. This can foster a sense of ownership over their learning and encourage perseverance through challenging concepts.
Ten students mentioned that they developed a sort of joy when asked to identify and fix the challenges they faced in the lesson. This helped them concentrate and understand the materials better. Integration of emotion with rigor helps students internalize concepts more effectively. Emotional engagement makes learning memorable, resulting in better understanding of complex scientific concepts.
Most students revealed that they became more confident in their abilities. They discovered that science is not just facts and numbers; it involves creativity, emotion, and critical thinking. Balancing emotion and rigor can help break down stereotypes about science. Students feel more confident when they see that they can connect emotionally with the content and understand it. They may become more interested and more determined to work with abstract concepts and difficult problems.
Most of the students analyzed the way they acted during discussions and the role of active listening in communication, reaching agreement, which contributed to their successfully accomplishing the task. They appreciated such talks with their teachers about how to communicate respectfully and responsibly. Introducing EI in science lessons can help students become more aware of others and more empathetic. Students pay more attention to different points of view and learn how to work together.
To sum up, students' reactions are generally characterized by increased enthusiasm, deeper understanding, and emotional growth, leading to a more meaningful and enjoyable science learning experience.

5.4 Multimedia & Technology

Technology provides learners accessible and relevant subject matter and expertise and it is a tool which can enhance student engagement. Teachers reported that technology increased aspects of student engagement, such as taking initiative and responsibility for learning, using resources wisely, time on task, and having interest and desire and joy to pursue information and learn inside and outside of school. It is important to note that not everyone agrees that digital technology is the best option for cognitive and affective engagement in children.
The participants discussed the role of AI in learning. In their opinion AI should not be ignored. Some of them even thought of including a new component in EI related to a person’s ability to recognize AI’s influence on our emotions and to manage our relationships with AI competently and responsibly. Our teachers’ ideas align with recent studies that stipulate that Emotional intelligence in the context of AI

involves recognizing AI's influence on our feelings and interactions and managing these emotions effectively [30]. These new issues carry profound implications for education and leadership development. It facilitates a curriculum that harmonizes technical expertise with emotional intelligence, equipping individuals to manage technology with integrity and responsibility.

6. Conclusions

Teaching science effectively relies on combining emotional connection with academic rigor. Teachers may stimulate curiosity, empathy, and determination in their students by carefully planning lessons that link scientific ideas to real-life situations, personal experience, and community contexts. This balanced approach not only cultivates competent scientists but also fosters emotionally intelligent individuals who recognize science as an essential aspect of human existence.
For teachers, the main point is that emotional engagement should be embedded into rigorous science learning instead of being considered an extra. In planning, this means choosing events, phenomena and contexts that are personally or socially important and relevant to students (community data, everyday experiences, health) and then making sure they are introduced and practiced through challenging scientific methods (modeling, evidence-based explanation, and critical interpretation). Teachers can include structured routines such as hands-on explorations, real stories relevant to students' community and experience, and brief reflection moments to enhance students' emotional engagement. This helps students connect feelings like curiosity, concern, confusion, or uncertainty to productive scientific thinking and persistence. Moreover, students' emotional engagement benefits when teachers create psychologically safe spaces in classes, where students can express ideas, confusion, and emotions without fear of judgment, while still being held to high expectations for reasoning and evidence.
Using discussion strategies that make it normal to feel uncertain ("it's okay not to know yet") also adds to students' emotional engagement in science learning. It encourages multiple perspectives and helps students turn their emotional reactions into questions about scientific sensemaking ("what does the evidence suggest?"). In assessment, this means using formative methods that focus on students' development, promoting both conceptual understanding and the supporting learning processes (collaboration, respectful communication, or reflection). Exit tickets, learning journals, and discussion procedures can demonstrate not only what students know but also how their thinking evolves over time. Overall, balancing rigor and emotion in science classes encourages inclusion and emotional engagement, helping more students build confidence and a lifelong relationship with science.

REFERENCES

[1] Sinatra, G. M. (2005). The" warming trend" in conceptual change research: The legacy of Paul R. Pintrich. *Educational psychologist*, *40*(2), 107-115.
[2] Bellocchi, A., Ritchie, S. M., Tobin, K., King, D., Sandhu, M., & Henderson, S. (2014). Emotional climate and high quality learning experiences in science teacher education. *Journal of Research in Science Teaching*, *51*(10), 1301-1325.
[3] Chevrier, M., Muis, K. R., Trevors, G. J., Pekrun, R., & Sinatra, G. M. (2019). Exploring the antecedents and consequences of epistemic emotions. *Learning and instruction*, *63*, 101209.
[4] Shannon G. Davidson, Lama Z. Jaber, Sherry A. Southerland. (2020). Emotions in the doing of science: Exploring epistemic affect in elementary teachers' science research experiences. *Science Education.* https://doi.org/10.1002/sce.21596, https://onlinelibrary.wiley.com/doi/full/10.1002/sce.21596
[5] Pierson, Brady, & Lee (2023), "Emotional configurations in STEM classrooms: Braiding feelings, sensemaking, and practices in extended investigations," in *Science Education* (107[5], 1126–1162). https://doi.org/10.1002/sce.21799
[6] Gutierez, S. B., & Han, M. (2025). Elementary School Science teachers' Enactment of Epistemic Empathy as a Responsive Teaching Strategy for students' Negative Epistemic Emotions During Scientific Sense-Making. *Journal of Science Teacher Education*, *36*(8), 1072–1091. https://doi.org/10.1080/1046560X.2025.2483359
[7] Zembylas, M. (2004). Emotion metaphors and emotional labor in science teaching. *Science Education*, *88*(3), 301-324.
[8] Sinatra, G. M., & Seyranian, V. (2015). Warm change about hot topics: The role of motivation and emotion in attitude and conceptual change about controversial science topics. In *Handbook of educational psychology* (pp. 259-270). Routledge.

[9] Jaber, L. Z., & Hammer, D. (2016). Learning to feel like a scientist. Science Education, 100(2), 189-220
[10] Woodruff, K. A. (2021). *Sensemaking for equity and agency: STEM teacher learning through a community of practice model*. Montclair State University.
[11] Matthews & Snowden (2007), "Making Science Lessons Engaging, More Popular, and Equitable Through Emotional Literacy," published in *The Science Education Review* 6(3) https://eprints.goldsmiths.ac.uk/id/eprint/3599/1/matthews-emotional_literacy.pdf
[12] Immordino-Yang, M. H., & Damasio, A. (2007). We feel, therefore we learn: The relevance of affective and social neuroscience to education. *Mind, brain, and education*, *1*(1), 3-10.
[13] Sinatra, G. M., Broughton, S. H., & Lombardi, D. O. U. G. (2014). Emotions in science education. *International handbook of emotions in education*, 415-436.
[14] Tyng, C. M., Amin, H. U., Saad, M. N., & Malik, A. S. (2017). The influences of emotion on learning and memory. *Frontiers in psychology*, *8*, 235933.
[15] Kang, H., & Nation, J. M. (2023). Transforming science learning framework: Translating an equity commitment into action through co-design. *Journal of Science Teacher Education*, *34*(6), 667-687.
[16] Lombardi, D., Sinatra, G. M., & colleagues. (2013). Emotions about teaching about human-induced climate change… *International Journal of Science Education.*
[17] Lombard, F., Schneider, D. K., Merminod, M., & Weiss, L. (2020). Balancing emotion and reason to develop critical thinking about popularized neurosciences. *Science & Education*, *29*(5), 1139-1176.
[18] Vilhunen, E., & colleagues. (2022). Epistemic emotions and observations are intertwined in science learning. *Frontiers in Psychology.* https://pmc.ncbi.nlm.nih.gov/articles/PMC9442553/?utm_source=chatgpt.com
[19] Poems project, https://poems.pixel-online.org/index.php
[20] Salovey, P., & Mayer, J. D. (1990). Emotional intelligence. *Imagination, cognition and personality*, *9*(3), 185-211.
[21] Mayer, J. D., Salovey, P., & Caruso, D. R. (2008). Emotional intelligence: New ability or eclectic traits?. *American psychologist*, *63*(6), 503.
[22] Bar-On, R. (2006). The Bar-On model of emotional-social intelligence (ESI). *Psicothema*, 18, supp., 13-25. (https://www.psicothema.com/pdf/3271.pdf)
[23] The APA Dictionary of Psychology, (2026), https://dictionary.apa.org/
[24] Linnenbrink-Garcia, L., Patall, E. A., & Pekrun, R. (2016). Adaptive motivation and emotion in education: Research and principles for instructional design. *Policy Insights from the Behavioral and Brain Sciences*, *3*(2), 228-236.
[25] Hunaepi, H., Suma, I. K., & Subagia, I. W. (2024). Curiosity in Science Learning: A Systematic Literature Review. International Journal of Essential Competencies in Education, 3(1), 77–105. https://doi.org/10.36312/ijece.v3i1.1918
[26] Ainley, M., & Hidi, S. (2014). Interest and enjoyment. In *International handbook of emotions in education* (pp. 205-227). Routledge.
[27] Ainley, J., & Ainley, M. (2011). Student engagement with science in early adolescence: The contribution of enjoyment to students' continuing interest in learning about science. Contemporary Educational Psychology, 36(1), 4–12.
[28] Carlone, H. B., & Johnson, A. (2007). *Understanding the science experiences of successful women of color: Science identity as an analytic lens.* Journal of Research in Science Teaching, 44(8), 1187–1218. https://doi.org/10.1002/tea.20237
[29] Liu, X. (2018). A literature review on rigour in mathematics education. *Proceedings of the British society for research into learning mathematics*, *38*(2), 1-6.
[30] Cinar, A. B., & Bilodeau, S. (2024). Incorporating AI into the inner circle of emotional intelligence for sustainability. *Sustainability*, *16*(15), 6648