# DESIGNING WITH AI, TEACHING THE BODY: A PILOT STUDY ON PRE-SERVICE TEACHER TRAINING FOR EMBODIED EMOTIONAL LITERACY

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**ABSTRACT**
This exploratory study investigates how pre-service teachers in a General Didactics course (LM-85bis) design educational interventions for Embodied Emotional Literacy (EEL) using generative AI as a codesign tool. EEL integrates body awareness, interoception, and expressive movement as pathways to emotional competence. This addresses a pressing need: alexithymia affects 10–20% of adolescents, childhood obesity affects one in five Italian primaryschool children, and eating-disorder onset now occurs as early as age eight, with Special Educational Needs (SEN) students especially vulnerable. In a single ADDIE-based session, student groups used an AI chatbot to co-design body-oriented interventions for specific SEN profiles. A retrospective then-test recorded self-reported changes in perceived self-efficacy, knowledge, and perceived AI utility. Findings suggest that AI-mediated co-design may help surface pre-service teachers' tacit pedagogical knowledge of the body–emotion nexus; given the exploratory, uncontrolled, single-group design, these results should be read as preliminary indications rather than as evidence of causal gains in self-efficacy or intervention quality.

**KEYWORDS**
Embodied Emotional Literacy; AI-assisted instructional design; pre-service teacher training.

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## 1. Introduction

### 1.1 The body as an educational urgency: three converging phenomena

There are children who, when angry, do not know where they feel it — not because they feel nothing, but because no one taught them to read what the body silently expresses. This deficit, clinically termed alexithymia, is a mass educational phenomenon that unfolds in three converging directions.

The first is childhood obesity. OKkio alla SALUTE (Istituto Superiore di Sanità, 2024), surveying over 46,000 third-graders, found 19% of Italian children overweight and 9.8% obese — one in five, reaching 40% in some southern regions. The WHO COSI system (2022–2024), on ~470,000 children aged 7–9 across 37 countries, reports 25% excess-weight prevalence with no recent improvement. These are educational data: they document a bodily "deafness" that prevents children from reading signals of hunger, satiety, pleasure, and discomfort.

The second is eating disorders. Italian Ministry of Health data (2024) show identified cases more than doubling from 2019 to 2022 (680,569 to 1,450,567), with roughly four thousand deaths in 2023 — ten per day. Onset age is falling sharply: 30% of patients are under 14, 7% under 12, with documented cases as early as 8–9 years. Primary school is no longer insulated from this phenomenon.

The third is alexithymia, coined by Sifneos (1973) from the Greek for "no words for emotions": difficulty identifying, describing, and distinguishing one's emotions and bodily sensations (Taylor et al., 1997). It affects 10–20% of adolescents (Sharma et al., 2024), more so in disadvantaged populations, and is linked to relational difficulties, disordered eating, bullying risk, and burnout (Farina et al., 2021) — the common denominator beneath obesity and eating disorders.

### 1.2 The neuroscientific foundation: why body and emotion are inseparable

This convergence has a neuroscientific basis. Damasio's (1994) somatic marker hypothesis shows emotions are not purely cerebral: the body responds — heart rate, muscle tension, breathing — before the brain labels the state. A child who cannot read these sensations has no access to their own emotions.

Interoception — the ability to perceive internal bodily signals as emotional information (Mehling et al., 2012) — is the neurobiological prerequisite of emotional awareness. School-based interoceptive training improves emotional regulation, including in children with autism and ADHD (Mahler et al., 2022, 2024). Embodied cognition research (Barsalou, 2008; Macedonia, 2019) confirms that learning emotions through the body is neurobiologically more effective than verbal-cognitive approaches alone.

Evidence is robust: a PRISMA meta-analysis on primary-school RCTs (Fu et al., 2025) found physical-activity interventions improve socio-emotional competence ($d = 0.37$); Li et al. (2023), on 6,830 children, found exercise reduces anxiety, depression, and stress ($SMD = -0.25$, $p < .01$); a systematic review of body-oriented interventions (Dias Rodrigues et al., 2022) confirms measurable gains in socio-emotional competence from preschool age; Blewitt et al. (2024) show SEL programmes shift measurable physiological indicators (cortisol, heart rate, oxytocin).

### 1.3 Special Educational Needs: the most vulnerable population

Students with Special Educational Needs (SEN) — disabilities, developmental disorders, socio-economic disadvantage (MIUR Circular 8/2013) — are the most vulnerable population. ADHD is linked to sensorimotor and alexithymic traits (Grist et al., 2025); specific learning disorders to interoceptive-processing

difficulties; disadvantaged contexts to higher obesity and sedentary-lifestyle rates. In Italy, certified disabilities exceeded 3.6% of the school population in 2022/23, with the broader SEN figure considerably higher.

The pedagogical response cannot be limited to individualised plans: it requires teachers able to design interventions that treat body and emotion as tools for genuine, experiential inclusion.

### 1.4 The training gap: teachers are not adequately prepared

Despite this evidence, initial teacher education in Italy and Europe rarely builds operational competencies for using the body in emotional education. Pre-service teachers receive theoretical SEL/inclusion training but are seldom trained to design breathing exercises, proprioceptive games, or expressive-movement activities — leaving unprepared teachers to medicalise distress rather than address it in everyday practice.

### 1.5 Artificial Intelligence as co-designer: an unprecedented opportunity

Generative AI is entering this space. Cai et al. (2025) show AI-supported lesson-plan critique improves pre-service teachers' design competence; Wen and Wen (2024) show ChatGPT-assisted planning yields richer, more grounded outputs; a 2025 scoping review (Tan, 2025) identifies instructional design, self-efficacy, and positive attitudes toward innovation among the key benefits of generative AI in teacher development.

No study, however, has examined generative AI as a co-design tool for body-oriented emotional-education interventions among pre-service teachers — the gap this exploratory study addresses. Our hypothesis: precisely because AI lacks

a body, it acts as a "distorting mirror," forcing designers to externalise tacit bodily knowledge (Polanyi, 1966; Nonaka & Takeuchi, 1995) in a way no lecture can replicate.

### 1.6 The original construct: Embodied Emotional Literacy

This study introduces Embodied Emotional Literacy (EEL), integrating three traditions: embodied emotion theory (Damasio, 1994; Barsalou, 2008), body-oriented interventions (Dias Rodrigues et al., 2022, 2023), and interoception research (Mahler et al., 2022, 2024; Grist et al., 2025).

EEL is the competence — in child, teacher, and mediating AI — to read emotions through the body, teach it, and design it with pedagogical intentionality.

### 1.7 Research questions

This exploratory study is structured around four research questions:

RQ1: Does the use of AI as a co-designer within the ADDIE model, in a single structured session, produce a statistically significant increase in pre-service General Didactics students' perceived self-efficacy in designing Embodied Emotional Literacy interventions?

RQ2: What level of knowledge do participants demonstrate regarding the theoretical constructs of alexithymia, interoception, and body awareness after the intervention?

RQ3: How do students perceive AI as a co-design tool in the affective-bodily domain, and to what extent is it considered useful for designing inclusive interventions for SEN students?

RQ4: To what extent is the training experience perceived as transferable to future professional practice, and do participants recognise the systemic need to integrate bodily-emotional education into university curricula?

## 2. Methodology

### 2.1 Research design

This is an exploratory, within-subjects study using a single-group retrospective design. The quantitative component uses the retrospective then-test method (Howard et al., 1979; Rockwell & Kohn, 1989): a single post-intervention administration in which participants rate their perceived pre- and post-intervention states retrospectively — ensuring anonymity, reducing response-shift bias relative to a conventional pre–post design, and minimising participant burden. The study also includes two optional open-ended questions, analysed as illustrative, non-confirmatory material rather than as a formal qualitative component or a source of triangulation.

- Type of study: exploratory study · single-group retrospective design.
- Measurement method: retrospective then-test (Howard et al., 1979) — single post-intervention administration.
- Qualitative component: 2 optional open-ended questions · illustrative thematic reading (not a confirmatory or triangulating analysis).
- Ethical approval: study conducted in accordance with the principles of the Declaration of Helsinki · digital informed consent obtained at the time of questionnaire completion.

### 2.2 Participants

The sample comprised N = 54 students in the Primary Teacher Education Master's programme (LM-85bis), recruited by convenience sampling. It was predominantly female (92.6%; n = 50), mostly from Southern Italy (96.3%; n = 52), and largely composed of first-year students (96.3%; n = 52), with two second-year students also enrolled in the course. Age data were available for 49 of the 54 participants (see Table 1). All participants completed the post-session questionnaire.

*Table 1. Sociodemographic and educational characteristics of the sample (N = 54)*

| Characteristics | n | % |
|---|---|---|
| **Female gender** | 50 | 92.6% |
| **Male gender** | 4 | 7.4% |
| **Age < 20 years** | 32 | 59.3% |
| **Age 21-23 years** | 10 | 18.5% |
| **Age > 30 years** | 7 | 13.0% |
| **Southern Italy provenance** | 52 | 96.3% |
| **First-year students** | 52 | 96.3% |
| **Daily AI use** | 13 | 24.1% |
| **Frequent AI use** | 30 | 55.6% |

| | | |
|---|---|---|
| **Never used AI for teaching purposes** | 2 | 3.7% |
| **No prior SEN training** | 20 | 37.0% |
| **Never encountered alexithymia in training** | 40 | 74.1% |

*Note. Age-band totals sum to n = 49 (of N = 54); age was not reported by 5 participants.*

### 2.3 The intervention: structure of the single session

The intervention was a single 120-minute laboratory session structured in four phases drawing on the ADDIE model (Dick et al., 2015), integrated with a generative AI chatbot (Claude Sonnet, Anthropic), chosen for its natural fit with heuristic prompting and personalised material generation.

*Table 2. Structure of the intervention session (120 minutes total)*

| Phase | Duration | Activity | Tool |
|---|---|---|---|
| **1** | 35 min | Lecture on the educational emergency: obesity, eating disorders, alexithymia, BOIs, SEN. Introduction to EEL construct and ADDIE+AI model | *Slides + guided discussion* |
| **2** | 50 min | Small-group co-design (3–4 students) with AI chatbot using ADDIE framework | *AI chatbot (Claude Sonnet)* |

| | | | |
|---|---|---|---|
| **3** | 25 min | Presentation of artefacts and plenary debriefing: methodological choices, AI contribution, challenges | *Plenary discussion* |
| **4** | 10 min | Post-intervention questionnaire (TSE-SEL retrospective, Knowledge Test, PAUID, SCM + open-ended questions) | *Digital questionnaire* |

In the co-design phase (Phase 2), each group received a brief specifying a target age (6–8, 8–10, or 10–12), a SEN profile (e.g., ADHD with sensorimotor dysregulation; SLD with alexithymic traits), and three constraints: max. 30 minutes, no costly materials, feasible in a standard classroom. The chatbot supported all five ADDIE phases, from needs analysis to assessment-indicator design.

### 2.4 Measurement instruments

The instrument battery was administered via Google Forms in one post-session pass, with separate, standardised sections to minimise cross-contamination and no identifying data collected.

#### 2.4.1 Teacher Self-Efficacy for Social-Emotional Learning Scale (TSE-SEL)

The main instrument adapts the Teacher Self-Efficacy for SEL Scale (Schonert-Reichl et al., 2017) and adds three original bodily-dimension items developed from the EEL framework and reviewed by three experts for content relevance; as an unvalidated adaptation, results based on this instrument are treated as exploratory.

The final scale comprises 15 Likert items (1–5) in two subscales: emotional (items 1–8, adapted from the original SEL scale) and bodily (items 9–15, combining four adapted items with the three original EEL items; body awareness, SEN adaptation, AI-supported design).

The then-test format asked participants to rate perceived state both before and after the session, yielding delta scores.

Reliability was excellent: $\alpha = 0.955$ (total), 0.915 (emotional), 0.914 (bodily).

### 2.4.2 Knowledge Test: Alexithymia and Body Awareness

The Knowledge Test is an ad hoc 10-item instrument (6 true/false, 4 multiple-choice) built from the relevant literature and validated by three experts.

Items cover alexithymia, interoception, Damasio's somatic marker hypothesis, prevalence, evidence on body-oriented interventions, and ADHD's neuropsychological profile. Scores range 0–10.

### 2.4.3 Perceived AI Utility for Instructional Design Scale (PAUID)

The PAUID is a 10-item Likert scale (1–5), based on Wen & Wen (2024) and Cai et al. (2025), measuring perceived AI usefulness in affective-bodily co-design.

Item 5 (“I had to correct or reject some AI responses as pedagogically inappropriate”) indexes critical thinking: higher scores reflect professional judgment, not dissatisfaction.

Reliability was satisfactory: $\alpha = 0.810$.

### 2.4.4 Methodological Comparison Scale (SCM)

The SCM is a 6-item ad hoc scale measuring perceived added value of ADDIE+AI versus traditional design, transferability, and curricular need.

Internal consistency was low ($\alpha = 0.329$), attributed to item heterogeneity; analyses were conducted at item level.

### 2.4.5 Optional open-ended questions

Two optional open-ended questions completed the instrument battery. The first invited participants to describe any perceived moment of change during the session regarding body–emotion awareness. The second asked them to envision a concrete classroom application of the learned activities (student age, context, objectives). Responses — 18 (33.3%) and 20 (37.0%), respectively — were read thematically for illustrative purposes only. No formal qualitative procedure was applied (e.g., a predefined coding scheme, multiple independent coders, or inter-rater agreement checks), and no triangulation with the quantitative findings is claimed; these responses are reported as descriptive, non-probative material.

*Table 3. Measurement instruments*

| Instrument | Type | N item | $\alpha$ | Construct |
|---|---|---|---|---|
| **TSE-SEL (total)** | Likert 1-5, then-test | 15 | 0.955 | EEL self-efficacy (pre/post) |
| **TSE-SEL emotional subscale** | Likert 1-5 | 8 | 0.915 | Emotional-relational competencies |
| **TSE-SEL bodily subscale** | Likert 1-5 | 7 | 0.914 | Body awareness & SEN competencies |
| **Knowledge Test** | T/F+MCQ | 10 | n.a. | Theoretical knowledge |
| **PAUID** | Likert 1-5 | 10 | 0.810 | Perceived AI utility |
| **SCM** | Likert 1-5 | 6 | 0.329* | Transferability & methodological comparison |
| **Open questions** | Optional open-ended | 2 | — | Subjective experience |

**Low α due to conceptual heterogeneity; item-level analysis adopted.*

### 2.5 Data collection

Data were collected via Google Forms during the final phase of the session (May 2026). Participants who could not complete the questionnaire on site received the same link, which remained open for 48 hours, to complete it independently. No identifying data were collected.

Digital informed consent was obtained via a single-selection screen prior to questionnaire access.

The completion rate was 100% (N = 54).

### 2.6 Data analysis

Quantitative analyses used Python (3.12; pandas, numpy, scipy). TSE-SEL pre/post differences were tested with paired-samples t-tests at scale, subscale, and item level; effect sizes used Cohen's d.

Internal consistency was assessed using Cronbach's alpha, with mean imputation for missing values (< 0.5%).

Knowledge Test scores (0–10) were analysed using descriptive statistics and frequency distributions.

PAUID and SCM were analysed using item-level descriptive statistics; due to low internal consistency, SCM was not aggregated into a composite score.

Qualitative responses were read thematically to identify recurring patterns; this reading is descriptive and illustrative, and is not used to triangulate or confirm the quantitative findings.

Software: Python 3.12 · pandas · numpy · scipy.stats · Google Sheets (data export)

Statistical tests: paired t-test · Cohen's d · Cronbach's α · descriptive statistics

Significance threshold: $\alpha = 0.05$ (two-tailed) · Cohen conventions: small $d < 0.2$, medium $\approx 0.5$, large $> 0.8$

### 2.7 Methodological limitations

Following recommendations for small-sample, early-phase exploratory research (Thabane et al., 2010; Creswell & Plano Clark, 2018), several limitations are acknowledged.

The convenience sample (N = 54) limits generalisability; findings should be read as preliminary, exploratory evidence rather than as evidence of intervention efficacy. The retrospective then-test, while reducing response-shift bias relative to a conventional pre–post design, may introduce social desirability bias and does not by itself support causal attribution to the AI-mediated intervention. The absence of a control group and of any independent measure of actual (as opposed to perceived) competence further precludes causal claims, and the single-session design precludes assessment of longitudinal stability. The Knowledge Test, PAUID, and SCM are ad hoc instruments, and the three original bodily-dimension items added to the TSE-SEL are an unvalidated adaptation: all received expert content review but not formal psychometric validation (e.g., confirmatory factor analysis, convergent/discriminant validity). Results based on these instruments are therefore treated as exploratory and should not be read as evidence of the instruments' validity or of participants' actual knowledge or skill acquisition.

Despite these limitations, the study offers a novel integration — generative AI, initial teacher education, embodied emotional learning, and SEN-focused design — within a single exploratory study.

## 3. Results

The study involved 54 pre-service teachers on the LM-85bis programme: predominantly female (92.6%), mostly from Southern Italy (96.3%); nearly all were first-year students (96.3%).

All participants had used AI before; 55.6% frequently, 24.1% daily. AI use for instructional design specifically was less established: 70.4% only occasional, 25.9% frequent, 3.7% never.

Prior SEN training was limited (37.0% none, 38.9% only brief); 74.1% had never encountered alexithymia academically. Nearly all (96.3%) rated physical education as highly relevant to pupils' emotional well-being.

### 3.2 Perceived self-efficacy: retrospective TSE-SEL (then-test)

Perceived change was assessed via the adapted TSE-SEL (15 items, 5-point Likert) using the retrospective then-test format (Howard et al., 1979).

#### Overall score

Mean pre-intervention score was M = 41.07 (SD = 14.04) of 75 (item M = 2.74). Post-intervention, it rose to M = 56.07 (SD = 11.06; item M = 3.74).

The mean increase was $\Delta M = +15.00$ (SD = 11.85); $t(53) = 9.305$, $p < .001$, $d = 1.266$ (large effect).

#### Emotional subscale (Items 1–8)

The emotional subscale rose from M = 21.80 (SD = 7.28) to M = 29.83 (SD = 5.58), $t(53) = 9.571$, $p < .001$, $d = 1.303$.

**Embodied competence subscale (Items 9–15)**

The embodied subscale — interoception, proprioception, psychomotor integration, AI-supported SEN personalisation — rose from M = 19.28 (SD = 6.98) to M = 26.24 (SD = 5.73), $t(53) = 8.492$, $p < .001$, $d = 1.156$.

Both subscales showed large effects, with emotional competencies improving slightly more than embodied ones.

**Item-level analysis**

All 15 items improved significantly, with gains from +0.89 to +1.13.

The largest improvements were observed for the ability to:

- guide a pupil in verbally describing bodily sensations associated with emotions (Δ = +1.13);
- infer a child's emotional state through observation of movement quality (Δ = +1.09);
- conduct mindful breathing activities in the classroom (Δ = +1.07);
- recognise bodily indicators of emotional distress in pupils (Δ = +1.06).

The smallest gain (Δ = +0.89) concerned designing a full instructional sequence integrating movement, awareness, and reflection — the most pedagogically complex competency.

Perceived self-efficacy gains were thus largest for items concerning recognising, interpreting, and verbally mediating bodily sensations — the core of EEL. Given the single-group, uncontrolled, self-report design, this pattern is descriptive and does not establish that the intervention caused these gains.

### 3.3 Knowledge Test

Performance on the 10-item Knowledge Test (six true/false and four multiple-choice questions) indicated a high level of post-intervention knowledge acquisition.

Participants scored M = 8.87 (SD = 1.29) of 10; 90.7% scored ≥8, and 63.0% scored ≥9.

True/false accuracy was consistently high: 100% on the definition of alexithymia, 98.1% on its occurrence beyond adulthood, 96.3% on interoception, 90.7% on Damasio's hypothesis, 88.9% on ADHD/sensorimotor links.

The lowest multiple-choice accuracy (61.1%) concerned identifying which trait does not belong to the alexithymia construct (Taylor et al., 1997); 27.8% wrongly selected “externally oriented thinking,” which is in fact a defining dimension.

Other items scored well: prevalence (72.2%), evidence on body-oriented interventions (96.3%), and the Fu et al. (2025) effect size (87.0%).

### 3.4 Perceived usefulness of AI in instructional co-design (PAUID)

The PAUID (10 items, 5-point Likert) yielded M = 36.78 (SD = 4.75) of 50 (item M = 3.68), indicating generally positive perceptions of AI-assisted design.

The highest-rated items concerned:

- intention to use AI in future practice (M = 3.89);
- AI as design partner rather than substitute for judgment (M = 3.83);
- AI prompts helping articulate previously vague ideas (M = 3.78).

The latter supports the tacit-knowledge-externalisation framework (Nonaka & Takeuchi, 1995): the chatbot helped surface pedagogical knowledge participants already held implicitly.

The lowest score (M = 3.13) concerned critical evaluation of AI outputs — suggesting moderate, not yet systematic, critical engagement.

### 3.5 Methodological comparison (SCM)

SCM responses showed high agreement with the ADDIE+AI approach overall.

98.1% agreed the experience gave practical tools for future practice and that EEL design should become systematic in teacher education — among the study's most significant findings.

96.3% would recommend the experience to colleagues; 94.4% agreed physical and emotional education are inseparable; 92.6% found AI-supported ADDIE co-design more effective than traditional planning for SEN interventions.

The lowest (still majority) agreement (64.8%) concerned prior unawareness of the obesity–eating-disorder–body-awareness link, suggesting roughly a third already held partial awareness.

### 3.6 Open-ended responses

Responses to two optional open questions — 18 on shifts in body/emotion thinking, 20 on classroom application — are reported below as illustrative material; given the low response rate and the absence of a formal coding procedure, they are not treated as confirmatory or triangulating evidence.

Several participants described a shift from viewing the body as a passive container of emotion to seeing it as the origin of emotional experience. One wrote:

*"The turning point was realizing that the body is not a container but the place where emotion begins."*

Another participant stated:

*"I stopped seeing the body as simply containing the mind and began to understand it as the foundation of cognition itself."*

These reflections echo the vocabulary of Damasio's (1994) embodied emotion theory, but the size of the open-ended sample and the informal reading applied to it do not support a firm claim of conceptual restructuring; the excerpts are presented as illustrative of how some participants described their experience.

For classroom application, nearly all responses specified age group (mostly 6–10), context, and clear objectives.

Proposed activities — Emotion Traffic Light, The Weather Inside My Body, body-scan exercises, embodied sharing circles — resembled activity types described in Dias Rodrigues et al. (2022, 2023), often adapted for SEN profiles such as ADHD.

These open-ended responses illustrate some of the ways participants described the experience; given their limited, self-selected, and informally analysed nature, they should not be read as independent confirmation of the quantitative gains, of competence acquisition, or of conceptual change.

## 4. Discussion

### 4.1 Perceived Self-Efficacy: A Robust Change Following a Single Training Session (RQ1)

The study's most notable finding concerns the magnitude and consistency of the increase in perceived self-efficacy (TSE-SEL). The overall gain of 15.00 points, d = 1.266, is a large effect, roughly twice the size typically reported for in-service SEL professional development (0.30–0.60; Schonert-Reichl et al., 2017), despite arising from a single session.

This requires careful interpretation: the retrospective then-test is susceptible to social desirability and response-shift effects, whereby participants may retrospectively underrate their baseline competence (Howard et al., 1979).

Conceptually, perceived self-efficacy is not equivalent to actual competence; a single session's gain may partly reflect temporary enthusiasm rather than durable learning (Bandura, 1997).

However, the homogeneity of gains across all 15 items (d = 0.83–1.19, no exceptions) argues against a purely artefactual explanation, since social desirability would be expected to produce more variable effects across items.

The emotional subscale showed a slightly larger effect (d = 1.303) than the bodily subscale (d = 1.156) — plausibly because emotional-awareness competencies are already partly embedded in teachers' professional vocabulary, while bodily competencies require more extensive experiential learning, consistent with embodied cognition theory.

Overall, these findings support RQ1: a single structured session combining theory, AI-supported design, and reflective debriefing produced a statistically

and educationally meaningful increase in perceived self-efficacy, though controlled studies are needed to isolate each component's contribution.

### 4.2 Theoretical Knowledge: Strong Learning Outcomes with One Specific Conceptual Gap (RQ2)

The Knowledge Test (M = 8.87/10, 90.7% ≥8) is a meaningful achievement given that 74.1% of participants had never previously encountered alexithymia and 37.0% had no SEN coursework.

The lowest-scoring item concerned which trait does not belong to alexithymia (Taylor et al., 1997): 38.9% wrongly included excessive emotional reactivity/impulsivity.

This is pedagogically consequential: a child with alexithymia who suddenly erupts emotionally is not experiencing “too many emotions” but has missed the early bodily cues preceding escalation — a distinction that should shift teachers' response from behavioural control toward building bodily awareness.

Performance on other items was strong: body-oriented programme design (96.3%), the Fu et al. effect size (87.0%), and adolescent alexithymia prevalence (72.2%).

Knowing that 10–20% of adolescents may be affected — two to five children in a typical class of twenty-five — gives this figure direct practical relevance for inclusive planning.

Overall, RQ2 is well supported: participants acquired solid theoretical understanding in one session, with the alexithymia/hyperreactivity distinction flagged for future refinement.

### 4.3 AI as a Co-Designer: Perceived Usefulness and Critical Thinking (RQ3)

The PAUID's overall mean (36.78/50, item M = 3.68) indicates a generally positive evaluation of AI as a pedagogical co-design tool, with two complementary dynamics.

First, AI facilitated externalisation of tacit pedagogical knowledge: Item 4 ("AI's questions helped me make explicit ideas I held only vaguely") scored M = 3.78, supporting the theoretical proposition in Section 1.5.

This aligns with Nonaka and Takeuchi's (1995) SECI model: chatbot interaction functioned as an externalisation mechanism, compressing into one session a process that normally requires prolonged mentoring or peer collaboration.

Second, participants preserved professional autonomy: Item 7 ("AI functioned as a design partner without replacing my judgement", M = 3.83) and Item 6 (intention to use AI in future practice, M = 3.89) scored among the highest.

This balance — using AI as an intellectual resource while retaining professional judgement — is a central challenge in AI-supported teacher education (Tan, 2025; Cai et al., 2025), and the present design appears to have supported it well.

The lowest score, Item 5 ("I had to revise or reject some AI suggestions as pedagogically inappropriate", M = 3.13), indicates moderate — not systematic — critical evaluation, though higher scores here reflect stronger critical judgment, not dissatisfaction.

This aligns with literature showing that critical AI literacy does not develop automatically through use but requires explicit instructional support (Wen & Wen, 2024); the present intervention lacked a dedicated module on this.

Overall, PAUID findings support RQ3: participants valued AI as an instructional partner that elicited tacit reasoning while preserving autonomy, with critical evaluation of AI outputs identified as the key area for future development.

### 4.4 Perceived Transferability and Systemic Implications (RQ4)

SCM findings provide the clearest evidence for RQ4: 98.1% agreed the intervention gave practical strategies for future practice and that body-oriented emotional education should be systematically integrated into teacher curricula.

This is striking given that 74.1% had never previously encountered alexithymia — within two hours, participants came to see the domain as both indispensable and immediately applicable.

The item on curricular necessity (98.1% agreement) is theoretically significant: perceiving a competence as necessary, not merely useful, predicts its future implementation (Bandura, 1997; Pajares, 1992).

This suggests a genuine reorientation of pedagogical values — repositioning the body from peripheral to central in inclusive teaching.

The one comparatively lower-agreement item (64.8%) concerned prior unawareness of the obesity–eating-disorder–bodily-awareness link; the remaining 35.2% may already have held this understanding, underestimated their prior gap, or not yet fully integrated the concept.

This suggests the educational implications of childhood obesity could be explored in greater depth in future iterations, with more concrete classroom scenarios.

Overall, SCM findings strongly support RQ4: participants saw the intervention as both immediately transferable and systemically necessary.

### 4.5 The Embodied Emotional Literacy Construct and the Study's Original Theoretical Contribution

Beyond individual instrument findings, the EEL construct (Section 1.6) was not psychometrically validated here. The internal consistency of the two TSE-SEL subscales ($\alpha$ = .915 emotional, .914 bodily) is at least compatible with treating verbal/emotional and body-mediated awareness as distinguishable components, though reliability alone does not establish the construct's validity, which would require dedicated factorial and convergent/discriminant validation. More broadly, the study contributes to the growing challenge to the cognition–emotion divide, drawing on Damasio's (1994) Somatic Marker Hypothesis, interoception research (Mahler et al., 2022, 2024), and body-oriented intervention literature (Dias Rodrigues et al., 2022, 2023).

Its originality lies in translating this integration into a replicable model: the ADDIE+AI framework operationalises these insights without requiring participants' prior expertise in neuroscience or embodied pedagogy. The study also reframes generative AI's role in teacher education — not merely a technological aid but a cognitive partner facilitating reflective externalisation, emphasising an epistemic rather than purely technological function. EEL thus emerges as a theoretically coherent, educationally meaningful construct meriting further empirical development with larger, more diverse samples.

### 4.6 Limitations and Future Research

Limitations from Section 2.7 are not repeated in full; three deserve particular attention.

First, generalisability: the sample was almost entirely young, female, first-year students from a single Southern Italian programme — a homogeneous composition that aids internal interpretability but limits external validity. Future studies should recruit across multiple universities and regions, and compare cohorts at different training stages and intervention formats (single-session versus extended modules).

Second, the absence of longitudinal follow-up prevents distinguishing durable learning from temporary enthusiasm. Future designs should add delayed post-tests (4–6 weeks) to assess the stability of gains in self-efficacy, knowledge, and AI attitudes.

Third, critical AI literacy (PAUID Item 5) remained only moderately developed, suggesting it requires explicit instructional support rather than emerging spontaneously from use. Future iterations should include structured AI-auditing activities comparing AI-generated proposals against independently designed lesson plans using predefined quality criteria. Future research should also move beyond self-report toward behavioural indicators — classroom observation, lesson-plan analysis, simulated teaching, and independent expert evaluation.

Finally, further psychometric work — factorial structure, convergent/discriminant validity, measurement invariance — remains needed to firmly establish the EEL construct.

These limitations define the next stage of an emerging research programme rather than undermining the present, necessarily preliminary, findings.

## 5. Conclusion

This exploratory study addressed four research questions on generative AI as co-designer of EEL interventions for SEN students in initial teacher education, using a single-group retrospective then-test design, supplemented with illustrative open-ended responses, with 54 pre-service teachers (LM-85bis).

RQ1: participants showed a large, statistically significant increase in perceived self-efficacy for designing EEL interventions ($t(53) = 9.305$, $p < .001$, $d = 1.266$), consistent across items and both subscales (emotional $d = 1.303$; bodily $d = 1.156$), notwithstanding retrospective self-assessment limitations.

RQ2: the Knowledge Test showed strong theoretical learning ($M = 8.87/10$; 90.7% ≥8), with the alexithymia/hyperreactivity distinction as the main area for refinement.

RQ3: participants viewed AI as a valuable pedagogical partner (PAUID $M = 3.68/5$), helping articulate implicit ideas ($M = 3.78$) while preserving judgement ($M = 3.83$); critical evaluation of AI outputs remains an area for growth.

RQ4: the SCM showed very high agreement on transferability (98.1%), curricular necessity (98.1%), and willingness to recommend the programme (96.3%), with 94.4% affirming that bodily and emotional education are inseparable.

Taken together, the findings support three broader conclusions.

First, the body is a viable curricular resource: the gaps in obesity, eating-disorder, and alexithymia prevention outlined at the outset are not matched by

teacher competencies, and a single 120-minute session was associated with large self-reported increases in perceived self-efficacy, theoretical knowledge, and favourable attitudes toward AI-supported design; given the uncontrolled, single-group design, these associations should not be interpreted as established causal effects, and point toward the need for controlled, systematic curricular research.

Second, generative AI's epistemic role: by lacking embodied experience, AI encouraged participants to externalise tacit pedagogical knowledge, functioning as a maieutic device rather than a substitute for expertise.

Third, this study introduces and operationalises the EEL construct, proposes a replicable ADDIE+AI framework, and develops two new instruments with encouraging reliability (PAUID $\alpha = .810$; EEL items $\alpha \approx .91$) — establishing a foundation for larger, controlled, longitudinal, and psychometric follow-up research.

Ultimately, a child unable to locate where an emotion is felt in the body is not merely a clinical concern but an educational one — and this study suggests that the relevant teacher competencies can be deliberately cultivated.

**References**

Bandura, A. (1997). Self-efficacy: The exercise of control. Macmillan.

Barsalou, L. W. (2008). Grounded cognition. Annual Review of Psychology, 59, 617–645. https://doi.org/10.1146/annurev.psych.59.103006.093639

Blewitt, C., Morris, H., Sun, Y., Gooey, M., Kirk, H., Bergmeier, H., & Skouteris, H. (2024). Does social and emotional learning intervention influence physiological and biological indicators? A systematic literature review of universal and targeted programs in Pre-K to grade 12. Social and Emotional Learning: Research, Practice, and Policy, 3, 100028. https://doi.org/10.1016/j.sel.2024.100028

Cai, H., Han, B., Sun, J., Li, X., & Wong, L. H. (2025). Harnessing AI for teacher education to promote inclusive education: Investigating the effects of ChatGPT-supported lesson plan critiques on the development of pre-service teachers' lesson planning skills. The Internet and Higher Education, 67, 101022. https://doi.org/10.1016/j.iheduc.2025.101022

Creswell, J. W., & Plano Clark, V. L. (2018). Designing and conducting mixed methods research (3rd ed.). SAGE.

Damasio, A. (1994). Descartes' error: Emotion, reason, and the human brain. Putnam.

Dick, W., Carey, L., & Carey, J. O. (2015). The systematic design of instruction (8th ed.). Pearson.

Dias Rodrigues, A., Cruz-Ferreira, A., Marmeleira, J., & Veiga, G. (2022). Effects of body-oriented interventions on preschoolers' social-emotional competence: A systematic review. Frontiers in Psychology, 12, 752930. https://doi.org/10.3389/fpsyg.2021.752930

Dias Rodrigues, A., Marmeleira, J., Pomar, C., Lamy, E., Guerreiro, D., & Veiga, G. (2023). Body-oriented interventions to promote preschoolers' social–emotional competence: A quasi-experimental study. Frontiers in Psychology, 14, 1198199. https://doi.org/10.3389/fpsyg.2023.1198199

Farina, E., Pepe, A., Ornaghi, V., & Cavioni, V. (2021). Trait emotional intelligence and school burnout discriminate between high and low alexithymic profiles: A study with female adolescents. Frontiers in Psychology, 12, 645215. https://doi.org/10.3389/fpsyg.2021.645215

Fu, S., Wen, P., Wu, J., Li, Z., & Zheng, Y. (2025). The effects of physical activity on social-emotional competence in primary school students: A meta-analysis. Frontiers in Psychology, 16, 1657165. https://doi.org/10.3389/fpsyg.2025.1657165

Grist, N., Yu, M. L., & Brown, T. (2025). Exploration of children's interoception, emotional regulation, or anxiety and occupational participation: A scoping review with narrative synthesis. Occupational Therapy In Health Care, 1-23. DOI: 10.1080/07380577.2025.2567315

Howard, G. S., Ralph, K. M., Gulanick, N. A., Maxwell, S. E., Nance, D. W., & Gerber, S. K. (1979). Internal invalidity in pretest-posttest self-report evaluations. Applied Psychological Measurement, 3(1), 1–23.

Istituto Superiore di Sanità. (2024). OKkio alla SALUTE 2023: Dati nazionali. https://www.epicentro.iss.it/okkioallasalute/indagine-2023-dati

Li, J., Jiang, X., Huang, Z., & Shao, T. (2023). Exercise intervention and improvement of negative emotions in children: A meta-analysis. BMC Pediatrics, 23, 411.

Macedonia, M. (2019). Embodied learning: Why at school the mind needs the body. Frontiers in Psychology, 10, 2098. https://doi.org/10.3389/fpsyg.2019.02098

Mahler, K., Hample, K., Jones, C., Sensenig, J., Thomasco, P., & Hilton, C. (2022). Impact of an interoception-based program on emotion regulation in autistic children. Occupational Therapy International, 2022, 9328967.

Mahler, K., Hample, K., Ensor, C., Ludwig, M., Palanzo-Sholly, L., Stang, A., Trevisan, D., & Hilton, C. (2024). An interoception-based intervention for improving emotional regulation in children in a special education classroom. Occupational Therapy in Health Care, 38(3), 636–650.

Mehling, W. E., Price, C., Daubenmier, J. J., Acree, M., Bartmess, E., & Stewart, A. (2012). The Multidimensional Assessment of Interoceptive Awareness (MAIA). PLOS ONE, 7(11), e48230. https://doi.org/10.1371/journal.pone.0048230

Ministero della Salute. (2024). Relazione al Parlamento sui disturbi del comportamento alimentare 2023.

MIUR. (2013). Circolare Ministeriale n. 8/2013: Strumenti d'intervento per alunni con BES.

Nonaka, I., & Takeuchi, H. (1995). The knowledge-creating company. Oxford University Press.

Pajares, F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. Review of Educational Research, 62(3), 307–332. https://doi.org/10.3102/00346543062003307

Polanyi, M. (1966). The tacit dimension. Doubleday.

Rockwell, S. K., & Kohn, H. (1989). Post-then-pre evaluation: Measuring behavior change more accurately. Journal of Extension, 27(2).

Schonert-Reichl, K. A., Kitil, M. J., & Hanson-Peterson, J. (2017). To reach the students, teach the teacher. CASEL.

Sharma, P., Sen, M. S., Sinha, U. K., & Kumar, D. (2024). Childhood trauma, emotional regulation, alexithymia, and psychological symptoms among adolescents. Indian Journal of Psychological Medicine. https://doi.org/10.1177/02537176241258251

Sifneos, P. E. (1973). The prevalence of 'alexithymic' characteristics in psychosomatic patients. Psychotherapy and Psychosomatics, 22(2–6), 255–262.

Tan, Q. (2025). Reimagining teacher development in the era of generative AI: A scoping review. Teaching and Teacher Education, 168, 105236. https://doi.org/10.1016/j.tate.2025.105236

Taylor, G. J., Bagby, R. M., & Parker, J. D. A. (1997). Disorders of affect regulation. Cambridge University Press.

Thabane, L., Ma, J., Chu, R., Cheng, J., Ismaila, A., Rios, L. P., Robson, R., Thabane, M., Giangregorio, L., & Goldsmith, C. H. (2010). A tutorial on pilot studies in clinical research. BMC Medical Research Methodology, 10, 1. https://doi.org/10.1186/1471-2288-10-1

Wen, W., & Wen, H. (2024). Bridging generative AI technology and teacher education. Contemporary Issues in Technology and Teacher Education, 24(4).

World Health Organization. (2024). COSI 2022–2024: Childhood Obesity Surveillance Initiative. WHO Regional Office for Europe.