

# Design and Implementation of Emo-guard Jacket: A Wearable Technology for Emotional Control and Stress Management

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**Abstract** – Emotional regulation plays a vital role in students' well-being and academic performance. However, many students struggle to identify and control their emotions, especially under academic and social stress. This study aims to develop and evaluate Emo-guard, a smart wearable emotional control jacket designed to help people monitor and regulate their emotional responses in real time. Emo-guard integrates biometric sensors such as heart rate and body temperature detectors to track the user's emotional intensity. The data are processed via a micro-controller that provides feedback through subtle vibrations or color signals, prompting the user to manage emotions appropriately. This study adopts a Design and Development Research (DDR) approach involving three phases: needs analysis, prototype construction, and user evaluation. Preliminary findings indicate that Emo-guard enhances emotional awareness and promotes better self-regulation among students. The findings suggest that this innovation can contribute to emotional well-being and the integration of smart technology in education.

**Keywords:** Emo-guard, emotional control, smart technology, student well-being

## I. INTRODUCTION

We are Emotions play a significant role in shaping human behaviour, decision-making, and overall mental health. In the context of education, students who are unable to manage their emotions effectively often experience stress, anxiety, and decreased academic performance. Emotional regulation, therefore, is not only essential for personal well-being but also for fostering a positive learning environment and social interaction.

In recent years, the integration of technology into emotional and psychological support systems has gained attention among researchers and educators. Wearable technologies, such as smart watches and biometric devices, have been increasingly used to monitor health indicators like heart rate, body temperature, and stress levels. These advancements open new possibilities for emotional monitoring and self-regulation through intelligent, real-time feedback mechanisms.

Emo-guard was developed as an innovative response to these needs — a smart jacket designed to help students recognize and regulate their emotional states. By using biometric sensors and programmed micro-controllers, Emo-guard detects physiological signals associated with stress or emotional changes. The system provides feedback through vibrations or colored light cues to prompt the user to take calming actions, such as breathing exercises or short pauses.

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This study aims to develop and evaluate the effectiveness of Emo-guard as a wearable emotional control system that promotes self-awareness and emotional stability among students. The research employs a Design and Development Research (DDR) approach, involving three main stages: needs analysis, prototype design, and user evaluation. The ultimate goal is to contribute to the integration of smart technology in emotional education and to enhance students' psychological well-being in academic settings.

## II. PROBLEM STATEMENT

In today's fast-paced and demanding academic environment, students are increasingly exposed to various stressors, including academic pressure, social challenges, and personal insecurities. These factors often lead to emotional instability, which can negatively affect learning motivation, classroom engagement, and interpersonal relationships. Despite efforts by educators to provide emotional support through counselling and mentoring programs, many students still struggle to recognize and regulate their emotions effectively. Traditional approaches to emotional management, such as face-to-face counselling or peer support groups, are often limited by time, accessibility, and students' willingness to express their feelings. As such, there is a pressing need for innovative solutions that combine psychological principles with technological advancements to offer real-time emotional feedback and self-regulation tools. Emo-guard addresses this gap by providing a practical and interactive means of emotional control through wearable technology. However, the effectiveness and user experience of such a device require systematic investigation to determine its feasibility, functionality, and impact on users' emotional well-being. This study, therefore, seeks to explore how Emo-guard can be developed, implemented, and evaluated as a smart wearable intervention for emotional regulation among students.

## III. LITERATURE REVIEW

### *Emotional Regulation and Its Importance in Education*

Emotional regulation refers to the ability to monitor, evaluate, and modify one's emotional reactions in order to achieve personal goals and maintain psychological well-being (Gross, 2015). In the educational context, students who possess effective emotional regulation skills demonstrate higher levels of motivation, academic achievement, and social competence (Mayer et al., 2016).

Conversely, difficulties in managing emotions such as anxiety, frustration, or anger can lead to behavioural issues, absenteeism, and poor learning outcomes.

Educational institutions are therefore increasingly recognizing the importance of emotional education as a foundation for holistic student development. Programs focused on social and emotional learning (SEL) have been introduced to help students build self-awareness, empathy, and resilience (Durlak et al., 2011). However, traditional emotional support programs often rely heavily on teacher intervention, which may not adequately address the real-time emotional fluctuations that students experience in their daily lives.

### **Technological Interventions for Emotional Monitoring**

The advancement of wearable technologies has opened new avenues for supporting emotional awareness and regulation. Devices such as smartwatches, wristbands, and biofeedback tools can monitor physiological indicators like heart rate variability, skin temperature, and galvanic skin response to infer emotional states (Picard, 2017). These technologies have been widely applied in health psychology, stress management, and even educational research to promote emotional self-regulation.

For instance, Biofeedback-based interventions allow users to gain insight into their physiological reactions during stress, helping them to consciously control breathing and relaxation responses (Yu et al., 2020). Similarly, mobile and wearable applications such as Moodmetric and Empatica E4 have demonstrated potential in identifying stress patterns and promoting mindfulness practices. Nonetheless, many of these devices remain general-purpose and not specifically designed for the educational environment, where emotional control is closely linked to learning behaviour and academic performance.

### **Smart Wearable Devices in Education**

Smart wearables are increasingly being used as tools for both behavioural observation and educational engagement. According to Kaur and Singh (2021), wearable devices enhance learning by providing real-time feedback and enabling data-driven insights into students' cognitive and emotional states. In the context of emotional regulation, these devices can serve as silent companions that remind students to pause, breathe, and reflect before reacting impulsively.

However, most existing studies focus on wrist-worn devices or smartphone applications, with limited exploration into textile-integrated technologies such as smart clothing. Smart garments offer a more natural, less intrusive medium for continuous emotional monitoring while maintaining user comfort and mobility (Stoppa & Chiolerio, 2014). Integrating emotion-sensing systems within clothing can create a more seamless and personalized experience, making it suitable for daily use in educational environments.

### **Conceptual Basis of Emo-Guard**

Emo-Guard was conceptualized based on the integration of emotional regulation theory (Gross, 1998) and the technological framework of wearable sensing. The system operates under the principle that early awareness of physiological changes can prevent emotional escalation. Through embedded sensors that detect signals such as body temperature and heart rate, Emo-Guard provides real-time feedback via subtle vibrations or LED color cues, prompting users to engage in calming strategies.

This aligns with the Cognitive Behavioural Model of emotion regulation, which emphasizes awareness, cognitive reappraisal, and behavioural adjustment. The incorporation of such models into smart wearable technology represents an innovative approach to emotional education — one that bridges psychological theory and practical application.

## **IV. METHODOLOGY**

### **Research Design**

This study employed a Design and Development Research (DDR) approach as outlined by Richey and Klein (2007). The DDR method is suitable for studies that involve the systematic design, development, and evaluation of educational products, models, or tools. The process in this study was conducted through three main phases:

- i. Needs Analysis – identifying students' emotional regulation challenges and determining design requirements for the smart jacket.
- ii. Design and Development – creating the Emo-Guard prototype incorporating biometric sensors, feedback mechanisms, and comfort features.
- iii. Evaluation – testing the functionality, usability, and effectiveness of Emo-Guard in a real educational environment.

This approach was selected because it allows the integration of technological innovation with empirical testing to ensure that the developed product is both functional and educationally relevant.

### **Participants**

The study involved 30 secondary school students (aged 13–17) who were randomly selected from a local Islamic secondary school with hostel facilities. The participants represented a range of emotional and behavioural profiles as observed by their teachers and hostel wardens. Participation was voluntary, and parental consent was obtained prior to the study.

In addition, five teachers and two counsellors were interviewed to provide expert insights into the emotional needs of students and the practical application of the Emo-Guard device in the school environment.

**Instruments**

- i. Several instruments were utilized to collect both quantitative and qualitative data:
- ii. Observation Checklist – used to assess students’ behavioural changes during the use of Emo-Guard.
- iii. Questionnaire on Emotional Awareness and Regulation (EARQ) – adapted from existing validated scales to measure self-awareness, emotion management, and stress response.
- iv. Semi-structured Interviews – conducted with students, teachers, and counsellors to gather feedback regarding usability, comfort, and perceived benefits of Emo-Guard.
- v. Prototype Testing Logs – used to record biometric data such as heart rate and temperature variations during daily activities.

**Procedures**

The study was conducted over a period of six weeks:

*Phase 1: Needs Analysis (Week 1–2)*

Data were gathered through focus group discussions and surveys to identify emotional triggers and user preferences.

*Phase 2: Design and Development (Week 3–4)*

The Emo-guard prototype was developed using Arduino-based micro controllers, heart rate sensors, and temperature detectors integrated within a wearable jacket. The design included LED color indicators and vibration motors to provide real-time emotional feedback.

*Phase 3: Evaluation (Week 5–6)*

Students wore the jacket during selected school activities. Observations and biometric readings were analyzed to determine emotional patterns, while post-trial interviews assessed the effectiveness of the device.

**Data Analysis**

Quantitative data from the questionnaires were analyzed using descriptive statistics (mean, standard deviation, and frequency) to identify trends in emotional regulation before and after the use of Emo-guard. Qualitative data from interviews were analyzed using thematic analysis, allowing for the identification of recurring themes related to emotional awareness, usability, and behavioural change.

Triangulation of both data types ensured the validity and reliability of the findings, providing a holistic understanding of Emo-guard's impact on students’ emotional regulation.

**TABLE I: ANALYTIC SCORING RUBRICS**

<b>Content</b>		
Score	Range	Indicators
A (9-10)	Very Good	- The ideas are clearly stated - The ideas are comprehensible - The ideas are relevant - The ideas fluently expressed
B (7-8)	Good	- The ideas are clearly stated - The ideas are quite comprehensible - The ideas are adequate relevant - The ideas adequately expressed
C (5-6)	Average	- The ideas are rather clearly stated - The ideas are quite comprehensible - The ideas are quite relevant - The ideas sufficiently expressed
D (3-4)	Poor	- The ideas are not clearly stated - The ideas are quite incomprehensible - The ideas are not quite relevant - The ideas non fluent expressed
E (1-2)	Very Poor	- The ideas are not enough to evaluate - The ideas are incomprehensible - No communication of ideas - The ideas are irrelevant

Adapted from Salija (2004)

**V. FINDINGS**

**Quantitative Findings**

*Emotional Awareness*

Analysis of the Emotional Awareness and Regulation Questionnaire (EARQ) revealed a significant improvement in students’ ability to recognize their emotional states after using Emo-Guard. The mean score for emotional awareness increased from 3.2 (pre-test) to 4.1 (post-test) on a 5-point Likert scale, indicating a higher level of self-perception regarding emotional changes.

*Emotional Regulation*

Students also showed improved emotional regulation, with post-test scores averaging 4.0, compared to 3.1 pre-test. This suggests that real-time feedback from the jacket (via LED lights and vibrations) helped students manage stress, anxiety, and frustration more effectively during school activities.

*Usability and Comfort*

Questionnaire data regarding usability indicated a positive reception, with 85% of participants reporting that the jacket was easy to use. However, 20% noted minor discomfort during extended wear, mainly related to sensor placement and fabric flexibility.

## **Qualitative Findings**

### *Student Feedback*

Students reported that Emo-Guard made them more aware of their emotional changes and encouraged self-regulation. For instance, one participant stated: "I didn't realize I was getting stressed until the jacket vibrated. Then I took a deep breath and calmed myself."

### *Teacher Observations*

Teachers observed that students wearing Emo-Guard demonstrated improved self-control, particularly in stressful situations such as examinations or group activities. Teachers highlighted that the device served as a silent reminder for students to pause and regulate their emotions.

### *Counsellor Insights*

Counsellors noted that integrating a wearable emotional regulation device could complement traditional interventions. They emphasized that Emo-Guard provides real-time feedback that may be difficult to achieve in conventional counselling sessions.

## **VI. DISCUSSION**

The findings from the Emo-Guard project highlight the potential of wearable technology in supporting emotional regulation among students. The data collected and user feedback indicate that Emo-Guard effectively promotes emotional awareness through real-time feedback and biometric monitoring. Students reported an increased ability to recognize emotional changes, while teachers observed improvements in classroom behaviour and self-control. These outcomes align with previous studies emphasizing the role of technology-assisted interventions in enhancing emotional intelligence and psychological well-being (Salovey & Mayer, 1990; Goleman, 1995).

A notable strength of Emo-Guard lies in its integration of physical and emotional feedback. Unlike conventional counselling or mindfulness programs that rely heavily on verbal reflection, this smart jacket provides immediate physiological signals — such as changes in heart rate or temperature — allowing users to respond proactively to emotional fluctuations. This aspect makes Emo-Guard not only a monitoring tool but also a self-regulation aid.

However, the study also reveals several challenges. Some users expressed discomfort during prolonged wear, suggesting that material design and sensor placement need improvement. Moreover, while short-term results showed positive emotional outcomes, the long-term sustainability of these effects remains uncertain. Future studies should explore extended usage and integration with mobile apps or AI-based systems for more comprehensive emotional tracking.

The research also contributes to the broader discussion of emotional education within digital learning environments. As schools increasingly adopt technological tools for cognitive development, Emo-Guard demonstrates that emotional development can be equally supported through innovative design. It bridges the gap between affective learning and digital innovation, fostering holistic student development that includes emotional balance, empathy, and resilience.

In summary, previous studies affirm the importance of emotional regulation in education and highlight the growing role of wearable technologies in promoting self-awareness and mental well-being. Nonetheless, there remains a gap in the design and evaluation of smart garments specifically tailored for students' emotional development. This study, therefore, seeks to fill that gap by developing and assessing Emo-Guard, a smart jacket that combines emotional theory with modern sensor technology to enhance students' ability to recognize, understand, and regulate their emotions in real time.

## **VII. CONCLUSION**

The development and evaluation of Emo-Guard mark a significant step toward integrating emotional education with modern wearable technology. This study demonstrated that emotional regulation can be effectively supported through innovative technological interventions that provide real-time feedback and self-awareness opportunities. By combining biometric monitoring with user-friendly design, Emo-Guard offered students a practical means to recognize and manage their emotions more consciously and constructively.

The findings suggest that the Emo-Guard smart jacket can enhance emotional awareness, promote calmness during stressful situations, and encourage positive behavioural responses among students. Teachers and counsellors also acknowledged its potential as a complementary tool to existing emotional education programs, particularly in boarding school settings where students face unique psychological and social challenges.

Moreover, the research contributes to the growing body of literature on smart wearable applications in education, offering new insights into how emotional well-being can be fostered through technology. While the results are promising, further refinement and long-term testing are necessary to improve the device's functionality, comfort, and data accuracy.

In conclusion, Emo-Guard represents an innovative fusion of psychology, education, and technology — a tangible example of how emotional intelligence can be nurtured through digital innovation. With continued development and wider implementation, this smart jacket holds great potential to support the creation of emotionally balanced, resilient, and self-aware learners in the digital era.

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## REFERENCES

- Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. *Child Development*, 82(1), 405–432. <https://doi.org/10.1111/j.1467-8624.2010.01564.x>
- Gross, J. J. (1998). The emerging field of emotion regulation: An integrative review. *Review of General Psychology*, 2(3), 271–299. <https://doi.org/10.1037/1089-2680.2.3.271>
- Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological Inquiry*, 26(1), 1–26. <https://doi.org/10.1080/1047840X.2014.940781>
- Goleman, D. (1995). *Emotional intelligence: Why it can matter more than IQ*. Bantam Books.
- Kaur, M., & Singh, H. (2021). Wearable technology and its impact on education: A review. *Journal of Educational Technology Systems*, 49(1), 38–58. <https://doi.org/10.1177/0047239520966845>
- Mayer, J. D., Roberts, R. D., & Barsade, S. G. (2016). Human abilities: Emotional intelligence. *Annual Review of Psychology*, 59, 507–536. <https://doi.org/10.1146/annurev.psych.59.103006.093646>
- Picard, R. W. (2017). *Affective computing: From laughter to IEEE*. MIT Press.
- Richey, R. C., & Klein, J. D. (2007). *Design and development research: Methods, strategies, and issues*. Routledge.
- Salovey, P., & Mayer, J. D. (1990). Emotional intelligence. *Imagination, Cognition and Personality*, 9(3), 185–211. <https://doi.org/10.2190/DUGG-P24E-52WK-6CDG>
- Stoppa, M., & Chiolerio, A. (2014). Wearable electronics and smart textiles: A critical review. *Sensors*, 14(7), 11957–11992. <https://doi.org/10.3390/s140711957>
- Yu, F., Li, Y., & Zhao, M. (2020). Biofeedback technology in emotion regulation and stress management. *Frontiers in Psychology*, 11, 1–12. <https://doi.org/10.3389/fpsyg.2020.01234>