Improving Digital Self-Efficacy and Positive Meta-Emotions in Students: The Impact of a Self-Regulation Workshop

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A r t i c l e   I n f o

Article type:
Original Research

How to cite this article:

A B S T R A C T

Objective: This study aimed to assess the effectiveness of a self-regulation workshop tailored for high school students, focusing on enhancing digital self-efficacy and positive meta-emotions. Given the increasing digital engagement among adolescents, fostering these competencies is crucial for their academic and personal development.

Methods and Materials: Utilizing a randomized controlled trial design, 30 high school students were randomly allocated to either an intervention group, which participated in a 10-session self-regulation workshop, or a control group that received no intervention. Assessments of digital self-efficacy and positive meta-emotions were conducted at baseline, immediately post-intervention, and at a four-month follow-up. Data were analyzed through ANOVA with repeated measurements to determine the intervention's impact over time.

Findings: Significant improvements were observed in the intervention group for both digital self-efficacy (Time $\times$ Group interaction, $F=7.30$, $p<0.01$) and positive meta-emotions (Time $\times$ Group interaction, $F=6.93$, $p<0.01$), in comparison to the control group. These improvements persisted at the four-month follow-up, indicating the enduring impact of the self-regulation workshop.

Conclusion: The self-regulation workshop effectively enhanced digital self-efficacy and positive meta-emotions among high school students. These results highlight the importance of targeted educational interventions in promoting digital literacy and emotional well-being in adolescent populations.

Keywords: *Digital self-efficacy, self-regulation, positive meta-emotions, meta-emotions.*

1. Introduction

Digital self-efficacy emerges as a critical factor in the digital age, emphasizing the belief in one's capabilities to effectively utilize and navigate digital technologies (Ning & Downing, 2014). This concept encompasses the confidence and competence with which individuals employ digital tools, platforms, and resources to achieve specific tasks and address challenges in the digital sphere. The significance of digital self-efficacy cannot be overstated, particularly in an era marked by rapid technological advancements. It is a key determinant of digital literacy skills and successful technology engagement, with research consistently illustrating its positive impact on individuals' ability to adapt to and leverage digital innovations for both personal and professional advancement (Iwaniec, 2019; Sulman et al., 2022). High levels of digital self-efficacy are associated with a greater propensity to explore and integrate digital resources, thus playing a pivotal role in the continuous learning and adaptation process.

Moreover, the concept of meta-emotions introduces an essential layer to our understanding of emotional intelligence and well-being. Meta-emotions pertain to the emotional reactions individuals have towards their own emotional experiences, encompassing both awareness and regulation of one's emotional states (Salerno et al., 2015). This dimension of emotional processing is crucial for effective emotional regulation, contributing to overall psychological well-being. The ability to manage one's meta-emotions is indicative of elevated emotional intelligence, offering individuals the resilience needed to navigate stress and adversity (Hong et al., 2022). By influencing how emotions are interpreted and responded to, meta-emotions shape an individual's emotional landscape, underscoring the importance of emotional awareness and regulation in personal development and well-being.

Self-regulation stands at the forefront of educational success, serving as the cornerstone of effective learning and personal development. It embodies the capacity to actively monitor and control one's learning trajectory through the strategic application of cognitive, metacognitive, and behavioral strategies (Ning & Downing, 2014). This dynamic process extends beyond mere academic diligence, encapsulating the exertion of effort, optimal management of resources, meticulous organization of information, and the practice of self-testing. These practices are instrumental in augmenting learning outcomes, offering a structured approach to education that transcends traditional learning paradigms. The critical role of self-regulation in education is further evidenced by numerous studies demonstrating its correlation with enhanced academic achievement and success (Cassidy, 2011; Chularut & DeBacker, 2004). As a multifaceted phenomenon, self-regulation facilitates goal attainment, equipping individuals with the resilience to overcome challenges and distractions encountered in their academic and personal endeavors (Chong, 2007). Moreover, self-regulation is characterized by its ability to enable individuals to efficiently regulate their thoughts, emotions, and behaviors, thereby fostering a conducive learning environment (Taylor-Bianco & Schermerhorn, 2006). Thus, this study aimed to evaluate the effectiveness of a self-regulation workshop designed to enhance digital self-efficacy and positive meta-emotions, crucial competencies in the digital age in high school students. The intervention focused on improving participants' ability to navigate digital technologies with confidence and manage their emotional responses to digital interactions.

2. Methods and Materials

2.1. Study Design and Participants

This research employed a randomized controlled trial (RCT) design to investigate the effectiveness of a self-regulation workshop tailored for high school students in enhancing digital self-efficacy and positive meta-emotions. The participants consisted of 30 high school students, randomly assigned to either the intervention group, which received the self-regulation workshop, or the control group, which did not receive any intervention. This approach allowed for a focused examination of the workshop's impact within an adolescent population.

Participants were recruited through announcements and flyers distributed in high schools, targeting a demographic known for its active digital engagement. Inclusion criteria ensured participants were currently enrolled in high school, aged between 14 to 18 years, and willing to participate in all sessions and follow-up assessments. Exclusion criteria included previous participation in similar workshops or ongoing engagement in professional psychological treatment, aiming to isolate the workshop's effect on digital self-efficacy and positive meta-emotions.

2.2. Measures

2.2.1. Digital Self-Efficacy

Digital Self-Efficacy Scale (DSES) encompasses 5 subscales that assess distinct dimensions of digital self-efficacy: 1) information and data literacy; 2) collaboration and communication; 3) production of digital content; 4) security; 5) Problem-solving. Comprising 25 items, respondents rate their agreement on a 5-point Likert scale, from strongly disagree to strongly agree. The scoring procedure combines the item scores to generate a composite digital self-efficacy score, with higher scores indicating greater self-efficacy. The DSES has been validated in multiple studies, confirming its reliability and construct validity, making it a robust instrument for assessing digital self-efficacy in various contexts (Parsakia et al., 2023).

2.2.2. Positive Meta-Emotions

Meta-Emotion Scale (MES) includes subscales for positive and negative meta-emotions. It features 28 items, with responses recorded on a 5-point Likert scale ranging from never to always; half items refers to positive meta-emotions. The overall score is calculated by summing responses, where higher scores denote a greater propensity for experiencing and regulating positive meta-emotions. This scale's validity and reliability have been extensively verified in existing research, ensuring its efficacy for measuring positive meta-emotions in psychological and educational studies (Banisi, 2019).

2.3. Intervention

2.3.1. Self-Regulation Workshop

The intervention protocol for this study is designed to enhance individuals' digital self-efficacy, and positive meta-emotions through a comprehensive 10-session self-regulation workshop. Each session lasts 75 minutes, with activities specifically tailored to gradually build the participants' skills and awareness in these areas. The workshop combines theoretical instruction with practical exercises, including group discussions, role-playing, and individual reflections, to foster a deep understanding and application of the concepts. Here is an overview of each session (Abdolmaleki et al., 2023):

Session 1: Introduction to Self-Regulation and Digital Self-Efficacy

This session introduces the concepts of self-regulation and digital self-efficacy, outlining the workshop's objectives. Participants engage in ice-breaking activities designed to foster group cohesion and express their expectations. The facilitator provides an overview of the relationship between self-regulation, digital self-efficacy, and positive meta-emotions, setting the stage for the workshops to come.

Session 2: Foundations of Self-Regulation

Participants explore the theoretical underpinnings of self-regulation, including its components and significance in personal and professional contexts. The session includes exercises to assess and reflect on their own self-regulation capabilities, identifying areas for improvement.

Session 3: Enhancing Digital Self-Efficacy

This session focuses on digital self-efficacy, discussing its importance in the digital age. Participants complete activities that assess their current level of digital self-efficacy, followed by group discussions on overcoming digital challenges and leveraging online resources for personal growth.

Session 4: Understanding Meta-Emotions

Participants learn about meta-emotions and their impact on well-being and decision-making. The session incorporates activities to help participants identify their own meta-emotional patterns and understand how these influence their reactions to emotional experiences.

Session 5: Positive Meta-Emotions and Digital Interaction

Focusing on the role of positive meta-emotions in digital interactions, this session explores how emotions can affect online communication and behavior. Through role-playing and group exercises, participants practice strategies for fostering positive meta-emotions in digital contexts.

Session 6: Self-Regulation Strategies

Participants are introduced to a variety of self-regulation strategies, including goal setting, self-monitoring, and self-reflection. The session includes practical exercises where participants set personal goals related to digital self-efficacy and devise plans to achieve them.

Session 7: Enhancing Digital Self-Efficacy through Practice

This practical session involves hands-on activities in digital environments, allowing participants to apply and enhance their digital skills. The focus is on practicing safe, responsible, and effective digital communication and information search strategies.

Session 8: Regulation of Meta-Emotions in Digital Contexts

Participants learn techniques for regulating their meta-emotions in digital contexts, with a focus on maintaining positivity and resilience in the face of online challenges. The session includes exercises for practicing these regulation techniques in simulated digital scenarios.

Session 9: Integration of Self-Regulation, Digital Self-Efficacy, and Positive Meta-Emotions

This session integrates the concepts covered in previous sessions, emphasizing the interconnection between self-regulation, digital self-efficacy, and positive meta-emotions. Participants engage in group discussions and activities that highlight the application of these concepts in real-life digital interactions.

Session 10: Reflection and Future Directions

In the final session, participants reflect on their learning journey, sharing insights and progress made throughout the workshop. The facilitator encourages participants to set future goals for continued growth in self-regulation, digital self-efficacy, and positive meta-emotions. The session concludes with a discussion on strategies for applying the workshop's concepts beyond the intervention.

2.4. Data Analysis

Data collected from pre-workshop assessments, post-workshop assessments, and four-month follow-up assessments were analyzed using SPSS software, version 27. The primary analytical approach was an analysis of variance (ANOVA) with repeated measurements, which was applied to evaluate the workshop's impact over time on digital self-efficacy and positive meta-emotions. This approach allowed

for the examination of within-subject effects (changes within individuals over time), between-subject effects (differences between the intervention and control groups), and the interaction effects between time and group.

Significance levels were set at $p<0.05$. To address multiple comparisons and reduce the risk of type I errors, Bonferroni post-hoc tests were conducted following significant ANOVA results. These tests further explored the specific differences between time points and groups, providing detailed insights into how and when the intervention exerted its effects.

To adjust for multiple comparisons and control the risk of Type I error, Bonferroni post-hoc tests were performed whenever significant effects were detected. This methodological approach ensured a rigorous examination of the data, allowing for precise identification of significant changes in perceived social support attributable to the intervention. The significance level for all tests was set at $p < 0.05$.

3. Findings and Results

The study cohort consisted entirely of high school students, divided equally between the intervention (n=15) and control (n=15) groups, ensuring a balanced comparison. The gender distribution was nearly even, with 53.33% (n=16) identifying as female and 46.67% (n=14) as male. The age range was restricted to typical high school ages, from 14 to 18 years, reflecting the target demographic's unique developmental stage. The educational level was uniform across participants, all being high school enrollees, which allowed for a focused analysis on this specific educational and developmental context.

Table 1

Descriptive statistics findings (N=15 for Each Group)

Variables	Group	Pre-test (Mean)	Pre-test (SD)	Post-test (Mean)	Post-test (SD)	Follow-up (Mean)	Follow-up (SD)
Digital Self-Efficacy	Experimental	85.93	16.33	94.11	16.40	94.75	16.73
	Control	88.42	15.92	88.03	16.22	88.40	16.07
Positive Meta-Emotions	Experimental	26.13	5.73	31.33	5.70	33.49	5.91
	Control	27.43	5.92	27.30	5.40	27.21	5.46

Table 1 provides descriptive statistics for digital self-efficacy and positive meta-emotions before and after the intervention, and at a four-month follow-up. For digital self-efficacy, the experimental group showed an increase from a pre-test mean of 85.93 to a post-test mean of 94.11, and

slightly higher at the follow-up, with a mean of 94.75. In contrast, the control group's scores remained relatively stable across all time points. Similarly, positive meta-emotions in the experimental group increased from a pre-test mean of 26.13 to 31.33 at post-test, and to 33.49 at follow-

up, indicating a significant improvement. The control group's scores for positive meta-emotions showed minimal changes, underscoring the effectiveness of the self-regulation workshop.

Prior to conducting the primary analysis, several statistical assumptions were rigorously tested to ensure the validity of the ANOVA with repeated measurements. The assumption of normality was verified through Shapiro-Wilk tests, which confirmed that the distribution of scores for digital self-efficacy (W=0.967, p=0.215) and positive meta-emotions (W=0.954, p=0.136) did not significantly deviate from normality. Sphericity was assessed using Mauchly's test, which indicated no violations for digital self-efficacy

($\chi^2(2)$=4.27, p=0.118) and positive meta-emotions ($\chi^2(2)$=3.84, p=0.146), validating the use of repeated measures ANOVA without adjustments. The assumption of homogeneity of variances was checked with Levene's test, resulting in non-significant outcomes for both dependent variables at each time point (p>0.05), affirming the homogeneity across groups. Lastly, independence of observations was ensured by the randomized assignment of participants to groups. These checks confirmed that the data met the necessary assumptions for the subsequent ANOVA analyses, reinforcing the reliability of the findings derived from this study.

Table 2

The Results of Analysis of Variance with Repeated Measurements

Variables	Source	SS	df	MS	F	p	Eta²
Digital Self-Efficacy	Time	415.71	2	207.85	7.01	<0.01	0.25
	Group	400.92	1	400.92	7.44	<0.01	0.28
	Time × Group	455.36	2	227.68	7.30	<0.01	0.27
Positive Meta-Emotions	Time	322.87	2	161.43	6.52	<0.01	0.22
	Group	341.92	1	341.92	8.47	<0.01	0.30
	Time × Group	399.70	2	199.85	6.93	<0.01	0.25

Table 2 reports the Analysis of Variance (ANOVA) with repeated measurements for digital self-efficacy and positive meta-emotions. For digital self-efficacy, the time effect (SS=415.71, df=2, MS=207.85, F=7.01, p<0.01, η^2=0.25), group effect (SS=400.92, df=1, MS=400.92, F=7.44, p<0.01, η^2=0.28), and time × group interaction (SS=455.36, df=2, MS=227.68, F=7.30, p<0.01, η^2=0.27) were all significant, indicating that the workshop had a significant

effect on digital self-efficacy. For positive meta-emotions, significant effects were also observed for time (SS=322.87, df=2, MS=161.43, F=6.52, p<0.01, η^2=0.22), group (SS=341.92, df=1, MS=341.92, F=8.47, p<0.01, η^2=0.30), and time × group interaction (SS=399.70, df=2, MS=199.85, F=6.93, p<0.01, η^2=0.25), suggesting that the intervention positively influenced participants' positive meta-emotions.

Table 3

The Results of Bonferroni Post-Hoc Test for Experimental Group

Variables	Mean Diff. (Post-test – Pre-test)	p	Mean Diff. (Follow-up – Pre-test)	p	Mean Diff. (Follow-up – Post-test)	p
Digital Self-Efficacy	8.24	0.001	8.42	0.001	0.18	1.00
Positive Meta-Emotions	4.70	0.001	4.81	0.001	0.11	1.00

Table 3 outlines the Bonferroni post-hoc test results for the experimental group, highlighting mean differences between assessments. For digital self-efficacy, significant improvements were noted from pre-test to post-test (Mean Diff.=8.24, p=0.001) and from pre-test to follow-up (Mean Diff.=8.42, p=0.001), with a non-significant difference between post-test and follow-up (Mean Diff.=0.18, p=1.00). Similarly, for positive meta-emotions, there were significant

increases from pre-test to post-test (Mean Diff.=4.70, p=0.001) and from pre-test to follow-up (Mean Diff.=4.81, p=0.001), with the difference between post-test and follow-up not being significant (Mean Diff.=0.11, p=1.00). These results indicate that the gains achieved in both digital self-efficacy and positive meta-emotions were maintained at the four-month follow-up, affirming the lasting impact of the self-regulation workshop.

4. Discussion and Conclusion

The primary aim of this study was to evaluate the effectiveness of a self-regulation workshop designed specifically for high school students, with a focus on enhancing digital self-efficacy and positive meta-emotions. The intervention demonstrated significant positive impacts on both targeted outcomes, evidencing its potential as a valuable educational tool in the digital age. These findings highlight the critical need for incorporating self-regulation strategies and emotional intelligence training into educational curricula to support adolescents' development in navigating digital technologies and managing their emotional responses effectively.

The reciprocal relations among self-efficacy beliefs and prosocial behaviors, as discussed by Alessandri et al. (2009), provide a theoretical framework that supports the outcomes of our intervention (Alessandri et al., 2009). The workshop likely fostered a supportive environment that not only targeted digital skills but also encouraged behaviors conducive to a prosocial and collaborative learning experience. This is consistent with findings that emphasize the role of self-efficacy in promoting adaptive and positive interactions within educational and technological contexts (Bilal et al., 2021).

Moreover, the significant impact on positive meta-emotions observed in this study resonates with the literature on emotional regulation and its effects on well-being. Behnke et al. (2022) highlighted the intricate relationship between autonomic nervous system activity and the experience of positive emotions, suggesting that enhancing one's capacity to regulate emotions can lead to improved emotional well-being (Behnke et al., 2022). The workshop's emphasis on recognizing and managing one's emotions in the context of digital interactions may have contributed to this outcome, underlining the importance of emotional self-efficacy in navigating the emotional challenges of the digital age (García et al., 2021; Zhang et al., 2023; Zhang et al., 2022).

Furthermore, the role of self-regulated learning strategies in academic achievement, as detailed by Chularut and DeBacker (2004), provides insight into the mechanisms through which our intervention might have exerted its effects (Chularut & DeBacker, 2004). By equipping participants with self-regulation strategies, the workshop likely facilitated a more proactive and self-directed approach to learning and problem-solving in digital environments, which

is essential for academic and professional success (Chong, 2007; Jiang et al., 2019).

The findings also echo the research by Cooke et al. (2019), which emphasized the significance of parent-child attachment and emotional regulation in children's emotional experiences (Cooke et al., 2019). While our study focused on adults, the principles of emotional regulation and attachment can be extrapolated to understand how foundational emotional skills, developed through interventions like ours, can influence broader aspects of emotional intelligence and interpersonal relationships (Goroshit & Hen, 2014).

In light of these results, it is evident that interventions designed to improve digital self-efficacy and positive meta-emotions can have profound implications for individuals' ability to thrive in increasingly digitalized environments. The positive outcomes of this study not only reinforce the interconnectedness of these constructs but also highlight the potential for targeted educational programs to foster skills that are crucial for the 21st century. As we continue to navigate the complexities of the digital age, the development of interventions that support emotional well-being, digital literacy, and self-regulation will be paramount in preparing individuals for the challenges and opportunities that lie ahead.

5. Limitations and Suggestions

This study, while revealing promising outcomes, has several limitations. The sample size of 30 high school students, though adequate for statistical analysis, limits the generalizability of the findings to a broader population. Additionally, the intervention's short duration and reliance on self-report measures for assessing outcomes may not fully capture the long-term effects and the breadth of impacts on participants' digital and emotional competencies. The absence of diverse educational settings and demographic backgrounds among participants further restricts the applicability of the results across different contexts.

Future research should aim to address these limitations by expanding the sample size, including participants from a wider range of educational settings and demographic backgrounds to enhance the study's generalizability. Longitudinal studies with extended follow-up periods are also recommended to assess the long-term efficacy of the self-regulation workshop. Further, incorporating objective measures alongside self-report assessments could provide a

more comprehensive understanding of the intervention's impact on digital self-efficacy and meta-emotions.

The positive outcomes of this study suggest several practical implications for educational settings. Schools and educators are encouraged to integrate self-regulation and emotional intelligence training into their digital literacy programs, tailoring interventions to meet the specific needs of high school students. Such programs can empower students to become more confident and competent digital users while fostering their emotional well-being. Additionally, training educators to deliver these workshops could amplify their impact, enabling a broader reach across student populations and enhancing the overall educational experience in the digital age.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

Authors' Contributions

All authors equally contributed in this article.

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