RESEARCH ARTICLE

Smartphone and social network addiction in early adolescents: The role of self-regulatory self-efficacy in a pilot school-based intervention

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Abstract

Background: Youths' online problematic behaviors, such as smartphone or social network sites (SNS) addiction, gained increasing attention nowadays, due to their impact on concurrent and later adjustment, such as emotional and/or behavioral problems, academic impairments, or relational issues.

Aims: This study aims to evaluate the effectiveness of a pilot school-based intervention to contrast online addictive behaviors while fostering adolescents' self-regulative abilities.

Materials & Methods: The intervention started in January 2022 in an Italian junior high school *located in Rome*, and consisted of four meetings with students. A total sample of 462 15-year-old adolescents ($M_{age} = 15.2$; SD = 0.50; 41% females; $N_{control} = 214$; $N_{intervention} = 248$) was considered. Within the latent difference score framework, we examined short-term changes from the pre-to-the-postintervention levels of SNS and smartphone addiction, and self-regulatory self-efficacy (SRSE) beliefs as a possible booster of the intervention's effectiveness.

Results: Results showed a significant decrease in both online addictions (*SNS and smartphone addiction*), controlling for age, gender, sexual orientation, and socioeconomic status, because of the short-term efficacy of the project. The buffering effect of SRSE beliefs was further supported.

Conclusion: These findings emphasized the usefulness of promoting youths' self-regulative beliefs to contrast problematic tendencies, according to a Positive Youth Development perspective which focused on resources rather than only on the prevention of negative outcomes for youths' adjustment.

KEYWORDS

adolescents, preventive school-based intervention, self-regulatory self-efficacy, smartphone addiction, social network addiction

1 | INTRODUCTION

Nowadays Internet-related problematic behaviors gained increasing attention among younger people, due to their impact on concurrent and later adjustment (Dong et al., 2022; Kato et al., 2020). Adolescents are the most at risk for Internet-related problems, due to their higher digital literacy and technological competencies, integrating information and communication

technologies (ICTs) innately and normatively, which has led in the last 20 years to a normative increase in the use of ICT (Cheng, Lau, et al., 2021; Cheng, Yang, et al., 2021). Additionally, most of the restrictions implemented to contrast the pandemic globally further encouraged *higher* ICT use (Gjoneska et al., 2022; Oka et al., 2021). The Italian government settled very restrictive measures, that led people to stay at home for many months, so adolescents used ICT to continue daily activities such as enrolling in lessons or relating to their friends (e.g., Mucci et al., 2020; Volpe et al., 2022), but, although the emergency in Italy has passed, the exponential growth of ICT use shows no signs of slowing down (Di Carlo et al., 2021).

Moreover, during adolescence, self-control abilities are settling, and impairments in self-regulation are frequent (Mahapatra, 2019; Rothbart & Bates, 2006). Thus, *excessive* ICT use, together with fluctuations in self-regulation, can increase adolescents' risk for online addictive behaviors (Andreassen et al., 2017; Fischer-Grote et al., 2019).

National and local agencies are heeding on containing the negative consequences of excessive ICT use, due to their negative impact on youths' well-being, which also increases economic and health costs for dealing with these problems (Diotaiuti et al., 2022; Throuvala et al., 2019). In fact, smartphone, and social network sites (SNS) *addictions* are associated with a variety of other onerous emotional, behavioral, and academic impairments, which burden on community's mental and physical health, as well as social policies and clinical treatments (Gerosa et al., 2022; Lopez-Fernandez & Kuss, 2020).

Therefore, the present study evaluated the effectiveness of an intervention aimed to contrast *specific* online addictive behaviors in the Italian context, within a promotion perspective that focuses not only on the negative effects, but also improves positive online behaviors, focusing especially on adolescents' own perceived capabilities in regulating their behaviors adaptively and contrasting transgressive, or addictive, behaviors (Andreassen et al., 2017; LaRose et al., 2010).

1.1 | Adolescents' Internet-related addictive behaviors

Contemporary adolescents are pervasively involved in ICT use, which is a normative part of their daily lives (Cheng, Lau, et al., 2021; Kuss et al., 2013). More than 74% of Italian youths use smartphones daily, and most of them spend at least 5 h/day using smartphones and SNS, which are frequently not turned off or silenced at night (e.g., Istituto Italiano di Statistica [ISTAT], 2020; Laboratorio Adolescenza, 2021). Youths are used to take SNS for relational, entertainment, and academic purposes, such as sharing emotions and feelings, making social interactions, maintaining/improving relational networks, and enjoying online content (i.e., videos, stories, reels, blog posts, etc.), sharing with classmate school projects or homework, and so on (e.g., Cheng, Yang, et al., 2021; Widyanto & Griffiths, 2006).

According to a strong body of literature (e.g., Griffiths & Pontes, 2014; Kuss et al., 2013), *Internet and ICT use can be operationalized in a continuum from a normative and adaptive use to a problematic use, until the extreme negative pole of addictive behaviors* (Kardefelt-Winther et al., 2017). *Therefore*, due to youths' huge engagement in online activities, is *helpful* to distinguish between adaptive and maladaptive use *according to this continuum* (Gjoneska et al., 2022; Throuvala et al., 2019). Adaptive ICT use (e.g., sharing new experiences with friends, increasing personal knowledge of something interesting, expanding awareness of trending topics, carrying out hobbies), positively affects well-being because *it* increases perceived social support and peer acceptance, promotes self-esteem and self-identity, fosters life satisfaction, and contrast loneliness and social isolation (e.g., Ryding & Kuss, 2020; Stănculescu & Griffiths, 2022). On the contrary, maladaptive ICT use (i.e., passively scrolling SNS homepages, using SNS without communicating with someone) decreases social interactions, damages self-esteem and self-identity, nurtures rumination, criticism, anxiety, loneliness, and withdrawal feelings, increases vulnerability to incur in cyberbullying or other online risks (i.e., grooming, privacy violations), until the emergence of psychopathological problems such as depressive syndromes, Hikikomori syndrome, or panic attacks (Kato et al., 2020; Polanin et al., 2021; Ryding & Kuss, 2020; Utz & Breuer, 2017). Negative consequences for youths of online problems are widely heterogeneous, such as emotional problems (anxiety, depression, social isolation, loneliness), behavioral problems (substance addictions, aggressive behaviors, cyberbullying), sleep problems (insomnia), academic problems (school performances that get worse, school absenteeism or dropout), and relational problems with peers and families (e.g., Alimoradi et al., 2019; Dong et al., 2022; Mascia et al., 2020; Oka et al., 2021).

Within this thriving literature, researchers proposed various definitions of the *most severe* problematic ICT behaviors, *such as addictive behaviors*. For example, Andreassen and Pallesen (2014) and Andreassen et al. (2017) defined SNS addiction as excessive social media use associated with concerns about this use, with significant negative consequences on more than one adjustment area, such as relations, school, or emotions. Similarly, smartphone addiction conceives excessive smartphone use, which impacts more than one adjustment area, with also negative consequences on physical health (e.g., Mahapatra, 2019; Vintilă et al., 2021). Adolescents that manifest one or both addictions spend most of their time thinking about smartphones/SNS, experiencing worries, concerns, or irritability while they cannot use them; they tend to over-use also while doing other activities, such as during school hours, while eating, or while they are out with friends; the tolerance for the amount of time spent using ICTs constantly increase, leading to a progressive intensification of ICT use to obtain the same satisfying feelings experienced in the past, with growing self-control issues (Andreassen et al., 2017; Turel & Serenko, 2012).

Previous research evidenced the potential severity of ICT problematic *and addictive* use, *and as regard cultural factors, these problems were more frequent in Asian samples rather than in Europe or America* (Cheng, Lau, et al., 2021; Vintilă et al., 2021). *However*, recent findings showed huge growing trends of SNS or smartphone addiction in several European countries (i.e., Finland, Poland, and Italy), so it becomes crucial to explore these problems broadly (Lopez-Fernandez & Kuss, 2020). Findings underlined several gender differences in the predisposition to incur online problems, such as girls appear more prone to SNS problematic use, while boys tend to over-use smartphones, especially for entertainment purposes (Bànyai et al., 2017; Vintilă et al., 2021). *In addition, several studies found that youths in higher-income families and with highly educated parents are more prone to online addictive behaviors, due to their higher economic resources, such as more devices, a better internet connection, and so on* (de Freitas et al., 2021; Fischer-Grote et al., 2019). Personality characteristics more anchored to self-regulation impairments also play a key role, such as impulsivity, sensation seeking, attentional problems, low anticipation, and risk-taking, especially in younger users (Andreassen et al., 2017; Gervasi et al., 2017; Griffiths & Pontes, 2014).

Therefore, analyzing existing literature on these topics appears clearly the importance of considering problematic *and addictive* ICT use trends in European youths, considering also individual characteristics related to adolescents' functioning that during earlier developmental stages become crucial, such as self-regulative abilities (Mahapatra, 2019; Muris, 2006).

1.2 | Adolescents' perception of their own self-regulatory beliefs

Several individual characteristics can exacerbate the vulnerability to problematic and addictive ICT behaviors, such as adolescents' personality attributes (e.g., Andreassen et al., 2017; Muris, 2006).

We assumed a sociocognitive perspective, in which behaviors are driven by youths' motivations, goal orientation, and self-regulation (Bandura et al., 2003; Cañas & Estévez, 2021; Pajares, 2002). Within this approach, adolescents' perceptions of their own self-regulative abilities in modulating/orienting their behaviors and strengths play a fundamental role (e.g., Bandura, 1997; Bandura et al., 2003). We focused on self-regulatory self-efficacy (SRSE) beliefs, which conceived the extent to which youths feel adequately capable of regulating behaviors toward transgressive activities, activating self-regulative skills against peer pressure to behave transgressively, or in general, to misbehave (Bandura et al., 2003; Bandura, 1997).

Self-efficacy beliefs are crucial for adolescents, and can influence addictive behaviors, for several reasons. First, they are goal-specific, so there are many different sets of beliefs for each context that are perceived as challenging, such as online adaptive behaviors (Bandura et al., 2003; LaRose et al., 2010). Second, self-efficacy beliefs are dynamic, and derive from individual environmental agency, so they can be enhanced through direct and mastery experiences, or indirectly through modeling that serves as reinforcement by the observation of successful experiences of similar people, such as peers and classmates (Caprara et al., 2008; Mahoney & Benight, 2019). Crucially for this study, SRSE beliefs can orient habits and tendencies, because they reflect cognitive self-regulation and reflective thinking, so they can predispose adolescents to use ICTs conscientiously or ruinously (Al Heneidi & Smith, 2021; Cannito et al., 2022; LaRose et al., 2010; Li et al., 2020).

1.3 | School-based interventions for contrasting Internet-related addictive problems in adolescents

The increasing interest in youths' problematic *and addictive* ICT use characterizes not only the research community, but also policymakers, stakeholders, and national agencies (Lopez-Fernandez & Kuss, 2020; Zajac et al., 2017). As a result, *the need for more interventions has been recently proposed* (e.g., Throuvala et al., 2019; Xu et al., 2021; Zajac et al., 2017).

The school is the most used context to draw preventive interventions, because is one of the most significant environments for adolescents (Throuvala et al., 2019). Several meta-analyses and reviews (e.g., Cañas & Estévez, 2021; Lopez-Fernandez & Kuss, 2020; Romero Saletti et al., 2021) demonstrated that school-based interventions allowed to touch wider target populations while reducing the socioeconomic costs to implement a primary intervention (e.g., Throuvala et al., 2019). For example, Haug et al. (2020) implemented a preventive intervention against addictive behaviors among 15-years-old vocational Swiss students, *who completed* online training via an ad hoc app for 4 months, which showed a significant 6-month decrease in problematic behaviors together with an increase in self-efficacy and life skills (Haug et al., 2020). Yang and Kim (2018) implemented a 10-week project with Korean middle-school students that comprised specific sessions (i.e., roleplaying sessions, and perspective-taking exercises) to contrast Internet addiction, demonstrating a significant reduction of Internet use together with increases in self-regulatory skills, without a follow-up effectiveness analyses (Yang & Kim, 2018). Thus, most of the existing interventions showed several limitations. One, due to the limited number of interventions, is hard to identify overall effectiveness evidence or synthesize practical implications that could be effective in different contexts (Throuvala et al., 2019).

Second, most interventions focused on a single component, such as generalized Internet addiction or online gambling, and interventions that considered multiple-risky online behaviors *or multiple online addictive behaviors* are limited (Throuvala et al., 2019; Xu et al., 2021). Therefore, considering specific subtypes of online addictive behaviors could be more meaningful, due to the large heterogeneity of online addictive problems (e.g., Romero Saletti et al., 2021; Spilkova et al., 2017). In terms of outcomes, most previous interventions considered the negative consequences of problematic online behaviors for youths, and a very limited number of them also encompass the promotion of positive strategies and resources (Cañas & Estévez, 2021; Throuvala et al., 2019). Furthermore, previous interventions were mainly designed for Asian contexts, and they encountered clinical adolescent populations (Lopez-Fernandez & Kuss, 2020; Throuvala et al., 2019). The few existing European studies considered also clinical subpopulations rather than wider groups of at-risk youths (e.g., Beranuy et al., 2013; Frölich et al., 2016; van Rooij et al., 2017), despite nonclinical findings with larger populations were very promising, especially when youths' personality was considered as a part of the intervention (Dalvi-Esfahani et al., 2021; Lopez-Fernandez & Kuss, 2020). To the authors' knowledge, there are no school-based interventions to prevent specific problematic online behaviors in Italian nonclinical youths (Lopez-Fernandez & Kuss, 2020; Romero Saletti et al., 2021).

To deal with these limitations, we proposed a primary intervention (i.e., designed not only for specific at-risk youths but considering the entire school population), within a preventive-promotive approach, which aimed to contrast online addictive behaviors while fostering socioemotional skills and positive media use *in a sample of* Italian middle adolescents (Throuvala et al., 2019; World Health Organization, 2002). *Theoretically, we referred to a sociocognitive approach* (e.g., Bandura et al., 2001), *which posits that behaviors and individual characteristics are bidirectionally associated and influence each other in predicting adjustment, as well as the Positive Youth Development (PYD) framework* (Lerner et al., 2018), *which emphasizes the importance of focusing not only on the negative symptoms which could characterize youths' development but bearing in mind that people-and especially youngsters-possess many resources that can foster their adjustment and* can help them in undertaking adaptive and positive developmental pathways (e.g., Lerner et al., 2018; Shoshani & Steinmetz, 2014).

Therefore, the main aims of the intervention were: (a) to prevent online addictive behaviors in youths, such as excessive and/or problematic smartphone and SN use, and (b) to promote the adoption of positive strategies and behaviors in relation to ICT use. The preventive-promotive approach was operationalized into four specific components: (i) increasing youths' awareness of online addictions; (ii) contrasting excessive smartphone and SN use; (iii) promoting positive online behaviors; and (iv) empowering youths' self-regulative abilities and self-efficacy. Four meetings were scheduled with the targeted classrooms during school hours (i.e., 1 h for each meeting). Each of the four meetings comprises an informative/didactic section, followed by an interactive section, to promote the active participation of all students. An extensive description of the intervention's design is provided in Supporting Information: Appendix A.

1.4 | The present study

*A*ccording to the aforementioned premises, the general aim of the present work was to preliminary evaluate the effectiveness of the pilot intervention that was implemented for experimental purposes, to identify whether the design of the intervention could be effectively impact on addictive ICT behaviors in youths. Specifically, the effectiveness of the pilot intervention was examined by analyzing the short-term changes in smartphone and SNS addiction (i.e., pre–post design), and evaluating if and how perceived self-regulatory capabilities could buffer the efficacy of the project (e.g., LaRose et al., 2010; Turel & Serenko, 2012). In particular, we aimed to:

(a) Examine changes in trends of smartphone/SNS addiction in Italian adolescents from 14 to 16 years old, because of the intervention. Addictive behaviors were assessed in two waves (Wave 1, preintervention; Wave 2, postintervention). To our knowledge, this represents the first work in Italy addressing these issues, as previous studies focused on the categorical presence of Internet-related addictions in European or non-European youths, rather than testing for the effectiveness of preventive-promotive interventions for online risks (e.g., Bányai et al., 2017; Longobardi et al., 2020; Mahapatra, 2019; Quaglieri et al., 2021; van den Eijnden et al., 2018). Previous research showed an overall normative increase in short-time trends of smartphone/SNS addiction (e.g., Andreassen et al., 2017; Monacis et al., 2017; van den Eijnden et al., 2018), therefore the effectiveness of the intervention should be traduced in a reduction of addictive behaviors in those who were in the intervention group. We analyzed these trends controlling for several background variables, such as age, gender, sexual orientation, and socioeconomic status, as previous studies evidenced how several youths' characteristics could affect trends of problematic smartphone and SNS use (Andreassen et al., 2017; de Freitas et al., 2021; Vintilă et al., 2021). According to previous studies (e.g., de Freitas et al., 2021), we hypothesized that both online addictions would be positively predicted by socioeconomic status and negatively by age, while gender would influence SNS addiction and smartphone addiction, meaning that higher smartphone/SNS addiction levels would be manifested by younger adolescents with better socioeconomic conditions, and that girls would manifest higher SNS addiction while boys would manifest higher smartphone addiction. Regarding youths' sexual orientation, no previous

studies investigated specifically this point, but, considering that several contributions evidenced how nonheterosexual people could be more vulnerable to several online risks, such as sexting (e.g., Morelli et al., 2016; Van Ouytsel et al., 2019), we exploratory considered this variable in our analyses.

(b) Examine the moderating effects of adolescents' SRSE beliefs on the effectiveness of the intervention (Eastin & LaRose, 2000; LaRose et al., 2010). According to the buffering effect that SRSE beliefs have in modulating adaptive behaviors while reducing the risk to incur transgressive behaviors (e.g., Caprara et al., 2008; LaRose et al., 2010), we hypothesized that lower SRSE beliefs could have a detrimental effect on the decrease of smartphone/SNS addiction, as well as on the effectiveness of the intervention, while adequate SRSE beliefs could represent a further resource for students for dealing with online risks, that in turn could further enhance the effectiveness of the intervention (LaRose et al., 2010; Li et al., 2020).

2 | MATERIALS AND METHODS

2.1 | Participants

Participants were recruited from an Italian public high school. For the purposes of the present study, we considered all the students *who* completed both the surveys, collected in January–February 2022 (pretest) and in April–May 2022 (posttest). Data from the control group were collected in February and April 2023. The final longitudinal sample consisted of 248 students in the intervention group, with a mean age of 15.27 (range = 14–17; SD = 0.55; 38% girls), and 214 students in the control group, with a mean age of 15.13 (range = 14–17; SD = 0.45; 44% girls). In the intervention group, most youths enrolled in the second year of high school (i.e., 79% of students), and few students enrolled in the third year (i.e., 21% of students), while all youths in the control group enrolled in the second year. Parents of the students involved in the study had a part-time or a full-time work position (respectively, 89% of mothers and 97% of fathers), and a high education level (respectively, 39% of parents had a master's or a bachelor's degree and 39% had a high school diploma). Further information on the characteristics of the sample is provided in supplementary analyses in Supporting Information: Appendix A.

2.1.1 | Attrition analyses

Missing data ($N = 127$; 22% of Wave 1 subjects) from the pre-to-the-posttest assessment were handled according to Little et al. (2007) recommendations, by testing patterns of missingness. Analyses of variances between missing and longitudinal subjects revealed no significant differences among levels of smartphone [$F (1, 460) = 0.74$; $p =$ ns; $\eta^2 = 0.00$] or social network addiction [$F (1, 460) = 0.01$; $p =$ ns; $\eta^2 = 0.00$], nor in SRSE beliefs [$F (1, 461) = 0.40$; $p =$ ns; $\eta^2 = 0.00$] from longitudinal subjects to those who dropped the second evaluation.

2.2 | Procedures

The school was selected using a convenient sampling procedure, and a preliminary meeting with the school staff was conducted to illustrate the design, the planned activities, and the timeline of the project. The project was further presented also with teachers, for encouraging proactive participation and empowering the school's involvement (e.g., Blatchford et al., 2009). Approvals by local Institutional Review Boards at the Clinic Center were obtained, and parental informed consent was sent directly from the school staff to all the families involved 1 month before starting the intervention. The formal assents of youths were obtained including them in a form at the beginning of the surveys. Surveys were administered in each classroom as a part of the intervention, and in each control classroom without specifying anything about the project. Each participant completed autonomously the survey using their own digital device (i.e., smartphones, tablets, notebooks, etc.). The links for the online surveys were shared in each classroom via QR codes, and two trained researchers provided support for any students' questions. An extended procedure is provided in Supporting Infomation: Appendix A.

2.3 | Measures

2.3.1 | Background information

Categorical information about youths' age, gender (coded as 0 for boys, 1 for girls, and 2 for the third gender), and sexual orientation (coded as 1 for heterosexual, 2 for homosexual, 3 for bisexual, and 4 for other LGB+ sexual orientations), and

continuous information of socioeconomic status (derived from education and work occupation levels of youths' parents, from lower socioeconomic levels—lower education and modest occupation to higher socioeconomic levels—higher education and better occupation) were collected in the first survey. An ad hoc dummy variable for the condition was created (i.e., one for intervention and two for the control group—see Table 1 and 2 for descriptive statistics and correlation analyses for the total sample, and for the two subsamples).

2.3.2 | Bergen Social Media Addiction Scale (BSMAS; Andreassen et al., 2016)

The Italian version of the BSMAS was adopted, which assesses behaviors, feelings, and emotions related to individuals' social media use. The six items (i.e., "How often during the last year have you become restless or troubled if you have been prohibited from using social media?" or "How often during the last year have you felt an urge to use social media more and more?") were rated on a 5-point Likert scale ranging from 1 "Very rarely" to 5 "Very often." Previous studies supported the statistical properties of this measure (e.g., Monacis et al., 2017). In our study, internal consistency was good (ωBSMAS W1 = 0.75; ωBSMAS W2 = 0.76) (Table 1 and 2).

2.3.3 | Smartphone Addiction Scale (SAS, Kwon et al., 2013)

The Italian version of the SAS was considered, which conceives several key aspects of this addictive behavior (i.e., negative outcomes in daily life, positive anticipation, withdrawal, poor offline relations, use frequency, and tolerance). The 10 items (e.g., "Having a hard time concentrating in class or while doing assignments due to smartphone use," or "Won't be able to stand not having a smartphone") were rated on a 6-point Likert scale, ranging from 1 "Totally disagree" to 6 "Totally agree." Previous studies supported the psychometric properties of this measure in Italian adolescents (e.g., De Pasquale et al., 2017). In our study, internal consistency was good (ωSAS W1 = 0.87; ωSAS W2 = 0.87) (Table 1 and 2).

2.3.4 | SRSE scale (Pastorelli et al., 2001)

Individual beliefs of youths' own abilities about activating self-regulative skills against peer pressure, and not behaving transgressively, were assessed using six items derived from the SRSE scale (e.g., "How well can you resist peer pressure to do things that could get you into trouble," or "How well can you avoid committing transgressions even when the risk of penalty is low"), rated on a 5-point Likert scale from "1 = Not well at all" to "5 = Very well." A large body of studies supported the

TABLE 1 Descriptive statistics and correlations among the study variables for the total sample.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Age	–								
(2) Gender	−0.09	–							
(3) Sex. Orient.	−0.01	0.23***	–						
(4) SES	−0.07	0.08	0.02	–					
(5) BSMAS W1	−0.05	0.34***	0.09	−0.03	–				
(6) SAS W1	−0.01	0.24***	0.05	−0.06	0.65***	–			
(7) SRSE W1	−0.02	−0.03	−0.01	−0.00	−0.16***	−0.19***	–		
(8) BSMAS W2	0.01	0.27***	0.04	−0.03	0.53***	0.51***	−0.41***	–	
(9) SAS W2	−0.03	0.23***	0.02	−0.01	0.49***	0.57***	−0.30***	0.63***	–
Means (SD)	15.21 (0.51)	–	–	0.04 (0.99)	2.36 (0.80)	2.51 (94)	4.02 (0.80)	2.36 (0.68)	3.54 (0.83)
Reliability (ω)	–	–	–	–	0.75	0.87	0.80	0.75	0.86

Note: The first value refers to the total sample; in parentheses, the first value refers to the intervention group, and the second value refers to the control group.
BSMAS = SNS addiction.

Abbreviations: BSMAS, Bergen Social Media Addiction Scale; SAS, Smartphone Addiction Scale; SES, socioeconomic status; Sex. Orient., youths' sexual orientation; SNS, social network sites; SRSE, self-regulatory self-efficacy.

***$p < .001$.

TABLE 2 Descriptive statistics and correlations among the study variables were divided into intervention and control groups.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Age	–								
(2) Gender	−0.07 (−0.08)	–							
(3) Sex. Orient.	−0.07 (0.07)	0.19** (0.27***)	–						
(4) SES	−0.10 (0.01)	0.08 (0.07)	0.01 (0.04)	–					
(5) BSMAS W1	−0.05 (−0.01)	0.37*** (0.29***)	0.03 (0.20*)	−0.02 (−0.06)	–				
(6) SAS W1	−0.03 (0.05)	0.29*** (0.18***)	0.02 (0.11)	−0.03 (−0.14)	0.70*** (0.57***)	–			
(7) SRSE W1	−0.04 (0.03)	0.03 (−0.08)	0.08 (−0.15*)	0.01 (−0.03)	−0.24*** (−0.04)	−0.21*** (−0.14*)	–		
(8) BSMAS W2	0.02 (−0.07)	0.27*** (0.27***)	0.03 (0.05)	−0.02 (−0.03)	0.54*** (0.51***)	0.51*** (0.51***)	−0.40*** (−0.42***)	–	
(9) SAS W2	−0.03 (0.00)	0.23*** (0.22***)	0.01 (0.02)	−0.02 (−0.01)	0.50*** (0.47***)	0.57*** (0.57***)	−0.29*** (−0.33***)	0.62*** (0.65***)	–
Means (SD)	Int. G. = 15.27 (0.51) Con. G. = 15.13 (0.45)	–	–	Int. G. = 0.02 (0.99) Con. G. = 0.07 (1.01)	Int G. = 2.28 (0.82) Con. G. = 2.45 (0.79)	Int. G. = 2.42 (0.95) Con. G. = 2.61 (0.93)	Int. G. = 4.10 (0.80) Con. G. = 3.93 (0.81)	Int. G. = 2.19 (0.77) Con. G. = 2.54 (0.59)	Int. G. = 2.30 (0.91) Con. G. = 4.78 (0.75)
Reliability (ω)	–	–	–	–	0.75 (0.74)	0.88 (0.86)	0.82 (0.77)	0.76 (0.74)	0.87 (0.84)

Note: The first value refers to the intervention group, and the second value in parenthesis refers to the control group.

BSMAS = SNS addiction.

Abbreviations: Con. G., control group; Int. G., intervention group; SAS, Smartphone Addiction Scale; SES, socioeconomic status; Sex. Orient., youths' sexual orientation; SNS, social network site; SRSE, self-regulatory self-efficacy.

*$p < .050$; **$p < .010$; ***$p < .001$.

TABLE 3 LDS steps comparisons.

	χ^2	df	S.C. factor	CFI	RMSEA	Model comparisons χ^2 diff	Δdf	ΔCFI	ΔRMSEA
Smartphone Addiction Scale (SAS)									
SAS Model 0: baseline	315.51	177	1.1282	0.94	0.04 (0.03–0.05)	–	–	–	–
SAS Model 1: condition	341.03	195	1.0945	0.94	0.04 (0.03–0.05)	22.66***	18	0.00	0.00
SAS Model 2: covariates	380.63	267	1.0511	0.95	0.04 (0.03–0.04)	28.73	72	0.01	0.00
SAS Model 3: moderator	405.72	285	1.0557	0.94	0.04 (0.03–0.04)	25.13	18	−0.01	0.00
Social network addiction									
BSMAS Model 0: baseline	195.44	57	1.1150	0.86	0.07 (0.06–0.08)	–	–	–	–
BSMAS Model 1: condition	203.20	67	1.1041	0.87	0.07 (0.06–0.08)	38.15***	10	0.01	0.00
BSMAS Model 2: covariates	209.12	107	1.0632	0.89	0.05 (0.04–0.06)	02.02	40	0.02	−0.02
BSMAS Model 3: moderator	218.17	117	1.0656	0.90	0.05 (0.04–0.06)	09.29	10	0.01	0.00

Note: As baseline models, we considered the final models provided by step 1 in preliminary LSD comparisons in Supporting Information: Appendix A.

All Δ index comparisons were made comparing the model with its antecedent in the same step (see Supporting Information: Appendix A for more details). ***$p < .001$.

Abbreviations: BSMAS, Bergen Social Media Addiction Scale; CFI, comparative fit index; df, degrees of freedom; LDS, latent difference score; RMSEA, root-mean-square error of approximation; S.C. factor, scaling correction factor; χ^2, chi-square goodness of fit.

psychometric properties of this measure (e.g., Bandura et al., 2001; Vecchio et al., 2007). In our study, internal consistency was good (ωSRSE = 0.80) (Table 1 and 2).

2.4 | Statistical approach

We framed our research questions within the latent difference score (LDS) model framework (McArdle & Hamagami, 2001), estimating the LDS from the pre-to-posttest in smartphone and SNS addiction levels, and the effects of self-efficacy beliefs on these trends, controlling for youths' age, gender, sexual orientation, and socioeconomic status, within Mplus 8.11 (Muthén & Muthén, 2017). LDS framework allows modeling the change as a second-order latent factor, capturing the latent estimated difference score from the pre- to the posttest levels of the variables (Grimm et al., 2012; McArdle & Hamagami, 2001). We ran two separate models, one for each of the two addictive behaviors.

We first tested a baseline model with no, covariates, or moderator effects, and then we constrained factor loadings and intercepts of the items to be equal across time to investigate to verify the measurement structure of each model (e.g., Grimm et al., 2012). Second, we then included the intervention condition (i.e., coded as a dummy variable that represents the intervention, and the control groups), to analyze the effect of the intervention on the change variable (e.g., Grimm et al., 2012; McArdle & Hamagami, 2001). In the next step, we included the covariates and the moderator in the equation (e.g., Grimm et al., 2012; McArdle & Hamagami, 2001). In testing the effects of the covariates, we considered several background variables (i.e., youths' age, gender, sexual orientation, and socioeconomic status) on both the initial level and the latent change scores of each addictive behavior (e.g., Cirimele et al., 2022; Grimm et al., 2012). All the models were estimated by referring to the maximum likelihood with standard errors robust (MLR) to non-normality estimator (Muthén & Muthén, 2017). Each step was compared to the previous one using the $\Delta\chi^2$ for MLR estimations, the Δcomparative fit index, and the Δroot-mean-square error of approximation, with significant cutoff p value levels of .01 (Grimm et al., 2012; Muthén & Muthén, 2017; Satorra & Bentler, 2010). Intermediate results are provided in Supporting Information: Appendix A, while, for simplicity, in the main text we reported only the final estimated models (Table 3).

3 | RESULTS

Overall, results of the two final univariate LDS models considering both intervention and control groups evidenced a small significant decrease in short-term levels of both smartphone and SNS addiction levels in adolescents (Table 4), controlling for their age, gender, sexual orientation, and socioeconomic status. Thus, in both smartphone and SNS addiction, we found a further significant contribution of adolescents' self-regulatory self-efficacy beliefs, that buffered the effectiveness of the intervention.

TABLE 4 Intervention, covariates, and self-regulatory self-efficacy effects on the initial levels and change factor of smartphone and social network addiction models.

| | Initial levels | | | | | | Change factor | | | | | |
| | Smartphone addiction model | | | Social network addiction model | | | Smartphone addiction model | | | Social network addiction model | | |
	β	SE	p	β	SE	p	β	SE	p	β	SE	p
Model A: Condition												
Condition	.07	0.06	.23	.06	0.06	.32	**−.13**	**0.09**	**.00**	**−.34**	**0.14**	**.02**
Model B: Covariates												
Age	−.01	0.06	.85	−.06	0.06	.30	−.03	0.07	.67	.02	0.07	.73
Gender	**.31**	**0.06**	**.00**	**.38**	**0.06**	**.00**	.07	0.08	.38	.06	0.09	.46
Sexual orientation	−.04	0.05	.45	−.04	0.06	.49	−.02	0.07	.80	−.04	0.07	.60
Socioeconomic status	−.07	0.06	.18	−.05	0.06	.39	−.03	0.08	.73	−.01	0.08	.84
Model C: Moderator												
Self-regulatory self-efficacy	**−.19**	**0.06**	**.00**	**−.16**	**0.06**	**.01**	**−.21**	**0.07**	**.00**	**−.33**	**0.09**	**.00**

Note: Bold represents significant paths.

Condition = the intervention (i.e., intervention and control groups).

Abbreviations: p, p value; SE, standard error; β, standardized regression coefficient.
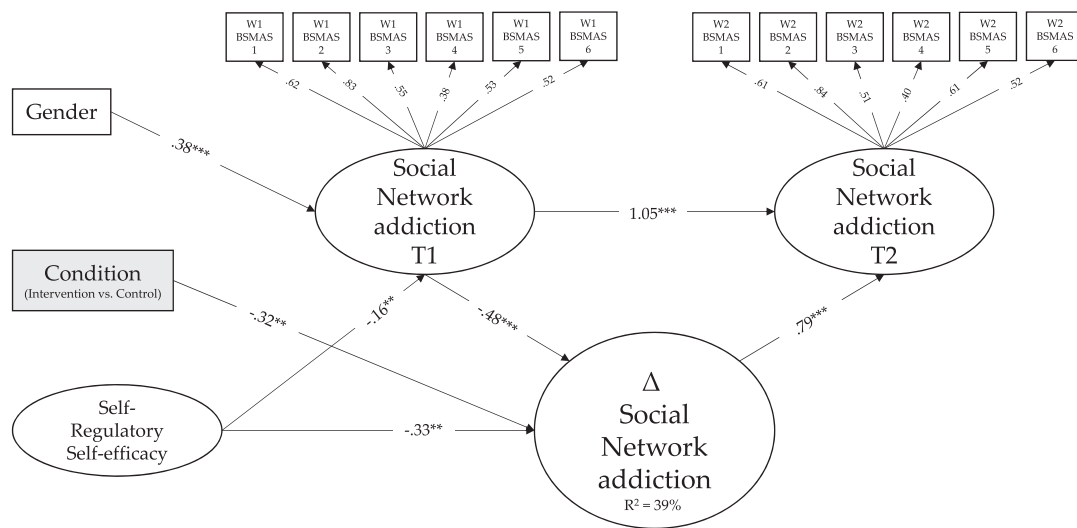

FIGURE 1 The LDS model for social network addiction levels. Model fit: χ^2 (117) = 218.17 ($p < .001$); CFI = 0.90; TLI = 0.89; RMSEA = 0.05 (CI: 0.04–0.06); SRMR = 0.07. The model was estimated controlling for youths' age, gender, sexual orientation, and socioeconomic status, but whether these paths were not significant, these were not depicted for simplicity. CFI, comparative fit index; CI, confidence interval; LDS, latent difference score; RMSEA, root-mean-square error of approximation; SRMR, standardized root mean squared residual; TLI, Tucker–Lewis index.

For SNS addiction (Figure 1), we found a small significant decrease in SNS addiction levels across time in the intervention group, compared to the control group (Cohen's $d = −0.51$ [95% confidence interval, CI: −0.69; −0.32]). Thus, SNS-addiction trends in the intervention group significantly decreased as a function of the intervention ($\beta = −.34$; $p < .05$). Initial levels of SNS addiction did not significantly differ in the two groups ($\beta = .06$; $p = $ ns). Regarding the covariates, only gender significantly impacted initial SNS addiction levels ($\beta = .38$; $p < .01$), meaning that adolescent girls showed higher problematic SNS use than boys at the beginning of the project. Finally, we also found a significant contribution of SRSE on both initial levels and change in the SNS addiction levels (respectively, $\beta_i = −.16$; $p < .05$; $\beta_c = −.33$; $p < .01$).

Similar findings were found for smartphone addictive use (Figure 2). A small significant decrease in smartphone addiction across time in the intervention group emerged, compared to the control group (Cohen's $d = −2.95$ [95% CI = −3.22; −2.69]). Also, for problematic smartphone use, trends in the intervention group significantly decreased as a function of the intervention ($\beta = −.13$; $p < .01$). Initial smartphone addiction levels were equal across the two groups ($\beta = .07$; $p = $ ns).
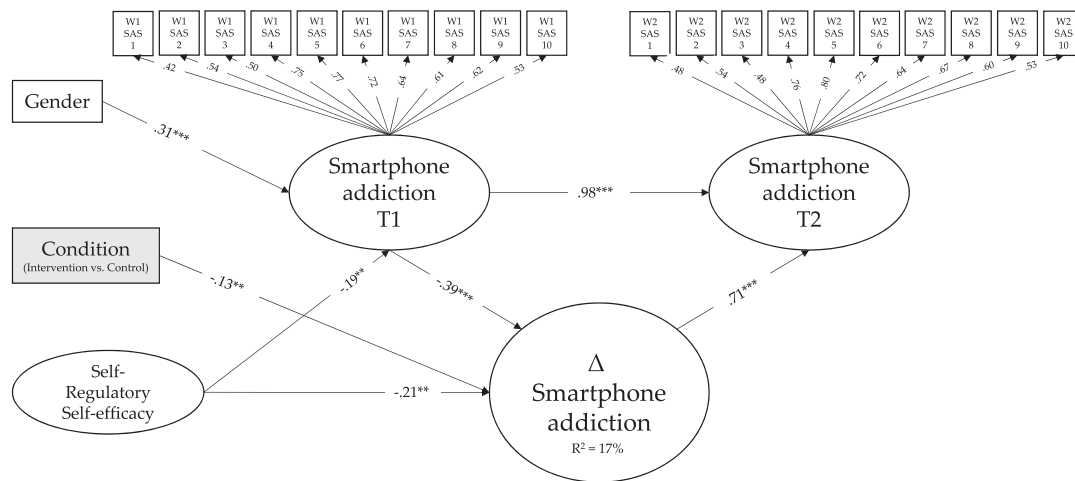
FIGURE 2 The LDS model for smartphone addiction levels. Model fit: χ^2 (285) = 405.72 ($p < .001$); CFI = 0.94; TLI = 0.93; RMSEA = 0.03 (CI: 0.03–0.04); SRMR = 0.06. **$p < .01$, ***$p < .001$. The model was estimated controlling for youths' age, gender, sexual orientation, and socioeconomic status, but whether these paths were not significant, these were not depicted for simplicity. CFI, comparative fit index; CI, confidence interval; LDS, latent difference score; RMSEA, root-mean-square error of approximation; SAS, Smartphone Addiction Scale; SRMR, standardized root mean squared residual; TLI, Tucker–Lewis index.

Regarding the covariates, adolescent girls showed also higher problematic smartphone use at the beginning of the project, as attested by the significant effect of gender on initial problematic smartphone use ($\beta = .31$; $p < .01$). Finally, SRSE significantly influenced both initial and change levels of smartphone addiction (respectively, $\beta_i = -0.19$; $p < .01$; $\beta_c = -0.21$; $p < .01$).

4 | DISCUSSION

Despite the attested importance to consider online risky behaviors and their maladaptive consequences in European nonclinical youths (e.g., Cañas & Estévez, 2021; Lopez-Fernandez & Kuss, 2020), at this time very few studies and preventive programs on these topics are available, and less of them have been supported by evidence-based effectiveness results. This work represents a preliminary step forward in this sense, because, overall, our findings supported the short-term effectiveness of our project (Shi et al., 2022; Xu et al., 2021). Moreover, our results emphasize the usefulness of fostering youths' self-regulative beliefs to promote adjustment, according to a PYD perspective that underlined the importance of positive attitudes and behaviors, rather than focusing only on the prevention of negative outcomes (Lerner et al., 2018).

Going through our research questions, we supported the short-term effectiveness of the intervention (Catalano et al., 2019; Lerner et al., 2016), because our findings showed a significant reduction in smartphone and SNS addiction levels in youths that participated in the program, compared with those who did not participate (Romero Saletti et al., 2021; Schwartz et al., 2016). The effectiveness of the intervention was further supported by the differences between the intervention and control groups in online addiction initial levels: being part of one of these two groups did not influence youths' baseline levels of smartphone and or SNS problematic use, so we can conclude that all the differences that we found in the short-term trends of the two addictive behaviors could capture the effectiveness of the intervention rather than an a priori difference among students (Catalano et al., 2019; Grimm et al., 2012). Results supported our hypotheses and previous literature (e.g., Cañas & Estévez, 2021; Shoshani & Steinmetz, 2014; Uysal & Balci, 2018), by evidencing how the implementation of a school-based preventive intervention can encourage the reduction of online problematic behaviors (Lerner et al., 2016, 2018; Schwartz et al., 2016).

For the background characteristics, our results partially supported our hypotheses and previous findings (e.g., Fischer-Grote et al., 2019; de Freitas et al., 2021; Longobardi et al., 2020; Spilková et al., 2017). We found that only adolescents' gender influenced smartphone and SNS addictive behaviors. In our sample, young girls manifested higher SNS and smartphone addictive use at the beginning of the project, but, conversely, previous research attested that girls on average tend to be involved especially in problematic SNS use rather than a smartphone or online gambling addictive use, due to their normative marked preference for communication and relationships with others (e.g., Andreassen et al., 2017; Cheng, Yang, et al., 2021; Utz & Breuer, 2017). Similarly, previous studies evidenced that the most at-risk for smartphone addiction are young boys (e.g., Demirci et al., 2014; Vintilă et al., 2021), but our results evidenced the opposite pattern. Other youths' characteristics, such as their age, sexual orientation, or socioeconomic status, did not impact online addictions, contrary to previous research which evidenced how younger adolescents with higher socioeconomic conditions are more vulnerable to

online addictive behaviors, due to their greater resources which make easier for them to buy more sophisticated and newest ICT devices, that are also more normatively integrated with their habits (e.g., Andreassen et al., 2017; Fischer-Grote et al., 2019; Spilková et al., 2017). This partial incongruence with previous literature should be explained by several reasons. First, we implemented a pilot intervention in a convenience school, so applications of this project in wider contexts could better capture the features of online addictions. Moreover, the participating school provided extensive Science, Technology Engineering, and Mathematics education, which is normatively preferred by young boys or specific groups of girls (Card & Payne, 2021), so this could affect our results. The participating school was also located in an egalitarian neighborhood, and youths of the lowest socioeconomic conditions generally attend other schools (ISTAT, 2020), so probably our sample could not reflect the wider socioeconomic Italian condition but revealed the specific functioning of average-to-high socioeconomic status.

As regards the buffering role of youths' self-regulatory self-efficacy in short-term decreasing trends of online addictive behaviors, our results supported the significant contribution of adolescents' perception of their own abilities in regulating their behaviors, as an operationalization of their agentic role within their functioning and environments (Caprara et al., 2008; Vecchio et al., 2007), which in turn fostered the beneficial effects of the intervention (Cheng, Yang, et al., 2021; Eastin & LaRose, 2000; Li et al., 2020). In our sample, youths who at the beginning of the project possessed higher self-regulatory self-efficacy beliefs took more advantage of the participation in the project and manifested further reduction over time of problematic smartphone and SNS use (LaRose et al., 2010; Li et al., 2020).

This result supported previous literature that evidenced how promoting youths' self-regulative abilities can encourage intrinsic motivation, adaptive coping skills, and emotional and behavioral abilities, which in turn can represent a key component for preventing ICTs risks for adolescents, enhancing the effectiveness of preventive interventions (e.g., Li et al., 2020; Lopez-Fernandez & Kuss, 2020; Xu et al., 2021). This study, according to previous research, evidenced the need to go beyond the negative effects of problematic ICTs use, promoting youths' resources, by fostering their sense of being capable of regulating their behaviors and emotions toward transgressive or risky activities, online as well as offline (Cañas & Estévez, 2021; Lerner et al., 2016; Li et al., 2020).

4.1 | Limitations and future directions

Despite all its strengths, this work has several major limitations. First, the major limitation of this study is that it was a pilot project, due to the convenience sampling procedure and allocation to the control or the intervention groups, so further empirical evidence and wider applications in the Italian context are needed to support the effectiveness of the project and its generalizability across the country (Lopez-Fernandez & Kuss, 2020; Throuvala et al., 2019). Considering also wider groups of adolescents in terms of age, such as younger or older adolescents, could help future studies to generalize our findings on middle adolescence (Andreassen et al., 2017; Shi et al., 2022). Extending the project to other schools in other regions and proposing the integration of the program into their Triennial Plan of the Educational Program—Piano Triennale dell'Offerta Formativa could represent a concrete next step.

Second, we referred only to adolescents' quantitative self-reports, and the risk for reported biases was concrete (De Los Reyes, 2011; De Los Reyes et al., 2019). Future applications of this project could also include the perception of parents and teachers, to better capture youths' functioning in different significant environments, and to obtain a wider picture of behavioral changes, as a core aspect of the intervention (de Freitas et al., 2021; Pellerone et al., 2019). Additionally, including a qualitative evaluation of processes underlying youths' online use while considering the social contexts more widely, could allow us to better understand the specificity of online behaviors and could consider the qualitative effects of the preventive strategies (Lopez-Fernandez & Kuss, 2020; Throuvala et al., 2019).

Thus, future improvements of the project should include an extended analysis of youths' family functioning, such as parenting styles and practices, that have been demonstrated to significantly influence the emergence and the maintenance of addictive behaviors in youths, as well as an examination of the school context, which also play a significant role for online addictive behaviors (e.g., Gugliandolo et al., 2020; Pellerone et al., 2019). To better capture the contextual factors that could predispose or protect youths from incurring online addictive behaviors, an evaluation of the policies and actions that the schools already used to deal with these issues, at local and national levels, to summarize best practices and empower more efficient strategies should be done (Romero Saletti et al., 2021; Throuvala et al., 2019).

Another crucial limitation of the present work was the absence of a follow-up to analyze the long-term efficacy of the program in reducing maladaptive online behaviors in adolescents (Cañas & Estévez, 2021; Romero Saletti et al., 2021; Throuvala et al., 2019). The inclusion of a follow-up to evaluate the effectiveness of the intervention within a wider longitudinal period will improve the methodological quality of the study (Catalano et al., 2019; Ciocanel et al., 2017), so future steps surely will examine additional results provided by the follow-up assessment, to further support our findings.

Despite these limitations, this work represents an important first step to understand of which and how preventive and promotive practices could be implemented in schools, to contrast online risky behaviors in youths.

This work can have important practical implications. To one, the effectiveness of this project could be traduced in the implementation of a better-structured school-based intervention for schools, that proposes effective strategies to promote adolescents' adjustment and reduce socioeconomic costs of youths' addictive behaviors management (Cañas & Estévez, 2021; Lopez-Fernandez & Kuss, 2020). Second, the relevance of this preventive-promotive intervention for dealing with Internet-related risky behaviors in youths could help economic and social entities adopt effective strategies to contrast Internet-related addictive behaviors within the school context (Andreassen et al., 2017). In clinical contexts, our results could help professionals in dealing with adolescents that manifest problematic Internet-related behaviors, suggesting focusing on the improvement of their' self-regulative abilities as a possible resource for dealing with risky and addictive behaviors (van Rooij et al., 2017; Zajac et al., 2017).

DATA AVAILABILITY STATEMENT

Data and code can be shared under request for legal, ethical, and privacy restrictions, in accordance with the ethical consent provided by participants.

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