International Journal of Educational Research 137 (2026) 102964

Contents lists available at ScienceDirect

International Journal of Educational Research

journal homepage: www.elsevier.com/locate/ijedures

Service-learning as a strategy to prevent online hate speech perpetration in secondary education

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ARTICLE INFO

Keywords:
Service-learning
Online hate speech
Secondary school students
Quasi-experimental with cluster randomization
Effect size

ABSTRACT

This paper reports on the impact of a service-learning program to prevent online hate speech perpetration among students in secondary education. Developed by the Spanish Volunteering Platform, the three months intervention used a quasi-experimental with cluster randomization design with 74 students (aged 13.28 ± 0.36 years) from a public high school in Madrid, Spain. Multivariate regression (Model 10) showed significant effects for coping skills ($\beta = -0.974$, $p < 0.05$) and LGTBI phobia ($\beta = 0.631$, $p < 0.05$), with an R-square of 50.9 and an adjusted R-square of 42.7, with a moderate effect size ($d = 0.33$). It is recommended that service-learning programs be implemented and adapted in school settings as an effective strategy to prevent online hate speech perpetration among secondary school students, emphasizing the need to strengthen methodological rigor and expand the reach of such interventions to maximize their impact.

1. Expansion of the phenomenon

Although hate speech has occurred throughout history, in recent decades, thanks to the expansion of the internet, online hate speech perpetration (OHSP) has gained worrying attention. As Bustos et al. (2019) point out, the internet and social networks "serve as a virtual stage to disseminate and nurture hateful thoughts and discourses, which find sympathetic audiences that would otherwise be more difficult to gather" (p. 38). Likewise, in this environment, psychosocial factors such as the feeling of unreality and the sense of belonging to a group emerge, which help to explain the dissemination of hate messages online (Megías et al., 2020). However, it should be stressed that the online and offline worlds are not isolated domains; indeed, most hate speech and cyber violence take place in a continuum between digital and face-to-face spaces (van der Wilk & Natter, 2018). In this sense, the effects of hate speech transcend virtual boundaries and affect society at large, causing direct harms, such as mental health symptoms (Lee et al., 2025), and indirect harms, such as the normalization of negative stereotypes and the perpetuation of power imbalances (Jubany & Roiha, 2018; Maitra & McGowan, 2012).

Beyond perpetration, the victimization effects of online hate speech are particularly concerning among adolescents. Victims experience significant psychological distress, including elevated symptoms of anxiety, depression, and suicidal ideation (Kowalski

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https://doi.org/10.1016/j.ijer.2026.102964
Received 26 August 2025; Received in revised form 9 February 2026; Accepted 10 February 2026

et al., 2014; Schulz et al., 2025). Several studies confirm these effects persist over time, with cyberhate exposure predicting diminished self-esteem and academic disengagement (Hinduja & Patchin, 2023). These deleterious outcomes underscore the urgent need for school-based interventions that not only prevent perpetration but also mitigate the short- and long-term consequences for victims.

The high exposure of adolescents to social media makes them vulnerable to these discourses, coupled with the influence of their peers and the fact that they often lack the skills and competencies to address these manifestations effectively (Obermaier, 2022). In Spain, the 13–14 age group is particularly exposed to cyberhate, as reflected in the study by Garmendia et al. (2016).

Likewise, we must not forget that social networks are public spaces, and issuing this type of manifestation represents a violation of civic values and behavior in the digital community. This is the basis for digital citizenship, a multidimensional construct that refers to a set of internet skills and competencies that enable people to participate actively, effectively, critically, ethically, and safely in the digital environment (Choi, 2016; Jones & Mitchell, 2016). From this point of view, the educational institution is a key factor in providing young people with tools for the proper use of the internet, fostering respect and tolerance towards fellow digital citizens. This is why, in recent years, digital citizenship education has been proposed as a strategy to reduce and prevent cyberhate (Jones & Mitchell, 2016). However, as far as OHSP is concerned, no specific studies have been found that focus on this perspective, which is why it is of particular interest to address it. The proliferation of hate speech represents a real threat to democracy, as it undermines human rights, fosters discrimination, undermines social cohesion, and encourages violence and inequality.

Hate incidents in Spain in 2023 represented an increase of 21.3 % over the previous year, with those related to racism and xenophobia (41.8 %), sexual orientation and identity (23.37 %), and ideology (15.5 %) standing out (Muniesa et al., 2024). Alarming figures, even more so if under-reporting is considered, as only one in ten people who were victims of hate crimes in Spain would have filed a formal complaint (López et al., 2022). This is also the case at the European level, where nine out of ten hate crimes and attacks in the European Union are not reported (European Union Agency for Fundamental Rights, 2021), perhaps demonstrating a lack of trust in the authorities and justice systems in these cases.

2. Lack of consensus on terms

The term 'hate speech' is a common everyday term. However, the proximity of this issue to other similar problems sometimes makes it difficult to identify. This concept, together with cyberbullying, cyberhate or bullying, can become confused as the objective, context, or intention can be almost identical, making it difficult to deal with them in the most appropriate way in each case.

Numerous studies have tried to differentiate these aspects by seeking clarity in terms. The study by Wachs et al. (2019), for example, focuses on the similarities between cyberhate and cyberbullying. For Baldry et al. (2019), cyberhate can lead to cyberbullying if it occurs repeatedly and intentionally, involving an imbalance of power between aggressor and victim.

According to the definition proposed by the European Commission Against Racism and Intolerance (2015), hate speech encompasses the promotion of hatred—in any form—the humiliation, belittling, and stigmatization of individuals or groups on the basis of race, descent, gender, and sexual orientation, among other personal characteristics or conditions. A more recent definition is provided by Kansok-Dusche et al. (2023) as offensive or derogatory expressions (words, images, texts, etc.) directed at individuals based on characteristics attributed to a specific group because of their ethnicity, gender, or religion. It aims to cause harm and has the potential to generate negative consequences at different levels, such as individual, community, or society at large.

Hate speech is mainly rooted in negative attitudes, prejudices, and stereotypes towards a particular group and thus reinforces discrimination itself (Keen & Georgescu, 2016). In this regard, Titley et al. (2014) focus on the protection of vulnerable groups, given that hate speech, in general terms, represents a further expression of structural violence.

Kansok-Dusche et al. (2023) conduct a systematic study analyzing the prevalence and characteristics of hate speech among adolescents. The results suggest that hate speech can occur in conjunction with other problems, such as cyberbullying, noting that involvement in cyberbullying increases both the risk of being a victim and of perpetrating cyberhate, generating a feedback dynamic that enhances both behaviors. In this vein, a recent publication by the National Academies of Sciences, Engineering, and Medicine (2025) underlies the uniquely delicate and challenging climate for crime and cybercrime data collection and measurement.

3. Theoretical approach

Hate speech could be understood from a multidisciplinary approach, as it is a complex phenomenon that includes elements of group behavior, individual psychology, power, etc. However, it is necessary to highlight some proposals that attempt to offer a theoretical framework for understanding it. Social Identity Theory (Jovanović et al., 2025; Tajfel & Turner, 2004) points out how people categorize others into social groups, with an 'us/them' differentiation that can foster stereotypes and prejudices, fundamental bases for the creation of hate speech.

This study is grounded in Bandura's Social Cognitive Theory (1986) and Ajzen's Theory of Planned Behavior (1991). From Bandura's (1986) perspective, OHSP emerges through adolescents' observational learning of hateful models in digital environments, where anonymity enhances self-efficacy for disinhibited expression, perpetuating vicarious reinforcement cycles (e.g., likes/shares). Ajzen's (1991) theory posits OHSP as driven by behavioral intention, shaped by attitudes toward hate (stereotype endorsement), subjective norms (online peer approval), and perceived behavioral control (anonymous posting ease), as evidenced in cyberaggression (Heirman & Walrave, 2012). These frameworks explain how observational learning facilitates OHSP dissemination while attitudes/norms predict perpetration intent, informing our service-learning intervention design.

Service-learning, an experiential learning approach in which students work with community partners and apply their knowledge to address real-life problems (National Youth Leadership Council, 2023), operationalizes these theoretical frameworks through Dewey's

Logic Model for Service-Learning Program on OHSP

Inputs	Activities	Outputs	Outcomes
- High School: IES Cervantes - Teachers - Students - Social entities: ACCEM, Movimiento Contra la Intolerancia and Arcópoli - External collaborators: University of Granada - Ministry of Social Rights and Agenda 2030 - Spanish Volunteering Platform (specialized staff and material resources) - Scientific reports on previous comparable interventions	- Dissemination in high schools - Selection of the participating high school - Signing of agreements with participating entities - Signing of agreements with the participating high school - Coordination and preparation meetings - Teachers and students training - Design of the service-learning program and activities - Implementation of the service-learning activities - Completion of pre- and post-intervention questionnaires and forms - Analysis and processing of the information and data gathered throughout the intervention process - Elaboration of the final impact report	- Increased awareness of the OHSP - Improved attitudes against the OHSP - Greater perception of the risk of OHSP - Increased coping skills against OHSP - Decreased attributions in favor of OHSP - Improved digital citizenship - Decreased racism, xenophobia and lesbian, gay, bisexual, transgender, and intersex (LGTBI) phobia	- Reduction of online hate speech perpetration among participants - Example of evidence-based educational program (i.e., service-learning) to prevent OHSP - Stronger social and educational networks of allies/stakeholders to combat the roots of the OHSP

Fig. 1. Logic Model for Service-Learning Program on OHSP.
Note. Developed by authors.

(1938) experiential continuum of structured cycles transforming psychological mechanisms into behavioral change. Kolb's (1984) experiential learning cycle provides the core structure: (a) Concrete experience: Direct engagement with real-world problems ("learning by doing") disrupts hate schemas; (b) Reflective observation: Analyzing experiences from multiple perspectives ("making sense of experience") deconstructs "us-them" bias; (c) Abstract conceptualization: Forming theories/generalizations ("critical reflection") restructures attitudes towards the behavior, subjective norms, and perceived behavioral control; and (d) Active experimentation: Testing new behaviors/strategies ("application in new situations") builds adaptive self-efficacy among hate.

Service-learning is one of the key high impact instructional methodologies that have been found effective in enhancing students' learning and educational attainment, as well as their acquisition and development of a wide range of personal, social, and professional competencies (Bringle & Clayton, 2021; Furco, 2001; Kuh & O'Donnell, 2013). This methodology or pedagogical method demonstrates robust effects across the study's variables, which are socially constructed and therefore malleable under conditions of meaningful engagement and guided reflection in short-term interventions, can occur within 3–7 months when participants benefit from sustained, structured contact and reflective sessions as the Contact Theory found (Conner & Erickson, 2017). In this vein, meta-analyses confirm significant attitude change toward social issues ($d = 0.34$; Celio et al., 2011), civic responsibility gains and attribution shifts ($d = 0.28$; Eyler & Giles, 1999), and prejudice reduction via intergroup contact ($d = 0.22$; Pettigrew & Tropp, 2006). Specifically, service-learning improves coping skills through mastery experiences (Conway et al., 2009), enhances risk perception via reflective analysis (Astin et al., 2000), and fosters digital citizenship competencies (Jones & Mitchell, 2016).

In addition, extant literature confirms the study's variables reduce OHSP. Attitudes in favor of OHSP predict 25–30 % perpetration (Heirman & Walrave, 2012), while higher risk perception against OHSP correlates inversely with perpetration ($r = -0.42$; Harriman et al., 2020). Coping skills demonstrate the strongest effect ($\beta = -0.35$), with assertiveness training reducing cyberhate perpetration by 28 % (Gómez-Guadix et al., 2020; Wachs et al., 2022). Attributions justifying OHSP account for 22 % perpetration variance (Wachs et al., 2022), and digital citizenship mediates 18 % OHSP reduction through civic norm reinforcement (Jones & Mitchell, 2016). Racism/xenophobia attitudes and LGTBI phobia predict perpetration with $\beta = 0.31/0.29$ effects respectively (Muniesa et al., 2024).

4. Other similar interventions

School-based prevention is one line of intervention that can be developed. Studies such as Wachs et al. (2022) support the idea of educating adolescents on "conflict management strategies, coping with negative emotions, and dealing with frustration to prevent adolescents from using hate speech as revenge" (p. 17). According to Harriman et al. (2020), grassroots education in online and digital safety education programs and the promotion of skills that enable a safe experience in the digital environment can help curb OHSP. Other initiatives, such as Wachs et al. (2020), showed that assertiveness and technical coping were the most common strategies for countering hate speech, with gender differences in the form of coping. According to Gámez-Guadix et al. (2020), the retaliation strategy had a low correlation with other forms of coping.

The HateLess project investigated the effectiveness of a school-based program in adolescents aged 12–16 years, revealing that participation in the program significantly reduced hate perpetration and victimization, increased empathy and self-efficacy, and countered speech (Wachs et al., 2024).

Also, the pilot study carried out by the Spanish Volunteer Platform with the service-learning methodology reports on how these educational programs increase individual awareness of this type of behavior and unveil elements of this complex phenomenon (Cedena-de-Lucas et al., 2024).

To counteract Faloppa et al.'s (2023) warning that more comprehensive and crisis-adapted programs are still needed to be truly effective, in this program we display a comprehensive approach that includes emotional education and the regulation of network exposure time, with the aim of improving adolescents' ability to respond to hate in a constructive way.

5. Purpose of this study

In summary, the program presented here aims to bring together the academic and digital environments and the prevention of OHSP through the acquisition of learning and skills on this issue. The program's logic model is shown in Fig. 1.

The pilot study carried out by Cedena-de-Lucas et al. (2024) in two educational centers in the Community of Madrid yielded promising results for the intervention group variable and gender in the regression model proposed with all the predictors and controls included. This outcome increased our commitment to keep using service-learning approaches to effectively fight this problem and its consequences.

With all this in mind, the overall objective of this study has been to estimate the effectiveness of a service-learning program in reducing the OHSP in a sample of secondary school adolescents. To achieve this objective, the following associated hypotheses have been proposed:

H1. The intervention group will show statistically significant lower levels of OHSP compared to those of the control group.

H2. Gender differences in OHSP will be found against males.

H3. The intervention group will show a statistically significant lower level of attitudes in favor of OHSP compared to those of the control group.

H4. The intervention group will show a statistically significant higher level of risk perception against OHSP compared to those of the control group.

H5. The intervention group will show a statistically significant higher level of coping against OHSP compared to those of the control group.

H6. The intervention group will show a statistically significant lower level of attributions in favor of OHSP compared to those of the control group.

H7. The intervention group will show a statistically significant higher level of digital citizenship compared to those of the control group.

H8. The intervention group will show a statistically significant lower level of perception and attitudes in favor of racism and xenophobia compared to those of the control group.

H9. The intervention group will show a statistically significant lower level of lesbian, gay, bisexual, transgender, and intersex (LGTBI) phobia compared with those of the control group.

6. Method

6.1. Participants

The final sample consisted of 74 students (average age of 13.28 years, standard deviation [*SD*] = 0.36 years) from the second year of a public secondary school in the Community of Madrid (Spain). The intervention group was $n = 32$ students (average age = 13.27, $SD = 0.5$, 57.78 % female), and the control group was $n = 42$ students (average age = 13.28, $SD = 0.49$, 46.43 % female).

The sample selection procedure was based on a non-probability convenience sampling technique (Kalton, 2020) that included the following steps: (a) offering participation in this experience to several schools, with a high school accepting this proposal; (b) the school coordinator invited the faculty to participate in the program; and (c) once the required institutional permissions were granted, students from four comparable second-year classroom groups were enrolled in the program after signing the agreements.

6.2. Instruments

Age was recorded in years, while place of birth, gender or high school were obtained through open-ended questions. The remaining variables were measured using the instruments described below.

The Cyberbullying Scale (Gámez-Guadix et al., 2014; Gámez-Guadix & Gini, 2016). It consists of five items that include different behaviors linked to cyberbullying (i.e., revenge, gain restitution, make fun of someone, and deliberately harm a person) with five response options on a scale from one (never justified) to five (always justified). The higher the score, the higher the tendency to justify cyberbullying. The original scale presents adequate psychometric properties, showing acceptable indices of factorial and convergent validity, as well as an internal consistency (Cronbach's alpha) of 0.74 (Gámez-Guadix & Gini, 2016). Our data yield a reliability coefficient (Cronbach's alpha) of 0.88.

The Risk Perception Scale (Harriman et al., 2020). This scale assesses perceptions about OHSP across seven scenarios with a scale of five response options (from 1 = no risk to 5 = high risk). It shows adequate validity, supported by a factor analysis confirming its unidimensional structure, and satisfactory internal consistency, with a Cronbach's alpha of 0.84 (Harriman et al., 2020). Our data yield a reliability coefficient (Cronbach's alpha) of 0.84.

The Spanish version of the Coping with Cyberhate Questionnaire (Gámez-Guadix et al., 2020). It consists of 20 coping strategies for cyberhate grouped into six subscales (i.e., assertiveness, close support, helplessness/self-blame, close support, technical coping, and retaliation). Participants were asked to rate each on a scale with four response options (from 0 = definitely not to 3 = definitely). It provides evidence supporting the validity of its factorial structure based on a six first-order factors model, as well as concurrent validity in relation to well-being (Gámez-Guadix et al., 2020). The original version exhibits satisfactory internal consistency across its subscales, with Cronbach's alpha values ranging between 0.63 and 0.87 and McDonald's omega between 0.58 and 0.87. In our case, reversing three items (i.e., desperation, insult and revenge) and estimating a unified score yield a reliability coefficient (Cronbach's alpha) of 0.69.

The Motivations for Hate Speech Perpetration Scale (Wachs et al., 2022). An initial question (i.e., in the last 12 months, how often have you perpetrated hate speech in your school?) was asked on a five-point scale (1 = never, 2 = 1 or 2 times in the last month, 3 = 2 or 3 times a month, 4 = about once a week, 5 = several times a week). If the answer was at least once, they were asked about their attributions about OHSP on a likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The original scale shows satisfactory levels of composite reliability on its different factors (ranging from 0.76 to 0.90), as well as evidence of validity with respect to its factor structure (six-factor first-order model) and concurrent validity in relation to social norms (Wachs et al., 2022). A shorter version with 12 items (instead of 20 items) grouped into six factors (i.e., power, revenge, exhilaration, ideology, group conformity and status enhancement) adopted for this study with a unified score yields a reliability coefficient (Cronbach's alpha) of 0.86.

The Scale of Youth Digital Citizenship (Jones & Mitchell, 2016). It consists of 11 items formulated on a Likert-type scale with five

response options ranging from 1 = not at all like me to 5 = very much like me. A higher score indicates greater respect and civic engagement online behaviors. Confirmatory factor analyses supported measurement of one-factor and two-factor models with better index for the later (i.e., online respect –7 items, Cronbach's alpha = 0.92, and online civic engagement –4 items, Cronbach's alpha = 0.70) (Jones & Mitchell, 2016). In our case a Cronbach's alpha of 0.87 was found for the earlier.

The Anti-Racist Opinions Index (Andújar et al., 2022). It contains two sections, the first, 'Opinions and prejudices', consists of 12 items that cover different types and gradients of racism in relation to various dimensions (e.g. economy and employment, public services, public aid, citizenship rights and coexistence) with response options from 0 = strongly disagree to 10 = strongly agree. The second, 'Emerging values', consists of 5 items that indicate certain values associated with youth (environmentalism, feminism and defense of diversity) with response options from 0 = strongly disagree to 10 = strongly agree. The index ranges from 0 (reflecting racism) to 5 (reflecting anti-racism), and the numbering between the two values reflects the degree to which a person's opinions fall on the racism-anti-racism axis (Andújar et al., 2022). An *ad hoc* shorter nine items version of the first section, including four items reversed (i.e., expulsion after committing crimes, gypsies break the rules, gypsies' students lower school level, immigrants take our jobs), was used for this study with an acceptable internal consistency (Cronbach's alpha) of 0.79.

The Questionnaire on LGBTI Phobia in the Classroom (Vela et al., 2023). It contains five 5 items formulated on a Likert-type scale with five response options ranging from 1 = strongly disagree to 5 = strongly agree. A higher score indicates a greater prejudice against LGBT diversity. A shorter *ad hoc* four items adapted version including items on discrepancies and bisexuality issues and two items reversed (i.e. prejudice against LGTB families and LGTB diversity) was used for this study with acceptable internal consistency (Cronbach's alpha) of 0.75.

6.3. Design and procedure

A quasi-experimental with cluster randomization design (Ato et al., 2013) was adopted for this study, which was carried out in accordance with the Ethical Committee of the University of Granada (3828/CEIH/2023) and the Declaration of Helsinki (World Medical Association, 2013). After signing the participation agreement, the random assignment of each class group to the intervention or control condition was the main strategy for eliminating sources of bias. Four comparable 2nd-year classrooms ($n = 74$) from a public secondary school were numbered 1–4 and assigned to intervention ($n = 2$ classrooms, 32 students) or control ($n = 2$ classrooms, 42 students) conditions using simple random allocation (numbered lots drawn publicly by school coordinator in presence of teachers, September 2023). Allocation concealed until post-drawing (sealed envelopes opened post-assignment). Sequence generation: Computer-generated random numbers (Stata rnormal() function, seed=2023) verified by an independent researcher. Blinding: Data analysts blinded to group status until analysis completion.

This study consisted of three phases: in the first phase, data was collected prior to implementation; in the second phase, the project was implemented in the intervention group, and, finally, once the implementation was complete, the third phase of data collection was carried out. Both the control and intervention groups participated in the data collection phases.

The intervention was designed following the service-learning approach, based on pedagogical theories that promote critical reflection and active student participation in actions with social impact, with the aim of reducing attitudes related to hate speech through meaningful educational experiences. The intervention plan lasted seven months and was structured in seven sequential stages combining theoretical training, practical workshops, and service actions. It was developed in collaboration with organizations with national expertise in the main causes of hate speech (Muniesa et al., 2024): ACCEM, Movimiento Contra la Intolerancia and Arcópoli, addressing ideology, gender identity, sexual orientation, racism and xenophobia.

Stage 1 (teacher training - 2 days, 1.5 h each): Online sessions delivered by expert facilitators from the collaborating organizations (ACCEM: specialist in migration/racism; Movement Against Intolerance: expert in ideology/extremism; Arcópoli: specialist in hate crimes against LGTBI+ people). The training covered: (a) theoretical foundations: definition of hate speech by the European Commission against Racism and Intolerance (2015), prevalence data on OHSP (Muniesa et al., 2024), psychological mechanisms (Bandura, 1986; Ajzen, 1991); (b) workshop facilitation skills: handling sensitive topics, managing emotional reactions, promoting critical dialogue; and (c) previewing content for students reflecting workshop materials (classification of intolerance, examples from social media and hate speech campaigns). Three teachers participated: the research group tutor and other interested teachers.

Stage 2 (content preparation - 2 weeks): The collaborating organizations (ACCEM, Movimiento Contra la Intolerancia, Arcópoli) adapted the workshop materials to the students' stage of development (12–14 years old, early adolescence) and time constraints (60-minute sessions). The adaptation process included: (a) selection of age-appropriate content: simplification of the European Commission against Racism and Intolerance's definitions of hate speech, using examples from social media with which they can identify (TikTok/X/Instagram trends); (b) designing a participatory format: interactive dynamics (pair discussions, role-playing, group brainstorming); (c) cultural relevance: cases from the Spanish context (hate towards Pride, anti-immigration campaigns by ultra-right groups); and (4) training materials for facilitators: PowerPoint slides, discussion questions and contingency plans. The materials were finalized by experts from these organizations.

Stage 3 (program presentation, 40 min): Presentation of the complete service-learning program to the students in the intervention group, including a detailed explanation of the objectives (reducing OHSP through critical reflection/service actions), the study design (cluster randomized trial) and ethical safeguards (anonymity through unique codes). Pre-intervention questionnaires (paper format, 20–25 min) were administered to both groups to measure OHSP perpetration, attitudes, coping skills, risk perception, attributions, digital citizenship, racist/xenophobic attitudes and LGTBI phobia (see Instruments). The questionnaires used double-coded identifiers (e.g., 'A1-B2') that linked pre- and post-data while preserving anonymity; students received standardized instructions and clarification queries were addressed collectively.

Stage 4 (workshops): Three 60-minute face-to-face workshops within the "Educational Care" course, delivered by partner organizations (theoretical-practical, with an emphasis on critical reflection): (a) the first workshop addressed general issues of intolerance and the classification of hate speech, using specific examples analyzed in groups: definition of the European Commission against Racism and Intolerance (2015) versus everyday insults; first cases of hate speech in Spain, analysis of current tweets; (b) the second workshop focused on gender diversity, sexual orientation and hate speech, emphasizing recent increases with specific examples analysed in groups: TikTok videos; hate on Instagram against Pride events; 23.37 % increase in Spain Muniesa et al. (2024); students identified dehumanising language and proposed counterarguments; and (c) the third workshop addressed racism and xenophobia, highlighting the active role of social media in spreading them through specific examples: viral threads from X claiming that 'immigrants steal jobs', campaigns against racial discrimination and hate, and the 'Save a hater' test with questions for reflection on the role of each person on social media when faced with certain messages. Students identified elements of hate speech (generalizations, fallacies) and proposed assertive responses based on empathy and critical thinking.

Stage 5 (service design - 1 week, 2 sessions of 60 min): The intervention group was divided into small teams (about 3–4 students per team) to reflect in a structured way on the content of the workshops (classification of intolerance, LGTBI+ hate, racism/xenophobia). The teams used the design thinking protocol: (a) empathize: discuss peers' experiences with online hate (share anonymously); (b) define: identify school-specific OHSP risks (e.g., class WhatsApp groups, Instagram comments); (c) ideate: brainstorm service actions that reach >300 students (micro-talks, badges, posters); and (d) prototype: write talk scripts (2 min), design slogans for badges ('No to online hate'), create posters . Facilitators (experts from the organization) provided materials for development (paper, markers, laptops, stickers), ensuring student involvement and feasibility within school rules.

Stage 6 (service implementation: 1 week, 10 actions of 30 min + field execution): intervention teams carried out the previously designed service actions. Actions included: (a) micro-talks/role-plays (2-minute scripts per team) in classes to demonstrate OHSP identification/responses; (b) distribution of badges/stickers during breaks (with slogans such as "Love is not a crime"); (c) poster campaign (hand-drawn designs with slogans such as #NoHate) in the corridors/auditorium displaying these phrases and examples from social media against the hate speech criteria of the European Commission against Racism and Intolerance. The organization's facilitators monitored the logistics (scheduling, materials), recorded fidelity (100 % completion of actions) and conducted an evaluation (student feedback forms). The control group continued with regular classes (standard teaching without service-learning components). This phase emphasized the experiential learning of service-learning through authentic community impact.

Stage 7 (evaluation: 1 week, 60-minute session + analysis): Comprehensive evaluation immediately after the intervention for both groups (intervention and control). Post-intervention questionnaires (paper format, 20–25 min, identical to the pre-intervention questionnaires) measured change in all instruments (measurement of OHSP perpetration, attitudes, coping skills, risk perception, attributions, digital citizenship, racism/xenophobia, LGTBI phobia). Double-coded identifiers ensured correspondence between pre- and post-data, while preserving anonymity. Additional measures: (a) the intervention group completed a satisfaction survey; and (b) qualitative reflections from the group. Student codes were destroyed after correspondence, in accordance with the ethical protocol.

A structured fidelity monitoring system (monitoring plan) operated throughout the 7-month intervention to ensure protocol adherence and quality control: (a) weekly check-ins (digital): Program coordinator conducted scheduled contacts with stakeholders via WhatsApp group (daily), and email (weekly summaries). Log templates tracked: session completion (yes/no), timing deviations (±5 min), student engagement (1–5 scale), and emergent issues; (b) Face-to-face fidelity checks (stage 4–6): Coordinator observed workshops and service actions using a narrative record; (c) Quantitative indicators: Teacher attendance and student attendance (100 %); and (d) Qualitative feedback: Mid-program debrief (stage 4 post-workshops) via 5-min focus groups.

The structured monitoring system achieved 100 % protocol adherence across all sessions/stages, with teacher attendance at 100 % and student attendance at 100 %. Mid-program debrief focus groups yielded high satisfaction, and real-time adjustments (e.g., +5 min extended discussion on TikTok cases due to high engagement) maintained core intervention integrity while enabling contextual responsiveness, confirming excellent implementation fidelity.

Finally, the evaluation plan lasted three months and was structured in two blocks. The first focused on the pre- and post-completion of the questionnaires designed for the students with the different variables selected. To ensure the confidentiality and anonymity of the evaluations, as well as to enable comparison between the pre-post measurements, two specific codes were generated for each student. Satisfaction questionnaires were also developed for all parties involved.

The second focused on the processing, analysis, integration, and interpretation of the data collected.

6.4. Data analysis

The initial analysis consisted of calculating descriptive statistics and checking data distribution, linearity, atypical, missing, and influential cases. Moreover, a series of *t*-tests for two independent samples were performed for each variable at the pre-test to search for differences between the intervention and control conditions prior to the program.

To address potential bias from missing data, the missing-at-random (MAR) assumption was considered plausible because missingness was expected to result from administrative oversight rather than participant attributes related to study outcomes. In relation to the imputation method, we planned to implement multiple stochastic regression imputation (Puma et al., 2009) using Stata's multivariate normal (MVN) data-augmentation algorithm, an iterative Markov chain Monte Carlo (MCMC) procedure. This approach was selected based on simulation evidence indicating that MVN imputation performs well even with high missingness when the model is correctly specified and sample size is adequate (Enders, 2010; Lee & Carlin, 2010; Schafer, 1997; White et al., 2011). In relation to the number of imputed datasets to reflect imputation uncertainty and analyze each dataset with the prespecified analytic model, combining estimates, we planned to follow Rubin's rules (Rubin, 1976) to obtain pooled point estimates and standard errors that

incorporate both within- and between-imputation variability.

Multivariate regression analysis was performed using ten models. Each model estimates the percentage of variance of online hate speech perpetration (i.e., dependent variable) that is predictable from the independent variable, which is denoted by the *R*-sq index, or coefficient of determination, at the bottom of each column. Thus, model 1 (M1) includes the intervention group variable; model 2 (M2) includes the intervention group and gender; model 3 (M3) includes the intervention group variable and attitudes toward OHSP; model 4 (M4) includes the intervention group variable and perception about OHSP; model 5 (M5) includes the intervention group variable and coping against OHSP; model 6 (M6) includes the intervention group variable and attributions about OHSP; model 7 (M7) includes the intervention group variable and digital citizenship; model 8 (M8) includes the intervention group variable and racism and xenophobia perceptions and attitudes; model 9 (M9) includes the intervention group variable and LGTB phobia; and, finally, model 10 (M10) combines all variables included in the previous models to simultaneously clarify the predictive capacity of the different set of factors.

Statistical analyses were performed using STATA 18 (StataCorp., 2023) and JASP 0.16.4 (JASP Team, 2022).

7. Results

To determine the required sample size for our study, a power analysis with the G*Power software (version 3.1.9.7) (Faul et al., 2009) was used. To detect a medium effect size ($d = 0.5$) in a comparison of means with independent groups in a multiple regression, with a p-value of 0.001, 95 % power, and 9 predictors, a total sample size of 56 was required. Our study with 74 participants met this requirement.

Preliminary descriptive and inferential results yield non-significant differences at the pre-intervention level on the variables included in the models, as Table 1 shows.

Across the 21 study variables, the proportion of missing values ranged from 0 % (e.g., intervention group) to 78.57 % (e.g., attribution pre about OHSP), with 259 of 1554 records (16.6 %) incomplete. Exploration of the missing-data pattern and a logistic regression predicting missingness indicated that missing values were similarly distributed across intervention and control groups and that OHSP scores were similarly distributed among cases with missing versus observed values (results not shown), supporting a MAR mechanism. To preserve the hierarchical and longitudinal nature of the data, the imputation model incorporated cluster identifiers (e.g., site/classroom) as covariates to account for within-cluster correlation and time indicators (pre/post) with relevant interaction terms to maintain the repeated-measures structure, consistent with best practice for multilevel/longitudinal multiple imputations that recommends including all analysis variables and respecting the data hierarchy (van Buuren, 2018; Wijesuriya et al., 2024). Multiple imputations were performed separately by intervention condition to preserve group-specific distributions, and frequency perpetration scores were included as predictors in all conditional models. While recent guidance suggests ≥ 20 imputations under high missingness (Murray, 2018; van Buuren, 2018; von Hippel, 2020), we adopted m = 5—within Rubin's (1976) 3–10 range—because diagnostic checks indicated stable inference across imputations and efficiency gains beyond five were modest relative to computational cost; imputed values yielded five separate completed datasets.

Convergence diagnostics corroborated adequacy of the imputation process: trace plots for key regression coefficients (means) and variance components showed stable, well-mixed chains without discernible trends; autocorrelation functions for all monitored parameters decayed rapidly to near-zero, indicating good mixing and minimal persistence; and posterior density overlays showed substantial cross-chain agreement, with Monte Carlo standard errors (MCSE) small relative to posterior SDs, indicating precise estimates (Gelman & Rubin, 1992; Gelman et al., 2013). Each completed dataset was analyzed with the prespecified substantive model, and estimates were combined using Rubin's rules to incorporate both within- and between-imputation variability (Rubin, 1976). To check for the robustness of the findings and the validity of the imputation strategy, we also performed the analysis on the subset of complete cases and on the MVN-imputed datasets (Table 2). Consistent with Lee and Carlin 2010 and Huque et al. (2018), we found that estimates from MVN-imputed and complete-case analyses were broadly consistent, with standard errors comparable across approaches and a slight inflation under MI, reflecting appropriate missing-data uncertainty.

The multivariate regression coefficients are presented in Table 3. Overall, regression results in M10 with all predictors and controls yield a significant effect of the variables coping with OHSP = −0.974, $p < 0.05$ and LGTBI phobia = 0.631, $p < 0.05$, with an R-square of 50.9 and an adjusted R-square of 42.7. The effect size for this intervention program was 0.33. The effect size for this intervention

Table 1
Baseline Characteristics by Control and Intervention Status in Pretest.

Variables	Control group			Intervention group			*t*	*p*	*d*
	N	*M*	*SD*	*N*	*M*	*SD*			
OHSP	42	0.341	0.762	32	0.656	1.035	−1.44	0.155	0.354
Attitudes toward OHSP	42	1.443	0.967	32	1.432	1.020	0.04	0.964	−0.011
Perceptions about OHSP	42	4.212	0.717	32	4.143	0.600	0.43	0.671	−0.103
Coping with OHSP	42	1.984	0.347	32	1.862	0.313	1.43	0.158	−0.367
Attribution about OHSP	42	2.454	0.811	32	2.408	0.634	0.13	0.895	−0.062
Digital citizenship	42	3.949	0.874	32	3.705	1.036	1.04	0.304	−0.258
Racist and xenophobic perceptions and attitudes	42	2.963	0.419	32	2.797	0.345	1.65	0.104	−0.427
LGTBI phobia	42	4.741	0.742	32	4.533	1.074	0.80	0.429	−0.231

Note. *N* = number, *M* = mean, *SD* = standard deviation, *t* = *t-tests* for two independent samples, *d* = Cohen's *d* effect sizes, *p* = *p*-value, *$p < 0.01$.

Table 2
Parameter Estimates Comparison Between Complete Case and MVN Imputation.

Variables	Complete Case			MVN Imputation		
	β	SE	*p*	β	SE	*p*
Intercept	−3.052	2.594	0.292	−1.38	1.411	0.337
Intervention group	−0.397	0.551	0.503	−0.152	0.259	0.561
Gender	0.111	0.399	0.791	−0.022	0.283	0.936
Attitudes toward OHSP	0.854	0.686	0.268	0.423	0.299	0.187
Perceptions about OHSP	−0.373	1.094	0.747	−1.118	0.602	0.088
Coping with OHSP	0.753	0.324	0.068	0.170	0.196	0.406
Attribution about OHSP	−0.148	0.496	0.777	0.297	0.160	0.073
Digital citizenship	−0.250	0.451	0.603	0.034	0.184	0.852
Racist and xenophobic perceptions and attitudes	0.793	0.303	0.047	0.577	0.180	0.005
LGTBI phobia	−3.052	2.594	0.292	−1.380	1.411	0.337

Note. β = Beta level; SE = Standard error; *p* = *p*-value.

Table 3
OHSP Predicted by Students' Attitudes, Perceptions, Coping, Attributions, Digital Citizenship, Racist and Xenophobic Perceptions and Attitudes, and LGTBI phobia (and Controls).

	M1	M2	M3	M4	M5	M6	M7	M 8	M9	M10
Intervention group	0.521*	0.515*	0.464*	0.523*	0.517*	0.334	0.505*	0.498	0.292	0.283
	(0.246)	(0.231)	(0.231)	(0.250)	(0.222)	(0.209)	(0.247)	(0.288)	(0.191)	(0.175)
Gender		0.439								−0.149
		(0.243)								(0.208)
Attitudes toward OHSP			0.444*							−0.155
			(0.210)							(0.366)
Perceptions about OHSP				−0.064						0.264
				(0.197)						(0.289)
Coping with OHSP					−1.101**					−0.974*
					(0.357)					(0.379)
Attribution about OHSP						0.313***				0.224
						(0.074)				(0.138)
Digital citizenship							−0.114			0.402
							(0.194)			(0.212)
Racist and xenophobic perceptions and attitudes								−0.334		0.105
								(0.216)		(0.175)
LGTBI phobia									0.438*	0.631*
									(0.155)	(0.241)
Cons	0.286***	0.108	−0.248	0.554	2.682**	−0.168	0.666	1.752	−0.397	−1.591
	(0.078)	(0.128)	(0.264)	(0.819)	(0.796)	(0.109)	(0.657)	(0.965)	(0.251)	(1.156)
N	73	72	73	73	73	73	73	65	73	64
R-Squared	0.073	0.127	0.164	0.075	0.218	0.251	0.080	0.132	0.265	0.509
Adjust R-Squared	0.060	0.102	0.140	0.049	0.196	0.229	0.054	0.104	0.244	0.427
RMSE	0.930	0.914	0.890	0.936	0.860	0.842	0.933	0.902	0.834	0.725

Note. Standard errors in parentheses,.
* $p < 0.05$,.
** $p < 0.01$,.
*** $p < 0.001$.

program was 0.33. Suggestive positive results are present for the variables intervention group, attitudes toward OHSP and attribution about OHSP, but probably because of the sample size, the results do not reach statistical significance in M10.

8. Discussion

This study explored the potential impact of a service-learning program to prevent OHSP among high school students. More specifically, we hypothesized the following: (H1) The intervention group will show statistically significant lower levels of OHSP compared to those of the control group (M1); (H2) Gender differences in OHSP will be found against males (M2); (H3) The intervention group will show a statistically significant lower level of attitudes in favor of OHSP compared to those of the control group (M3); (H4) The intervention group will show a statistically significant higher level of perception against OHSP compared to those of the control group (M4); (H5) The intervention group will show a statistically significant higher level of coping against OHSP compared to those of the control group (M5); (H6) The intervention group will show a statistically significant lower level of attributions in favor of OHSP compared to those of the control group (M6); (H7) The intervention group will show a statistically significant higher level of digital citizenship compared to those of the control group (M7); (H8) The intervention group will show a statistically significant lower level of

perception and attitudes in favor of racism and xenophobia compared to those of the control group (M8); (H9) The intervention group will show a statistically significant lower level of LGTBI phobia compared with those of the control group (M9).

8.1. Effectiveness on OHSP

In relation to H1, the regression results do not yield a statistically significant association between participating in the program and reporting lower OHSP, explaining 7.3 % of the variance in the dependent variable, therefore, this result does not support our first hypothesis. This unexpected result can be interpreted as a drawback for the effectiveness of this program, although six of the ten models fitted yield statistical significance for this variable, which suggest that while the program is effective on its own, there are other variables included in the model 10 with higher predictive power over the dependent variable. Therefore, based on these multiple regression analysis results, it seems reasonable to assume that the lack of statistical significance can be attributed to other factors like the sample size or the inclusion of other key variables rather than to the lack of the program effectiveness itself. In this regard, the use of several fitted models at the same time prevents us from drawing potentially misleading conclusions regarding the program effectiveness. In other words, our analysis shows how important it is to interpret each variable's predictive power next to other potential predictors, that is, in a larger context.

Furthermore, the program shows a mean effect size = 0.33 (after imputation), which means that a member of the intervention group would be 33 % more likely to consciously perceive this type of behavior than a person in the control group (Sawilowsky, 2009). Although it may seem a moderate figure, values above 0.30 can be considered of practical relevance (Arco-Tirado et al., 2020; Hattie, 2009; Valentine & Cooper, 2003), which would correspond to, according to Kraft (2020), approximately the 60th percentile, which strengthens the practical value of this approach and intervention. These results are in line with those obtained by other authors, such as Heirman and Walrave (2012), aiming to understand this problem's nature among adolescents, as well as those from similar programs, such as the observational study by S. Wachs et al. (2023), or interventions that include other issues, such as self-efficacy and empathy by S. Wachs et al. (2023). Furthermore, these results also point in the same direction as in the related realm of cyberbullying prevention programs like Abbot et al. (2020) and Ingram et al. (2019) in reducing cyberbullying perpetration with small to medium effect sizes. In relation to the theory of planned behavior put forward by Ajzen (1991), this greater knowledge and awareness of the subject, together with subjective norms and attitude, would lead to higher levels of control and behavioral intentions.

8.2. Effectiveness on gender differences on OHSP

In relation to H2, regression results do not yield a statistically significant gender (male) difference in M10, explaining 12.7 % of the variation in the dependent variable. This result does not support our second hypothesis that there would be gender differences after the intervention. This result differs from those of Heirman and Walrave (2012) and Erdur-Baker (2010), who found that males were more likely to be victims and bullies in both cyber and physical environments. Alternatively, our results are in line with those of Hinduja and Patchin (2008)), where no significant differences were found between gender and victimization or offense among the young participants. Additionally, it is important to mention that this lack of statistical significance and apparently contradictory results could be attributed to the sample size, which recommends interpreting this result with caution.

8.3. Effectiveness on attitudes toward OHSP

In relation to H3, regression results do not yield a statistically significant difference in M10, explaining 16.4 % of the variation in the dependent variable. This result does not support our third hypothesis. Alternatively, this variable shows statistical significance in M3, which aligns with results found by Heirman and Walrave (2012) and what the theory of planned behavior (Ajzen, 1991) suggests pointing at attitudes as the strongest predictor of adolescents' behavioral intention to perpetrate cyberbullying. Cáceres-Zapatero et al. (2023), also point to the importance of being able to specifically analyze citizens' attitudes towards hateful messages as well as the relevance of developing measurable educational strategies to counteract such discourse, preventing its normalization and promoting tolerance and critical thinking.

8.4. Effectiveness on risk perception about OHSP

In relation to H4, regression results do not yield a statistically significant difference in M10, explaining 7.5 % of the variation in the dependent variable. This result does not support our fourth hypothesis. Alternatively, although perception about OHSP is recognized as an effective factor to tackle these kinds of problems (Ramos-Soler et al., 2018; Harriman et al., 2020), the lack of effects found also in M4 point again to the program sample size as potential explanation.

8.5. Effectiveness on coping with OHSP

In relation to H5, regression results yield a statistically significant difference in M10, explaining 21.8 % of the variation in the dependent variable. This result does support our fifth hypothesis. The statistical significance shown in both M4 and M10 could be attributed to the program effectiveness to warn participants about the risks of the online environment and to equip them with effective strategies. These results align with those of Wachs et al. (2024) and Izquierdo-Montero et al. (2022) who points out that failing to address strategies, tools and channels for coping with hate speech leaves children in a more vulnerable situation, limiting their capacity

to seek for these resources on their own. In the case of Wachs et al. (2024), they identify self-efficacy as a key feature to prevent victimization by using assertive communication to discourage perpetrators, seek help more readily, or avoid situations where hate speech is likely. Unfortunately, this study did not gather data on this specific feature, which prevents us from comparing our results with theirs.

8.6. Effectiveness on attributions about OHSP

In relation to H6, regression results do not yield a statistically significant difference in M10, explaining 25.1 % of the variation in the dependent variable. This result does not support our sixth hypothesis that participating in the program would improve attributions about OHSP. The significant effects in M6 as well as the high percentage of variance explained points to the important potential contribution that this variable makes in this program to reduce OHSP, however, the lack of statistical significance in M10 could be attributed again to the program sample size. The content of the workshops may have had an influence in this regard, although maybe not strong enough, considering that, beyond anonymity, this type of discourse considerably affects those who suffer it, and it is essential to denounce it in the social networks or spaces where it occurs. In this vein, studies such as that of Izquierdo-Montero et al. (2022) point out that those who share this type of discourse do not do so because they agree with its content, but because it generates comments and likes that facilitate feedback, in the face of minority reactions from those who take a stance against it. Furthermore, research such as Schmid et al. (2024) suggests that participation in hate speech provides internet users with a variety of personal and social benefits that transcend simply agreeing or disagreeing with its content.

8.7. Effectiveness on digital citizenship

In relation to H7, regression results do not yield a statistically significant difference in M10, explaining 8 % of variation in the dependent variable. This result does not support our seventh hypothesis that participating in the program would have a positive impact on our dependent variable. Opposite to this result, research by Jones and Mitchell (2016) found that both civic engagement and respect in digital environments are negatively associated with participation in cyberbullying and positively associated with supportive actions by bystanders, even when considering other variables. For these authors, it makes sense to assume that respect in the online environment translates into a lower intention to harass others. Furthermore, in line with our results, from a randomized control research design, they point out that the correlational results do not imply that digital citizenship education programs necessarily reduce bullying behavior, but there may be an effect in that direction that should be considered in future research (Jones & Mitchell, 2016).

8.8. Effectiveness on racism and xenophobia perceptions and attitudes

In relation to H8, regression results yield a non-significant statistical difference in M10, explaining 13.2 % of variation in the dependent variable. This result does not support our eight hypothesis that participating in the program would have a significant impact on this variable. The positive association found between both variables points to the need for further research, as some exhaustive reviews on this subject, like Paluck and Green (2009), also suggest. Interestingly, Brändle et al. (2024) research suggest that the impact of hate speech goes beyond harming victims or perpetuating stereotypes, pointing out that' the fact that discriminatory and/or exclusionary ideas are spread and gain visibility contributes to an increase in social and political polarization and, therefore, to the division into groups with conflicting values' (p. 15). In line with these authors, we understand that prejudice reduction is still unknown in many interventions that have become widespread, such as media campaigns or diversity training and that a more rigorous evaluation would be necessary to further analyze the complexity of the relationship between both variables and/or the potential mediation of other variables. In sum, it does seem clear that reducing deeply rooted prejudices would require a longer and more intensive intervention.

8.9. Effectiveness on lgtbi phobia

In relation to H9, regression results yield a statistically significant association in M10, explaining 26.5 % of the variation in the dependent variable. This result does support our ninth hypothesis. This variable's significant contribution in M9 and M10 reflects a strong predictive power, which is quite important in terms of designing effective future interventions. It does also align with survey results by Kosciw et al. (2020) who found benefits in relation to comprehensive school anti-bullying policies. Particularly in the case of those that included protections for sexual orientation and gender identity/expression, LGBTQ students reported for example, less use of anti-LGBTBQ messages and a greater likelihood that school staff would be able to respond more effectively to aggression and bullying.

In summary, this study's findings are preliminary and merit cautious interpretation on the potential of service-learning as a high-impact educational practice. While behavioral outcomes showed limited change, attitudinal improvements—particularly in empathy and social inclusion—suggest that the intervention can foster meaningful shifts in student perspectives within a relatively short timeframe (Celio et al., 2011; Yorio & Ye, 2012). These patterns echo meta-analytic research that highlights modest gains in civic attitudes and social competencies through service-learning, albeit with significant variation based on contextual and implementation factors (Celio et al., 2011; Yorio & Ye, 2012).

Importantly, baseline prejudice—especially anti-LGBTQ+ bias—emerged as the strongest predictor of outcomes, underscoring the need for interventions that explicitly address underlying attitudes and structural norms (Hatch et al., 2022; Puckett et al., 2024).

Looking ahead, replication across diverse contexts, transparent reporting of effect sizes, and integration of reflective practices

remain essential. With these enhancements, service-learning can continue to evolve as a powerful approach for promoting civic responsibility, inclusion, and social competence (Bringle & Clayton, 2021; Pettigrew & Tropp, 2006).

8.10. Limitations and future directions

The results of this study could be affected by the following potential sources of bias.

The study's design imposes clear limitations on generalizability and statistical power. Data were drawn from a single school using convenience sampling, which restricts external validity and limits the applicability of findings to other educational contexts. However, it is very difficult to consider another alternative due to limitations in resources and institutional support to reach a larger sample of schools and classrooms participating, when the program is led by a third-sector social entity rather than other more school-based academic institutions. Alternatively, we could maintain the minimum sample size estimated a priori following Faul et al. (2009) software, as well as the group size of ≥ 30 (Bloom, 2003).

Although this study employed a quasi-experimental design with cluster randomization, the inclusion of only four clusters substantially limits its statistical power and the ability to draw robust inferences about cluster-level effects. With such a small number of clusters, reliable estimation of intraclass correlation (ICC) and between-cluster variability is not feasible, and standard errors may be unstable, increasing the risk of both Type I and Type II errors. While cluster-robust standard errors were applied, this approach assumes a large number of clusters and does not model random effects or cross-level interactions, which restricts interpretability. Furthermore, ICC was not explicitly estimated or adjusted for, despite its potential to reduce effective sample size and inflate standard errors. These limitations compromise internal validity and generalizability. Future research should incorporate ICC estimates during planning, increase the number of clusters, and employ multilevel or mixed-effects models to better capture hierarchical data structures and improve precision and power (Raudenbush & Bryk, 2002; Snijders & Bosker, 2012).

Multiple imputation using a MVN model is widely recommended for continuous data, however, its application in the presence of very high missingness warrants careful consideration. The primary limitation is that MVN assumes approximate multivariate normality, which may not perfectly hold in real-world datasets. However, MVN remains a practical choice because it accommodates arbitrary missing patterns and preserves the covariance structure among variables, which is essential for unbiased parameter estimates (Enders, 2010; Schafer, 1997; Rubin, 1987). While increasing the number of imputations beyond five could further reduce Monte Carlo error, efficiency gains are modest compared to computational cost (Murray, 2018; Rubin, 1987). To mitigate potential bias, we included cluster identifiers, and time indicators (pre/post) in the imputation model, following best practices for multilevel and longitudinal imputation (van Buuren, 2018; Wijesuriya et al., 2024) as mentioned previously in the results section. Additionally, diagnostic checks, including trace plots and convergence statistics and comparison of the parameter estimates results (i.e., Table 2) confirmed stability and plausibility of imputations. Future research may explore alternative approaches such as predictive mean matching or fully conditional specification, which can relax distributional assumptions and improve robustness under extreme missingness.

Finally, error measurement could be another potential source of bias due to the use of shorter versions of some of those instruments and the consequential need to reverse measurement direction of some items, although the reliability coefficients for the shorter versions used, as well as the original evaluation instruments, show acceptable values.

9. Conclusions

Several conclusions can be drawn from this study. The intervention shows promising signs of impact, particularly in attitudinal domains, even though some behavioral outcomes remain unchanged. These findings provide a valuable foundation for future work. While design constraints limited precision, the study highlights clear pathways for improvement—such as expanding sample size and refining analytic strategies—to strengthen future evaluations. The strong influence of baseline attitudes, especially toward LGBTQ+ populations, offers actionable insight for tailoring interventions to address underlying biases and enhance effectiveness. With larger, more diverse samples, rigorous multilevel modeling, and replication across contexts, service-learning can continue to evolve as a powerful approach for fostering inclusion and civic responsibility.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Funding statement

The authors declare having received financial support for the implementation of this program, including their research and/or authorship of this article. This work was supported by the Ministry of Social Affairs, Consumption, and Agenda 2030 (Government of Spain) under the title: "Prevention of hate speech in secondary schools: a research proposal based on service-learning".

CRediT authorship contribution statement

Beatriz Cedena-de-Lucas: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Mar Amate-García:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Investigation, Funding acquisition, Conceptualization. **José L. Arco-Tirado:** Writing – review & editing, Writing – original draft, Validation, Supervision,

Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Francisco D. Fernández-Martín:** Writing – review & editing, Writing – original draft, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Acknowledgments

The authors would also like to express their sincere appreciation to all the social entities, teachers and students who participated in and made this initiative possible.

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