



# Effectiveness of digital game-based GISCC program on cyberbullying prevention among Chinese adolescents

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## ABSTRACT

**Background:** The increasing use of social networking sites has increased the efficiency of social interactions but inevitably contributed to the risk of cyberbullying. Despite evidence of the effectiveness of offline intervention programs for cyberbullying, few have examined online interventions, especially in the Chinese context.

**Objective:** This study aims to develop and validate an innovative Game-based Intervention for School- and Cyberbullying for Children (GISCC), which combines training on psychosocial and behavioral components with interactive role-play games.

**Participants and setting:** A randomized trial method was used to evaluate the effectiveness of the GISCC intervention, comprising 105 Chinese adolescents who were randomly assigned to the experimental ( $n = 55$ ) and control ( $n = 50$ ) groups.

**Methods:** Independent sample *t*-test, paired-samples *t*-test, ANCOVA, and MANCOVA were used to test the differences in the trained components before and after the intervention.

**Results:** The results showed that the GISCC intervention significantly reduced cyberbullying behaviors ( $F = 37.50, p < 0.001$ ), violence intentions ( $F = 4.95, p < 0.05$ ), and mental health problems ( $F = 60.28, p < 0.001$ ); and increased self-efficacy ( $F = 18.26, p < 0.001$ ), and conflict resolution skills ( $F = 36.46, p < 0.001$ ).

**Conclusions:** Our study provided empirical evidence in the Chinese context for digital health intervention approaches for cyberbullying prevention. We also identified the essential components (empathy, self-efficacy, violence prevention, conflict resolution with families) for future research on developing effective digital intervention tools to reduce cyberbullying.

## 1. Introduction

Cyberbullying, understood as deliberate verbal attacks in electronic media, has become an important public health problem worldwide (Kennedy, 2019). In the Chinese context, the prevalence of cyberbullying victimization ranges from 6.3 % to 68 % (Leung et al., 2018; Rao et al., 2019), while cyberbullying perpetration varies between 3 % and 38 % (Chen & Zhu, 2022; Zhou et al., 2013). Recent research suggests that the anonymity of perpetrators and the ease of disseminating information greatly differentiate cyberbullying from traditional bullying, resulting in victims being unable to escape (Patchin & Hinduja, 2015). Thus, cyberbullying victims often suffer from more severe physical and mental health problems, including sleep disturbances, headaches, anxiety, distress,

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loneliness, depression, and suicidal ideation (Rao et al., 2019). Factors such as limited abilities in emotion management, poor relationships with peers and families, and less school support are related to cyberbullying perpetration (Doty et al., 2022). While studies on cyberbullying have mainly focused on its prevalence and risk factors, empirical research into the design and evaluation of effective interventions remain scarce (Chen et al., 2023). A better understanding of both risk and protective factors is essential for the early detection of cyberbullying and the development of preventative programs.

Traditional classroom-based, face-to-face intervention workshops, such as educational sessions for parents and peer support programs, have been effective in reducing school bullying behaviors and increasing awareness (Ng et al., 2022; Nocentini & Menesini, 2016). For example, discussions between parents and their children, along with positive parenting styles, significantly reduce their children's involvement in bullying and cyberbullying (Chen et al., 2022). However, these face-to-face courses require a sufficient number of qualified or licensed teachers, which often leads to a mismatch with the increasing scale of children's educational needs, especially in underdeveloped countries and remote areas (Fontaine et al., 2017). Addressing these economic and educational gaps is crucial in the future development of efficient interventions targeting high-risk groups. Digital interventions, using mobile applications such as games and web-based information, are increasingly used by health and education professionals to build knowledge. Many studies have shown that they are as effective as face-to-face interventions in improving learning outcomes (Divakar et al., 2019). Evidence suggests that digital health intervention workshops can enhance critical thinking skills, stimulate curiosity, and increase students' intrinsic motivation and engagement in learning (Wong et al., 2020). Various online education programs have been implemented globally to raise young people's awareness of cyber risks by imparting knowledge in a digital-mediated environment. Examples include the I-SAFE Internet Safety Course in the United States (Harshman, 2014), and Cyber-friendly Schools in Australia (Cross et al., 2015). Digital interventions can effectively tailor content to personalized characteristics, thereby improving bullying-related cognitions such as empathy, coping strategies, awareness, and attitudes, and reducing criminal intentions in interactive learning platforms (Garaigordobil & Martínez-Valderrey, 2018; Ingram et al., 2019). Conducting rigorous evaluations of the effectiveness of digital interventions and exploring their cultural components remain of primary importance.

Drawing from the Social Learning Theory (Bandura, 1986), children exposed to cyberbullying may exhibit passivity, endure peer bullying, or adopt aggressive behaviors by imitating outcomes they perceive as positive in violent interactions (Barlett, 2023). Deficiencies in social skills, emotional support, and coping mechanisms contribute to an increased susceptibility to problematic relationship dynamics (Buelga et al., 2017; Varela et al., 2022). Furthermore, these children may display heightened sensitivity to hostile interactions and encounter difficulties in managing peer conflicts (Kim et al., 2022). In the realm of cyberbullying prevention, individuals assimilate attitudes and behaviors by observing role models in their social milieu (Masoomah (Shamila) Shadmanfaat et al., 2020). Variations in awareness and motivation levels may prompt a transition from witnessing violence to future perpetration (Zych et al., 2019). Moreover, bullying is often seen as a way to establish a group identity, with parents and teachers sometimes viewing peer conflicts as inevitable and permissible (Moore et al., 2014). Those with higher levels of empathy and self-efficacy, striving for social integration, are less likely to engage in perpetration (Mesch, 2012). Conversely, individuals who internalize aggressive conduct may view violence or aggression as viable means to address conflicts and conform to group conformity (Wiertsema et al., 2023). Thus, education emphasizing proper interpersonal skills and coping strategies is critical to preventing cyberbullying among children and adolescents.

Intervention studies suggest that effective interventions can directly aim to reduce aggressive behaviors among perpetrators and increase potential victims' coping strategies to make them less vulnerable (Leung et al., 2018). Bystander interventions are crucial in the elimination of cyberbullying (Gaffney et al., 2019; Garaigordobil & Martínez-Valderrey, 2018). Recent studies have found that commonly used approaches for bystander interventions include videotaped reenactments and computer-adaptive software to address bullying in vivo as part of an online group process (DeSmet et al., 2018). For example, the KiVa program, one of the most widely applied digital interventions for bullying and cyberbullying, focuses on how bystander actions can influence the maintenance of bullying or the adjustment of victims (Salmivalli et al., 2011). Influencing the behaviors and knowledge of bystanders in cyberspace can reduce the rewards for and motivations of perpetrators, and empower bystanders to take action to intervene to help victims (Doane et al., 2016). Research also indicates that training in empathy and self-efficacy can contribute to the support given to potential victims (Salmivalli et al., 2011). Therefore, developing and evaluating interventions that target the psychosocial characteristics of potential perpetrators, victims, and bystanders of cyberbullying is essential to determine the core principles of effective interventions and to identify implications for practice and policy.

Conducting rigorous evaluations to test the effectiveness of evidence-based programs for cyberbullying prevention among Chinese adolescents are critical due to the high prevalence of cyberbullying, driven by rapid digitalization and widespread internet use among the younger generation in the globe and in China as well. The Chinese government has recently promoted the "six-in-one" protection system to protect children from cyberbullying in China, outlining family protection, school protection, social protection, online protection, government protection, and judicial protection. This system states the responsibilities of stakeholders, including the state, society, schools, families, and network service providers, to protect children's best interests (Chen, 2024; State Council Leading Group for the Protection of Minors, 2021). Researchers have provided empirical evidence in designing cyberbullying interventions among Chinese cyber-bystanders in Hong Kong (Leung, 2021). Using the Chinese sample, it is essential to contribute to the understanding of how cultural norms and social dynamics influence cyberbullying, particularly, in the process for developing targeted prevention strategies. This study aims to draw on findings from prior interventions and models to develop a digital intervention program to increase awareness of and reduce aggression towards cyberbullying among Chinese adolescents. The findings can inform policymakers and educators in shaping evidence-based policies and educational initiatives to combat cyberbullying in Chinese schools and communities. Moreover, research in China can contribute valuable insights to the global knowledge base on cyberbullying prevention, enhancing efforts to address this issue on a broader scale. We hypothesize that participants in the experimental group who receive the GISCC

program will report less cyberbullying victimization and perpetration, and increased awareness of cyberbullying compared with those in the control group. To the best of our knowledge, this study is one of the first to develop and evaluate a program in mainland China to reduce cyberbullying behaviors. The GISCC intervention is designed to integrate theoretically and empirically derived risk and protective factors that potentially mediate adolescents' cyberbullying, such as empathy, violent intention, self-efficacy, and conflict resolution, which can predict cyberbullying outcomes (Baroncelli & Ciucci, 2014; Sasson & Mesch, 2014). The program's objectives are to improve users' understandings of: (1) Definition and factors: to differentiate cyberbullying behaviors from normal behaviors; (2) Health correlates: to understand the physical and psychological consequences faced by cyberbullying victims; (3) Coping strategies: to defend as bystanders with appropriate conflict resolution strategies in response to cyberbullying; and (4) Psychosocial capacity: to improve communication and emotional regulation skills to reduce violence intentions.

## 2. Methods

### 2.1. Participants

This study was conducted with adolescents enrolled in seventh grade at a middle school in Qingdao City, China. The sample was randomly selected from two seventh-grade classes in the fall semester of 2022 using the random sampling method based on student numbers. We selected only seventh-grade students to ensure they had enough time to participate in the whole study process. A final sample of 105 adolescents, aged between 13 and 15 years, was finally recruited. Of these, 55 (52.4 %) were randomly assigned to the experimental group, and 50 (47.6 %) to the control group. The mean age was 13.27 years old ( $SD = 0.61$ ), with a majority of boys ( $n = 57, 54.3\%$ ) compared to girls ( $n = 48, 45.7\%$ ). Our team provided participants with an information sheet listing the purpose and main content of the trial. The consent procedure includes formal approval from the school, assent from the student, and consent from the parents. Participants agreed to take part in the study based on their subjective willingness, with respect for their right to privacy and confidentiality. Before conducting the formal research, four parents were selected for a pilot study to provide feedback on the assessment instruments.

### 2.2. Features and activities

Digital education approaches range from interactive to passive modes, such as PowerPoint and video animations (Divakar et al., 2019). Although web links and video materials are convenient for providing training content, users may find maintaining interest difficult. The GISCC program is hosted by the WeChat application platform, which is the most popular instant messaging application in China, to provide an interactive and convenient game environment. The program was initially designed for adolescents and can be implemented with younger or older age groups. This pilot study was conducted under the instruction of social workers, teachers, parents, and school psychologists can also participate. Experienced social workers developed the intervention sessions and storylines to mobilize the development of adolescents' social and emotional capacities. These capacities include empathy, self-efficacy, and conflict resolution, which aim to inhibit violent intentions and behaviors. The game features several activities to help players learn rational thinking and positive coping strategies through multiple-choice questions within a simulated cyberbullying environment. Activities and interactions are distributed across the following four intervention modules.

### 2.3. Character selection

Participants log into their account and enter their preferred character name. Players can also set other identity information for their favorite character, such as age, gender, and hobbies, from the given options. They then assume their role as bystander or victim in different scenarios from a first-person perspective during the game's virtual dialogue.

### 2.4. Background introduction

Players watch an animated introduction that presents the background of the selected story, helping them to understand the premise and the identities of the relevant characters. Players encounter other virtual non-player characters and click on these non-player characters to learn about their profiles.

### 2.5. Interactions

The game features several activities designed to help players develop rational thinking and positive coping strategies through interactive experiences in a simulated cyberbullying environment. It is crucial to ensure that users are actively engaged, not just passively acquiring relevant knowledge but also developing a solid understanding of the skills acquired through gameplay. To achieve this, a "pop-up quiz" feature was implemented to reinforce their learning outcomes. The player's objectives in the game include recognizing the problems faced by non-playable characters, locating people or resources that can assist these characters, and aiding the characters in effectively communicating or utilizing these resources.

Players explore the plot by clicking buttons and making choices based on their perception and evaluation in each situation according to the storyline, which lead to different endings. For example, a player might discover that their classmate Li posted their private information online without consent. The players are then presented with the question: "What would you do?" Options include:

(a) Talk to Li and ask her to delete the information; (b) Remain silent and unsure of what to do; (c) Seek help from teachers and school psychologists; (d) Dismiss this issue; (e) Confide in close friends and seek their help; (f) Contact the website administration to delete the information; and (g) Call the police. The player is also asked to reflect on their emotions and the potential consequences of those behaviors, choosing from pre-selected multiple-choice options to determine which strategies to adopt as victims or bystanders when coping with the situation.

Participants will receive rewards or encouragement throughout the gameplay experience. For instance, when a question is answered correctly, they should receive a response such as “Great job! Keep going!” followed by rewards or incentives. Conversely, when they answer a question incorrectly, they should receive encouraging message to try again, like “Think about it and give it another try.” Cumulative points are awarded for each correct answer to incentivize players to actively participate in the game, which will provide players with a sense of accomplishment and fulfillment. Each section of the selected game scene consists of approximately five to six interactions and lasts about 5 min.

## 2.6. Feedback

After completing the storyline, a feedback report is presented for the player’s reference. Players can replay the game unlimitedly, but only the first round of record will be synthesized for our evaluation. There is also space for users to provide their comments and contribute ideas for improving these activities. A comprehensive list of relevant websites and information sources on related legal codes and social work organizations is displayed at the end of the game.

## 2.7. Intervention procedure

A pretest (T1) was conducted with all 105 participants before the intervention. The intervention was commenced at the beginning of the fall semester. Following the collection of pretest data, 55 students in the experimental group were arranged to participate in four sessions of the online game intervention, while the control group did not receive any intervention. The experimental group accessed the GISCC program on digital platforms, such as tablets and cell phones, under the supervision of a trained research assistant. The control group did not partake in any additional activities. However, they were informed that they would have the opportunity to experience the same game after the study’s conclusion. Subsequently, the experimental group engaged in a weekly 30-minute session held in pre-scheduled classrooms during after-school hours. Each participant in the experimental group was provided with a personal login account, ID number, and password. The program tracked their in-app activity, including login time, game duration, and each player’s answers, for subsequent analysis. This encrypted procedure also helped prevent control group students from accessing the intervention. The experimental group underwent the month-long intervention from September to October 2022. After completing the intervention, all participants took the posttest (T2) using the same questionnaires as in the pretest. The response rate for the posttest was 100 %. This procedure was conducted in accordance with the ethical guidelines for human subjects research at the authors’ affiliated institution.

## 2.8. Measures

### 2.8.1. Cyberbullying

The European Cyberbullying Intervention Project Questionnaire (ECIPQ) (Del Rey et al., 2015) was used to measure participants’ cyberbullying experiences. The ECIPQ scale contains 11 items each on cyberbullying perpetration and victimization. The validated Chinese version of the scale (Zhu et al., 2022) showed good reliability in both subscales (0.935 for perpetration and 0.951 for victimization). Example questions include “I posted embarrassing videos or pictures of someone online” and “Someone posted embarrassing videos or pictures of me online.” Each item was rated on a dichotomous scale (0 = no, 1 = yes), and the frequency of each subscale was the sum of all 11 items. The Cronbach’s  $\alpha$  values of the overall ECIPQ (0.80) and victimization subscale (0.81) were good, while that for the perpetration subscale (0.60) was satisfactory.

### 2.8.2. Empathy

Participants’ empathy was assessed using the self-report Basic Empathy Scale (BES) (Sánchez-Pérez et al., 2014). The BES scale comprises 20 items for children to report the extent of their agreement towards the statement that measures cognitive and affective empathy. A forward-backward method was used by experienced bilingual social workers to translate from English to Chinese then translate back to English and compared it with the original one. Each item was measured using a five-point Likert scale (1 = “Strongly disagree” to 5 = “Strongly agree”). Scores on the empathy scale were calculated by adding all the responded items. The Cronbach’s  $\alpha$  (0.84) of the BES scale was good.

### 2.8.3. Self-efficacy

Self-efficacy was tested with the most widely used General Self-Efficacy Scale (GSE) (Luszczynska et al., 2005) containing 10 items. The validated Chinese version of the scale (Wang et al., 2001) showed good reliability (Cronbach’s  $\alpha$  = 0.87). An example question was “I am confident to handle any unforeseen situation.” Each item on this scale was scored using a four-point Likert scale (1 = not at all true, 4 = exactly true), and the total score on the scale was the sum of all 10 items. The total score ranged between 10 and 40, with higher scores indicating higher levels of self-efficacy. The overall Cronbach’s  $\alpha$  (0.89) was good.

#### 2.8.4. Violence intention

This study employed the Violence Intention Scale (Doane et al., 2014) to assess intentions of violence within the next month. The scale measures individuals' intentions to engage in both online and offline violence. An example item was "I intended to tease someone online within the next month." Each item was scored on a six-point Likert scale (0 = extremely unlikely, 1 = extremely likely), and the incidence of each subscale online and offline was the sum of all items. The overall Cronbach's  $\alpha$  (0.78), that of the online violence intention subscale (0.70), and that of the offline violence intention subscale (0.76) were satisfactory.

#### 2.8.5. Conflict resolution

The Family Conflict Resolution Scale (FCRS) (Roskos et al., 2010) was used to assess conflict resolution in the family and adapted to determine conflict resolution with friends. Each item was scored dichotomously (0 = no, 1 = yes), and the frequency of each subscale for friends and family was the sum of all 17 items separately. An example item was "We usually work it out when we have an argument." The range of total scores was 0–17 in each subscale, with higher scores indicating higher levels of conflict resolution skills. The overall Cronbach's  $\alpha$  (0.86), that of the conflict resolution with friends subscale (0.86), and that of the conflict resolution with family members subscale (0.87) were good.

#### 2.8.6. Depression, anxiety, and stress

The 21-item Chinese version of the Depression Anxiety Stress Scale (DASS-21) (Lovibond & Lovibond, 1995) was employed to assess depression, anxiety, and stress in the preceding week. Each subscale contains seven items, and each item was scored using a four-point Likert scale (1 = strongly disagree, 4 = strongly agree). The validated Chinese version of the scale (Chan et al., 2012) showed good reliability (Cronbach's  $\alpha$  = 0.80). The total score of each subscale was the sum of all items. Cronbach's  $\alpha$  for the overall DASS-21 (0.96), depression subscale (0.92), anxiety subscale (0.91), and stress subscale (0.90) were good.

### 2.9. Data analysis

To assess the effectiveness of the intervention, a pretest-posttest quasi-experimental design was adopted. First, descriptive analyses using mean and standard deviation were performed to summarize the outcome variables at both the pretest and posttest. Second, the adequacy of randomization before the intervention was examined by comparing the outcome variables between participants between

**Table 1**  
Summary statistics of outcome variables in experimental and control groups.

Variable/condition		Experimental ( <i>n</i> = 50)	Control ( <i>n</i> = 55)	Group comparison		
		<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>t</i>	<i>p</i>	<i>d</i>
Cyberbullying	Pre	0.38 (1.05)	0.47 (1.71)	0.34	0.74	0.07
	Post	0.06 (0.24)	0.29 (0.69)	2.26	0.03*	0.45
Perpetration	Pre	0.06 (0.31)	0.05 (0.40)	−0.08	0.94	0.02
	Post	0.00 (0.00)	0.04 (0.19)	1.43	0.16	0.27
Victimization	Pre	0.32 (1.02)	0.42 (1.50)	0.39	0.70	0.08
	Post	0.06 (0.24)	0.25 (0.64)	2.09	0.04*	0.40
Empathy	Pre	46.50 (7.64)	45.47 (7.43)	−0.70	0.49	0.14
	Post	47.28 (5.06)	47.87 (7.84)	0.46	0.65	0.09
Efficacy	Pre	27.18 (5.79)	28.71 (4.96)	1.46	0.15	0.28
	Post	30.42 (4.51)	28.40 (4.89)	−2.19	0.03*	0.43
Violence intention	Pre	0.82 (1.87)	0.38 (0.83)	−1.58	0.12	0.30
	Post	0.28 (0.83)	0.56 (1.57)	1.14	0.26	0.22
Offline	Pre	0.54 (1.09)	0.22 (0.63)	−1.83	0.07	0.36
	Post	0.16 (0.55)	0.35 (1.04)	1.16	0.25	0.22
Online	Pre	0.28 (1.18)	0.16 (0.54)	−0.66	0.51	0.13
	Post	0.12 (0.44)	0.22 (0.79)	0.78	0.44	0.15
Conflict resolution	Pre	20.46 (6.71)	26.56 (6.58)	4.70	0.00***	0.91
	Post	24.84 (4.07)	23.42 (5.27)	−1.54	0.13	0.30
With friends	Pre	9.62 (4.82)	14.60 (2.67)	6.46	0.00***	1.28
	Post	12.98 (1.72)	11.93 (3.18)	−2.13	0.04*	0.41
With family	Pre	10.84 (3.65)	11.96 (5.07)	1.31	0.19	0.25
	Post	11.86 (3.32)	11.49 (3.32)	−0.57	0.57	0.11
Mental illness	Pre	45.34 (12.73)	40.29 (15.08)	−1.86	0.07	0.36
	Post	33.30 (11.54)	40.04 (13.29)	2.78	0.01*	0.54
Depression	Pre	14.02 (4.54)	12.53 (5.05)	−1.59	0.12	0.31
	Post	10.22 (3.63)	12.04 (4.30)	2.33	0.02*	0.46
Anxiety	Pre	15.46 (4.54)	13.62 (5.30)	−1.90	0.06	0.37
	Post	11.56 (4.29)	13.96 (4.74)	2.72	0.01*	0.53
Stress	Pre	15.86 (4.68)	14.15 (5.30)	−1.75	0.08	0.34
	Post	11.52 (4.12)	14.04 (5.09)	2.77	0.01*	0.54

\*  $p < 0.05$ .

\*\*\*  $p < 0.001$ .

the experimental and control groups using independent sample *t*-tests. Paired samples *t*-tests were then performed to compare the pretest and posttest scores within the experimental and control groups to assess differences resulting from the intervention. To further investigate whether pretest scores affected the intervention's impact, analyses of covariance (ANCOVA and MANCOVA) of the posttest using the pretest scores as a covariate were conducted. SPSS 20.0 was used to perform all statistical analyses, and two-tailed *p*-values <0.05 were considered statistically significant.

### 3. Results

#### 3.1. Outcome variables before intervention

The pretest score results showed that no significant difference between experimental and control groups. This indicates that the pretest scores of the variables (cyberbullying, empathy, self-efficacy, violence prevention, conflict resolution with families, and mental health problems) did not significantly differ before the intervention. Only overall conflict resolution ( $t = 4.70, p < 0.001$ ) and conflict resolution with friends ( $t = 6.46, p < 0.001$ ) difference were statistically significant (see Table 1). An ANCOVA was conducted later to distinguish the differences caused by the intervention and pretest scores.

#### 3.2. Outcome variables after intervention

The post-test scores of the experimental and control groups were first tested using an independent sample *t*-test. Table 1 shows that the scores of overall cyberbullying ( $t = 2.35, p < 0.05$ ), cyberbullying victimization ( $t = 2.09, p < 0.05$ ), self-efficacy ( $t = -2.19, p < 0.05$ ), conflict resolution with friends ( $t = -2.13, p < 0.05$ ), overall mental health problems ( $t = 2.78, p < 0.05$ ), and its three subscale scores (all  $p < 0.05$ ) significantly differed between the experimental and control groups. Meanwhile, other scores were not significantly different.

#### 3.3. Effects of the GISSC Intervention

To examine the differences in post-test scores caused by the intervention, a paired sample *t*-test was first conducted. The results are reported in Table 2. In the control group, no significant change was observed in the majority of the pretest and posttest scores. Meanwhile, significant differences were observed in the majority of scores in the experimental groups, indicating that the changes were caused by the intervention and other confounding factors.

#### 3.4. Cyberbullying

The overall cyberbullying score of the experimental group decreased by 0.32 (SE = 0.16,  $t = -2.06, p < 0.05$ , 95 % CI = [-0.63, -0.01],  $d = 0.29$ ).

#### 3.5. Self-efficacy

The self-efficacy score of the experimental group increased by 3.24 (SE = 1.06,  $t = 3.07, p < 0.001$ , 95 % CI = [1.12, 5.36],  $d = 0.43$ ).

**Table 2**  
Results of paired-sample *t*-test of pretest-posttest differences in all grouped variables.

Pretest-posttest differences	Experimental					Control				
	$M_D$ (SE)	<i>t</i>	<i>p</i>	95 % CI	<i>d</i>	$M_D$ (SE)	<i>t</i>	<i>p</i>	95 % CI	<i>d</i>
Cyberbullying	-0.32 (0.16)	-2.06	0.04*	[-0.63,-0.01]	0.29	-0.18 (0.25)	-0.73	0.47	[-0.68,0.31]	0.10
Perpetration	-0.06 (0.04)	-1.35	0.18	[-0.15,0.03]	0.19	-0.02 (0.06)	-0.30	0.77	[-0.14,0.10]	0.04
Victimization	-0.26 (0.15)	-1.73	0.09	[-0.56,0.04]	0.24	-0.16 (0.22)	-0.73	0.47	[-0.61,0.28]	0.10
Empathy	0.78 (1.37)	0.57	0.57	[-1.98,3.54]	0.08	2.40 (1.31)	1.83	0.07	[-0.23,5.03]	0.25
Efficacy	3.24 (1.06)	3.07	0.00***	[1.12,5.36]	0.43	-0.31 (1.03)	-0.30	0.77	[-2.37,1.76]	0.04
Violence intention	-0.54 (0.26)	-2.07	0.04*	[-1.06,-0.02]	0.29	0.18 (0.26)	0.71	0.48	[-0.33,0.69]	0.10
Offline	-0.38 (0.15)	-2.56	0.01*	[-0.68,-0.08]	0.36	0.13 (0.17)	0.74	0.46	[-0.22,0.47]	0.10
Online	-0.16 (0.18)	-0.88	0.38	[-0.52,0.20]	0.12	0.05 (0.13)	0.41	0.68	[-0.21,0.32]	0.06
Conflict resolution	4.38 (0.92)	4.77	0.00***	[2.53,6.23]	0.67	-3.15 (1.20)	-2.61	0.01*	[-5.56,-0.73]	0.35
With friends	3.36 (0.70)	4.79	0.00***	[1.95,4.77]	0.68	-2.67 (0.60)	-4.41	0.00***	[-3.89,-1.46]	0.59
With family	1.02 (0.60)	1.69	0.10	[-0.19,2.23]	0.24	-0.47 (0.79)	-0.60	0.55	[-2.06,1.12]	0.08
Mental illness	-12.04 (2.48)	-4.86	0.00***	[-17.02,-7.06]	0.69	-0.25 (2.88)	-0.09	0.93	[-6.02,5.51]	0.01
Depression	-3.80 (0.79)	-4.83	0.00***	[-5.38,-2.22]	0.68	-0.49 (0.93)	-0.53	0.60	[-2.36,1.38]	0.07
Anxiety	-3.90 (0.93)	-4.21	0.00***	[-5.76,-2.04]	0.60	0.35 (1.01)	0.34	0.73	[-1.69,2.38]	0.05
Stress	-4.34 (0.94)	-4.60	0.00***	[-6.24,-2.44]	0.65	-0.11 (1.03)	-0.11	0.92	[-2.17,1.95]	0.01

\*  $p < 0.05$ .

\*\*\*  $p < 0.001$ .



### 3.6. Violence intention

The overall score of violence intention in the experimental group decreased by 0.54 (SE = 0.26,  $t = -2.07$ ,  $p < 0.05$ , 95 % CI = [-1.06, -0.02],  $d = 0.29$ ), and offline violence intention decreased by 0.38 (SE = 0.15,  $t = -2.56$ ,  $p < 0.05$ , 95 % CI = [-0.68, -0.08],  $d = 0.36$ ). However, online violence intention did not significantly differ.

### 3.7. Conflict resolution

The overall conflict resolution score increased by 4.38 (SE = 0.92,  $t = 4.77$ ,  $p < 0.001$ , 95 % CI = [2.53, 6.23],  $d = 0.67$ ) and the score of conflict resolution with friends increased by 3.36 (SE = 0.70,  $t = 4.79$ ,  $p < 0.001$ , 95 % CI = [1.95, 4.77],  $d = 0.68$ ). However, no significant change was observed for conflict resolution with families.

### 3.8. Mental health problems

The overall score of mental health problems in the experimental group decreased by 12.04 (SE = 2.48,  $t = -4.86$ ,  $p < 0.001$ , 95 % CI = [-17.02, -7.06],  $d = 0.69$ ). The three subscales also decreased, including depression by 3.80 (SE = 0.79,  $t = -4.83$ ,  $p < 0.001$ , 95 % CI = [-5.38, -2.22],  $d = 0.68$ ), anxiety by 3.90 (SE = 0.93,  $t = -4.21$ ,  $p < 0.001$ , 95 % CI = [-5.76, -2.04],  $d = 0.60$ ), and stress by 4.34 (SE = 0.94,  $t = -4.60$ ,  $p < 0.001$ , 95 % CI = [-6.24, -2.44],  $d = 0.65$ ). Thus, the mental health problems scores significantly decreased post-intervention.

### 3.9. Analysis of covariance controlling for pretest scores

The conflict resolution scores of the control group were significantly higher than those of the experimental group in the pretest. In contrast, no statistical difference between their scores was observed in the post-test. Significant group differences in the pretest may invalidate the posttest differences as treatment effect estimators (Van Breukelen, 2006). Thus, to further distinguish the differences caused by the intervention and pretest scores in the changes of the experimental and control groups, we conducted ANCOVA with all outcome variables and MANCOVA with all grouped variables.

Considering the limited number of cases in our sample, covariance analysis with bootstrapping was conducted to obtain a better approximation of the sampling distribution of a statistic (Erceg-Hurn & Miroseovich, 2008). This method can be used to corroborate the conclusion obtained by the classical parametric method and improve the reliability of the research conclusion. Specifically, analyses of covariance (ANCOVA and MANCOVA) with bias-corrected and accelerated bootstrapping (i.e., 1000 samples) were used to examine between-group differences in study outcomes at posttest scores while controlling for baseline scores.

As shown in Table 3, most posttest scores were statistically significant after controlling for pretest scores, including overall cyberbullying ( $F = 37.50$ ,  $p < 0.001$ ,  $\eta^2 = 0.04$ ,  $r = 0.19$ ), cyberbullying victimization ( $F = 29.58$ ,  $p < 0.001$ ,  $\eta^2 = 0.03$ ,  $r = 0.17$ ), cyberbullying perpetration ( $F = 15.66$ ,  $p < 0.001$ ,  $\eta^2 = 0.02$ ,  $r = 0.12$ ), self-efficacy ( $F = 18.26$ ,  $p < 0.001$ ,  $\eta^2 = 0.02$ ,  $r = 0.13$ ), overall violence intention ( $F = 4.95$ ,  $p < 0.05$ ,  $\eta^2 = 0.0049$ ,  $r = 0.07$ ), offline violence intention ( $F = 6.39$ ,  $p < 0.05$ ,  $\eta^2 = 0.01$ ,  $r = 0.08$ ), overall conflict resolution ( $F = 36.46$ ,  $p < 0.001$ ,  $\eta^2 = 0.04$ ,  $r = 0.19$ ) and its two subscales scores (all  $p < 0.05$ ), and overall mental health problems ( $F = 60.28$ ,  $p < 0.001$ ,  $\eta^2 = 0.06$ ,  $r = 0.24$ ) and its three subscales scores (all  $p < 0.001$ ). Thus, the interventions positively impacted the above outcome variables. The results of the covariance analysis were consistent with those presented in Table 2

**Table 3**

Results of posttest ANCOVA and MANCOVA of pretest-posttest differences in all variables.

	M (SD)		Pretest-posttest differences			
	Experimental	Control	F	p	Eta-square	r
Cyberbullying	0.07 (0.26)	0.26 (0.67)	37.50	0.00**	0.04	0.19
Perpetration	0.07 (0.25)	0.23 (0.63)	29.58	0.00**	0.03	0.17
Victimization	0.00 (0.03)	0.03 (0.18)	15.66	0.00**	0.02	0.12
Empathy	47.35 (5.08)	47.27 (7.68)	0.00	0.94	0.00	0.00
Efficacy	30.34 (4.52)	28.93 (5.18)	18.26	0.00**	0.02	0.13
Violence intention	0.30 (0.45)	0.45 (1.39)	4.95	0.03*	0.00	0.07
Offline	0.18 (0.57)	0.27 (0.99)	6.39	0.01*	0.01	0.08
Online	0.13 (0.17)	0.17 (0.69)	1.37	0.24	0.00	0.04
Conflict resolution	25.20 (3.74)	23.69 (5.08)	36.46	0.00**	0.04	0.19
With friends	12.97 (1.61)	11.85 (3.21)	27.89	0.00**	0.03	0.16
With family	12.22 (2.84)	2.84 (3.17)	0.01	0.01*	0.01	0.09
Mental illness	33.77 (11.28)	40.68 (14.48)	60.28	0.00**	0.06	0.24
Depression	13.82 (4.49)	12.51 (5.08)	14.73	0.00**	0.01	0.12
Anxiety	11.66 (4.22)	14.08 (5.07)	15.66	0.00**	0.02	0.12
Stress	11.73 (4.07)	14.28 (5.46)	59.84	0.00**	0.06	0.24

Note. Bootstrap  $n = 1000$ , experimental = 475, control = 525.

\*  $p < 0.05$ .

\*\*  $p < 0.001$ .

by the independent samples *t*-test, indicating that the intervention positively affected the experimental group. Notably, after controlling for pretest scores, the posttest scores of conflict resolution of the two groups showed statistically significant differences, which means that the GISCC intervention improved the conflict resolution abilities of participants in the experimental group.

#### 4. Discussion

The GISCC program is an innovative game-based intervention designed to prevent cyberbullying among adolescents in China. This study examines its effectiveness across multiple dimensions, including behavior and intention reduction, awareness, and skill improvement. The results suggest potential effectiveness in reducing participants' cyberbullying perpetration and victimization, as well as violence intentions. Additionally, the intervention appears to improve self-efficacy, conflict resolution skills, and mental health issues associated with cyberbullying. Overall, this evaluation offers valuable insights into the positive psychological impacts of a digital health intervention aimed at preventing cyberbullying among Chinese adolescents.

Notably, a significant reduction in self-reports for cyberbullying perpetration and victimization were observed among participants in the experimental group. Studies show that adolescents who participate in anti-cyberbullying interventions gain a better understanding of the scope of cyberbullying and such interventions may help them consciously control their aggressive behaviors (Dennehy et al., 2020; Doty et al., 2022). The presentation of legal codes at the end of the game may influence participants' appraisal of their intentions and deter aggressive conduct. In this way, the implementation of new legislation and policy is suggested to prevent criminal activities, such as cyberbullying perpetration. These efforts may help reduce not only direct cyberbullying behaviors but also encourage proactive interventions from a third-person perspective (DeSmet et al., 2018; Xue et al., 2021).

The results indicate that the GISCC program showed positive effects in enhancing self-efficacy and conflict resolution skills among participants in the experimental group, specifically in their interactions with friends. Indeed, research has shown the effectiveness of serious digital games in promoting healthy behaviors by improving self-efficacy (DeSmet et al., 2018). Digital games provide a safe and supportive virtual environment for participants to experience repeatable role-playing practice, and obtain positive feedback and supportive resources free from social pressure (Chen et al., 2023). The GISCC program intervention led to a reduction in participants' levels of stress, anxiety, and depression. Research has consistently highlighted the relationship between experiences of cyberbullying, mental health issues, and suicidal tendencies in seeking support (Gómez-Guadix et al., 2013). Digital settings are beneficial as they offer personalized experiences that enhance an individuals' sense of security and confidence in seeking support (Garaigordobil & Martínez-Valderrey, 2018; Ingram et al., 2019). As such, digital interventions impart knowledge via digitally mediated platform, which participants may find more flexible and sustainable. This approach can constantly increase students' self-efficacy and reinforce their abilities without temporal constraints (Divakar et al., 2019). Future interventions may capitalize on this promising approach to provide tailored instruction for developing cyberbullying interventions for the young generation.

Participants' offline violence intention significantly decreased after the intervention, whereas their online violence intention did not. Notably, the pretest scores of online violence intentions were very low in both the experimental and control groups. Since mobile phones are strictly regulated during school days among middle school students in China, their violent intentions may be reflected more in offline activities. Thus, limited access to cyberspace limits their recognition and understanding of online violence (Qi, 2019). Moreover, an interesting trend was observed over the intervention period: the experimental group's online violent intention scores decreased, while those in the control group increased. The timing of the measurement could play a role if an event that promotes violent behavior occurred during the measurement period. This might have particularly affected the control group if they lacked the coping strategies provided by the intervention. To some extent, this may demonstrate the effectiveness of the GISCC program in inhabiting online violent intentions. Research investigating the link between negative emotions and violent behaviors suggest that impulsive intentions can be reduced through emotion regulation training (Smeijers et al., 2020). The multiple-choice sections in the GISCC program, which include selecting emotional responses to conflict situations, may help participants differentiate between violent and positive intentions and understand the negative consequences of violent intentions better (Wong et al., 2020). These elements could be crucial in future programs designed to recognize violent intentions in bullying and cyberbullying contexts. Future research should explore the intervention's impact on this component by involving more high-risk adolescents who exhibit higher levels of violent intentions to enhance the effectiveness of the GISCC intervention in this regard.

Finally, there were no significant differences in the scores for empathy and conflict resolution within the family context. Contrary to prior research that has focused on empathy training (Del Rey et al., 2016; DeSmet et al., 2018), the GISCC intervention focused on enhancing awareness and coping strategies towards cyberbullying. Researchers have investigated the effects of empathy training on public humiliation and empathy towards victims of malice and reported significant improvements in these areas (Doane et al., 2016). Although our intervention activities highlighted the serious consequences of cyberbullying, we did not provide specific empathy training. Such training could be integrated into the current narrative, perhaps by including group processes to defend bystanders through role-playing or live practices. The GISCC intervention is mainly designed in scenarios of conflicts with peers, while parents are only influenced as supporters in the storyline. A recent meta-analysis provided evidence that parenting style, children's empathy, and parent-child interaction effectively reduce bullying among children and adolescents (Chen et al., 2022), while parental involvement in cyberbullying prevention is quite limited. Future researchers should explore the role of school-family cooperation in reducing cyberbullying via digital health interventions.

This study has some limitations. First, given the self-report nature of the study and the limited sample size, the findings should be interpreted with caution when applied to real-life cyberbullying situations. Second, this study conducted only a post-test immediately after the intervention without any follow-up assessment, preventing further comparisons. Research shows that repeated exposure to provided information and follow-up instructions can enhance the effectiveness of preventive measures (Doty et al., 2022). Therefore,



the durability of the game-based intervention effects warrants further investigation through time-series or booster evaluations to assess long-term impacts. Third, due to pandemic-related restrictions, this pilot intervention was brief, lasting only one month and had a narrow scope of individualized testing, which may limit its effective application across a broader spectrum of public health challenges. Future studies should explore the optimal conditions for further evaluations of the GISCC by conducting a larger-scale study in China. This would determine whether student populations that received the intervention experience decreased rates of cyberbullying and victimization compared to a control population that does not receive the GISCC. Digital intervention has been shown to be comprehensive yet cost-effective (Nocentini & Menesini, 2016) that have the potential to include multifaceted elements, such as incorporating the informants of school, parents, and peers, to facilitate service delivery and develop a school-wide implementation strategy. Fourth, the effects of the GISCC intervention were not compared to those of traditional face-to-face intervention in the pretest and tailored posttest processes. Future studies may consider involving concurrent evaluations to compare the outcomes of face-to-face and digital interventions on bullying and cyberbullying, thus providing a more integrated assessment of these approaches.

Overall, the GISCC program has shown promise as a game-based intervention by encouraging proactive user engagement in scenarios, attaining relevant knowledge, and teaching effective coping strategies to mitigate cyberbullying. Our findings carry implications for future research and practice applications, particularly in analyzing key components of cyberbullying prevention among Chinese adolescents. Given the high prevalence of offline victimization and its overlap with online victimization, future studies should broaden the scope of the intervention to encompass school and community environments targeting these issues. This may involve simulating common situations found in classrooms, playgrounds, streets, and Internet cafés to heighten adolescents' awareness of different types of violence and to bolster their strategic responses to potential threats (DeSmet et al., 2018). Chinese teachers and parents often prioritize academic success, which might cause reluctance to confront interpersonal conflicts (Wu et al., 2019). Furthermore, the "halo effect" of high-achieving students may also lead adults to disregard their involvement in cyberbullying even as perpetrators. Therefore, future studies should investigate digital approaches to increase teachers' and parents' awareness of effective cyberbullying interventions, such as the use of interactive platforms through digital apps for school-family collaboration, improving supportive parenting skills and provide timely help to victims. To enhance intervention and response capabilities, we suggest incorporating the GISCC program into comprehensive school initiatives, including themed class meetings, public education presentations, and the distribution of anti-bullying guides in schools and communities to foster a supportive culture for cyberbullying prevention.

#### CRedit authorship contribution statement

**Qiqi Chen:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Zujian Lu:** Writing – review & editing, Methodology. **Bofan Liu:** Writing – review & editing, Project administration. **Qiao Xiao:** Writing – review & editing. **Ko Ling Chan:** Writing – review & editing, Supervision, Conceptualization.

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#### Declaration of competing interest

The authors declare no conflict of interest.

#### Data availability

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

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