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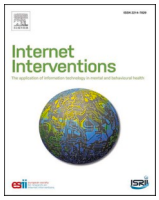

A chatbot-delivered intervention for optimizing social media use and reducing perceived isolation among rural-living LGBTQ+ youth: Development, acceptability, usability, satisfaction, and utility

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ABSTRACT

Background: Lesbian, gay, bisexual, transgender, and queer/questioning (LGBTQ+) youth are at higher risk of isolation and depression than their heterosexual peers. Having access to tailored mental health resources is a documented concern for rural living LGBTQ+ youth. Social media provides access to connections to a broader and like-minded community of peers, but it also is a vehicle for negative interactions. We developed REALbot, an automated, social media–based educational intervention to improve social media efficacy, reduce perceived isolation, and bolster connections for rural living LGBTQ+ youth. This report presents data on the acceptability, feasibility, and utility of REALbot among its target audience of rural living LGBTQ+ youth.

Methods: We conducted a week-long exploratory study with a single non-comparison group of 20 rural-living LGBTQ+ youth aged 14–19 recruited from social media to test our Facebook- and Instagram-delivered chatbot. We assessed pre- and post-test scores of social media self-efficacy, social isolation (4-item Patient-Reported Outcomes Measurement System – PROMIS), and depressive symptoms (Patient Health Questionnaire, Adolescent Version – PHQ-A). At post-test, we assessed acceptability (User Experience Questionnaire – UEQ—S), usability (Chatbot Usability Questionnaire –CUQ and Post-Study Satisfaction and Usability Questionnaire –PSSUQ), and satisfaction with the chatbot (Client Satisfaction Questionnaire – CSQ), along with two open-ended questions on 'likes' and 'dislikes' about the intervention. We compared pre- and post-test scores with standard univariate statistics. Means and standard deviations were calculated for usability, acceptability, and satisfaction. To analyze the responses to post-test open-end questions, we used a content analysis approach.

Results: Acceptability of REALbot was high with UEQ-S 5.3 out of 7 (SD = 1.1) and received high usability scores with CUQ and PSSUQ (mean score (M) = 78.0, SD = 14.5 and M = 86.9, SD = 25.2, respectively), as well as high user satisfaction with CSQ (M = 24.9, SD = 5.4). Themes related to user 'likes' and 'dislikes' were organized in two main categories: usability and content provided. Participants were engaged with the chatbot, sending an average of 49.3 messages (SD = 43.6, median = 30). Pre-/post- changes in scores of perceived isolation, depressive symptoms and social media self-efficacy were not significant (p's > 0.08).

Conclusion: REALbot deployment was found to be feasible and acceptable, with good usability and user satisfaction scores. Participants reported changes from pre- to post-test in most outcomes of interest and effect sizes were small to medium. Additional development and a formal evaluation of feasibility and engagement with behavioral targets is warranted.

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1. Introduction

Perceived isolation is an unsatisfactory quantity or quality of social relations with others at interpersonal, group, or community levels (Zavaleta et al., 2014), and it is a risk factor for depression, while community connectedness via family and school are protective (DiFulvio, 2011; Ge et al., 2017; Holt-Lunstad, 2020; Meyer, 2007; Paceley, 2016; Paceley et al., 2017). Lesbian, gay, bisexual, transgender, and queer/questioning (LGBTQ+) youth are at 2–3 times higher risk of reporting perceived isolation and depression than their heterosexual peers (King et al., 2008; Marshal et al., 2011; Medley et al., 2017), with LGBTQ+ youth living in rural areas at still higher risk than those living in urban areas (Cain et al., 2017; Horvath et al., 2014; Lyons et al., 2015). Indeed, rural communities that value familiarity and sameness may lack diversity and social support for LGBTQ+ youth living there, thus increasing risk for depression and perceived isolation (DiFulvio, 2011; Paceley, 2016).

Reducing isolation and increasing access to LGBTQ-specific mental health resources are needs well documented among rural living LGBTQ+ youth (Steinke et al., 2017). To fill these needs, rural living LGBTQ+ youth often turn to social media to meet others going through similar experiences, connect to a community, or seek information and social support perceived as unavailable in rural areas (Paceley et al., 2019, 2022). Unfortunately, social media can also be a vehicle for rejection, discrimination, and other negative experiences, potentially increasing perceived isolation and depression risk among these youth (Kim et al., 2018; Webb et al., 2021).

Social media self-efficacy refers to a person's perceived ability to reach desired outcomes in their social media interactions (i.e., skills in curating a positive and supportive online environment) (Hocevar et al., 2014). Education to promote social media self-efficacy may improve social media interactions (Haraldstad et al., 2019) and reduce perceived isolation among youth. Social media experiences of rural living LGBTQ+ youth could benefit from educational interventions that reduce the risk of negative interactions and mental health outcomes (Paceley et al., 2019, 2022). Despite the limitations of the empirical evidence (i.e., focus on screen time, reliance on self-report and lack of data-intensive longitudinal studies focused on impact of social media interactions on mental well-being), initial recommendations to improve social media experiences have been developed with a focus on several personal behaviors that could help users improve their social media interactions (Primack et al., 2018). Furthermore, digital health interventions (e.g., delivered via web, social media, mobile apps, conversational agents) could be a suitable conduit to deliver this educational content, given their wide acceptability to LGBTQ+ persons (Gilbey et al., 2020). Unfortunately, said interventions are few (Escobar-Viera et al., 2021), and to the best of our knowledge, just one has been developed with substantial input from rural living LGBTQ+ youth (Fish et al., 2021). Additionally, the COVID-19 pandemic has highlighted difficulties for mental health services to keep up with an ever-increasing demand and for LGBTQ+ youth to maintain mental well-being while isolated with unsupportive families (Fish et al., 2020).

To help address this gap, we now report the development and deployment of an automated, social media–based educational intervention called REALbot. Specifically, we evaluated the REALbot's acceptability, feasibility, and utility for increasing social media self-efficacy and reducing perceived isolation among rural living LGBTQ+ youth.

2. Methods

2.1. Study design and recruitment

We conducted a one-week exploratory pilot study using a single group, pretest-posttest design to evaluate REALbot, a chatbot intended to deliver an educational program to increase social media self-efficacy and reduce perceived isolation among rural living LGBTQ+ youth. Fig. 1 provides an overview of the study flow. Between November 2021 and February 2022, we recruited participants via social media ads placed on Instagram and Facebook using the software platforms' ad creation feature and made them viewable only in rural zip codes within the United States as classified by the Health Resources Service Administration (https://www.hrsa.gov/rural-health/about-us/what-is-rural/data-files). Youth who were interested tapped on a link in the ads that redirected them to a study website and eligibility screening survey. Youth were eligible to participate if they were 14–19 years of age, identified as LGBTQ+, lived in a rural area, had access to Facebook Messenger web-based or mobile app, and screened positive (score of 16 or more out of 20) for social isolation on the 4-item PROMIS Social Isolation Scale (Patient-Reported Outcomes Measurement Information System, 2015). To protect the privacy of youth under 18 years of age from being accidentally outed to their parents/guardians, we obtained a waiver of parental consent. Eligible youth were then shown informed assent/consent forms and those who consented were asked to provide their contact information.

2.2. Ethics approval

All recruitment and study procedures were approved by the Internal Review Board at the University of Pittsburgh (STUDY19070379).

2.3. Program development

REALbot is a rule chatbot deployed on the Facebook Messenger app and on a social media profile on Instagram to deliver educational content. To inform development, we conducted an intensive and iterative formative research process to learn about youth preferences toward intervention content and favored technology delivery modality. In the spring of 2020 (in coincidence with the initial stages of the COVID-19 lockdown in the U.S.), we conducted a series of online interviews with rural living LGTBQ+ adolescents aged 14–19 years to inquire what they would like to be included in an intervention focused on improving social media use and reducing isolation. Our findings have been published elsewhere (Escobar-Viera et al., 2022) and included elements like seeing a positive representation of LGBTQ+ people and learning from people with shared experiences. Participants also wanted to learn about social media platform features to help them select different audiences to connect with and make their social media experience safer. Additionally, we found that youth preferred using LGBTQ-specific groups on existing social media platforms where they already have accounts, but their personal information was not as publicly accessible (Karim et al., 2022).

Based on prior research (Primack et al., 2018) and our own formative work (Escobar-Viera et al., 2022; Karim et al., 2022), we decided to develop content related to four areas of social media interactions. These included (1) avoiding negative content and interactions, (2) keeping a balance between engaging more passively (i.e., scrolling) and more actively (i.e., commenting on other people's content), (3) connecting with actual allies or people with a potential of becoming in-person friends, and (4) limiting time, frequency of checks, and number of social media platforms to those that are more personally significant to the individual and bring them more enjoyment. We chose to focus on these because the state of the evidence on social media use and mental health specifically pointed at reducing the likelihood of negative interactions, which might explain depressive symptoms among LGBTQ+ people who are social media users (Escobar-Viera et al., 2020).

To deliver the program content, we decided to have REALbot deployed on Facebook Messenger app and a social media profile on Instagram. We chose this combination because our formative work indicated that rural living LGBTQ+ youth preferred a combination of delivery modalities for accessing intervention (Escobar-Viera et al., 2022). Chatbots are convenient artificial intelligence–operated

conversational agents; they can be deployed within a social media site, do not require user download, and do not take up space in a user's device. Chatbots provide real-time personalized health promotion, prevention, and screening (Aggarwal et al., 2023; Laranjo et al., 2018). In addition to providing ongoing monitoring and fast access to information and support tools, chatbots have demonstrated acceptability for mental health interventions, especially for hard-to-reach populations such as rural living LGBTQ+ people (He et al., 2022; Vaidyam et al., 2019). We chose Instagram because it is quite popular app among youth (Vogels et al., 2022) and Facebook Messenger because it provides an easy path to deploy chatbots and because, given that it serves users of both Instagram and Facebook, participants did not need to create new accounts or leave the environment of the social media apps they use to interact with the chatbot.

2.4. REALbot: development and content

For developing and designing the content, we conducted two human centered design (HCD) (Lyon et al., 2019, 2020) sessions with 20 youth of lived experience in the winter of 2021. Fig. 2 provides an overview of REALbot's infrastructure and functions. HCD sessions were conducted online with one participant at a time. Along with two research assistants, we developed a series of infographics, animated short videos, and short text stories with alternate endings to cover each of the four main topics (i.e., avoiding negative content and interactions, keeping a balanced engagement, connecting with actual allies, and limiting use), as well as design and color options. HCD sessions were then used to share text, design, and color palette ideas with participants and get their feedback, as well as suggestions for other topics that should be covered.

Next, we used a private hosting service to create the code for all interactions that would occur between the chatbot and the user. Chat interactions followed a classic unidirectional "tree" structure and text for these was stored in a collaborative text document platform (i.e., Google Docs). Fig. 3 provides screenshots of interactions between the user and the chatbot. Once REALbot was deployed on Facebook Messenger, it included four educational modules called Reneging negativity, Engaging with balance, Connecting with real allies, and Limiting use. Each module covered one of the target social media behaviors and interactions we selected, and it comprised a set of infographics, an animated video, and a story with alternate endings depending on the user's choice. Content for each of these included providing a definition of the topic the module would cover, examples of negative and positive interactions, practical suggestions to avoid negative interactions and increase likelihood of positive ones, and testimonies and suggestions from other rural living LGBTQ+ youth. Infographics, videos, and stories with alternate endings were hosted in Amazon Web Services, YouTube, and a private server, respectively. Finally, when users entered their zip code, REALbot provided a list of resources including contact information of community based organizations for LGBTQ+ rural youth at their local and state level. Fig. 4 provides examples of infographics included in REALbot.

2.5. Assessment measures

Demographic characteristics were assessed at baseline, including date of birth, gender identity ("do you consider yourself transgender" with options 'yes', 'no', and 'don't know/not sure'), gender assigned at birth ("what gender were you assigned at birth" with options 'female', 'male', and 'not sure/I don't know'), sexual orientation ("which of the following best describes you" with options 'gay or lesbian', 'bisexual', 'not sure', 'straight'), race and ethnicity ("which of the following describes your race/ethnicity (please check all that apply)" with the options 'Hispanic or Latino', 'White or Caucasian', 'Black/African-American', 'Asian/Asian American', 'Native Hawaiian/Other Pacific Islander', 'Middle Eastern/North African', 'other'), education status (7th' 8th, 9th, 10th, 11th, 12th, and college), employment status ('employed for wages', 'a student', 'other'), relationship status ('single', 'member of an unmarried couple', 'in a polyamorous relationship with more than one person'), person(s) currently living with ('parent/guardian', 'by myself', 'significant other', 'friends', 'acquaintances', 'other'), current state of residence, and zip code.

Acceptability, usability, and satisfaction were assessed at the end of the 7-day pilot, with the post-test survey. These included *(1) Usability*, with the Chatbot Usability Questionnaire –CUQ (Holmes et al., 2019; Larbi et al., 2022) and the Post-Study Satisfaction and Usability Questionnaire –PSSUQ (Lewis, 1992). CUQ comprises 20 statements (e.g., "The chatbot explained its scope and purpose well") rated on a 5-point Likert scale: (1) Strongly disagree to (5) Strongly agree. PSSUQ consists of 16 statements (e.g., "It was easy to learn to use this system") with choices ranging from (1) Strongly disagree to (7) Strongly agree. *(2) Acceptability*, with short version of the User Experience Questionnaire –UEQ-S (Laugwitz et al., 2008; Schrepp et al., 2017). Items comprise eight domains (obstructive/supportive, complicated/easy, inefficient/efficient, confusing/clear, boring/exciting, not interesting/interesting, conventional/inventive, usual/leading edge), each rated on a 1 to 7 Likert scale, with higher scores indicating better acceptability. We also included two open ended questions that asked, "Tell us the things you did like about REALbot" and "Tell us what you did not like about REALbot and would like to see improved." *(3) Satisfaction*, with the Client Satisfaction Questionnaire –CSQ-8 (Larsen et al., 1979), which included eight items (e.g., "I am satisfied with the amount of help I received through the chatbot") rated from (1) Strongly disagree to (4) Strongly agree. For all scales, higher scores indicated better outcomes. Finally, 'frequency' of use had a range of 0 to 7 for each single calendar day of use, and 'time' of use was

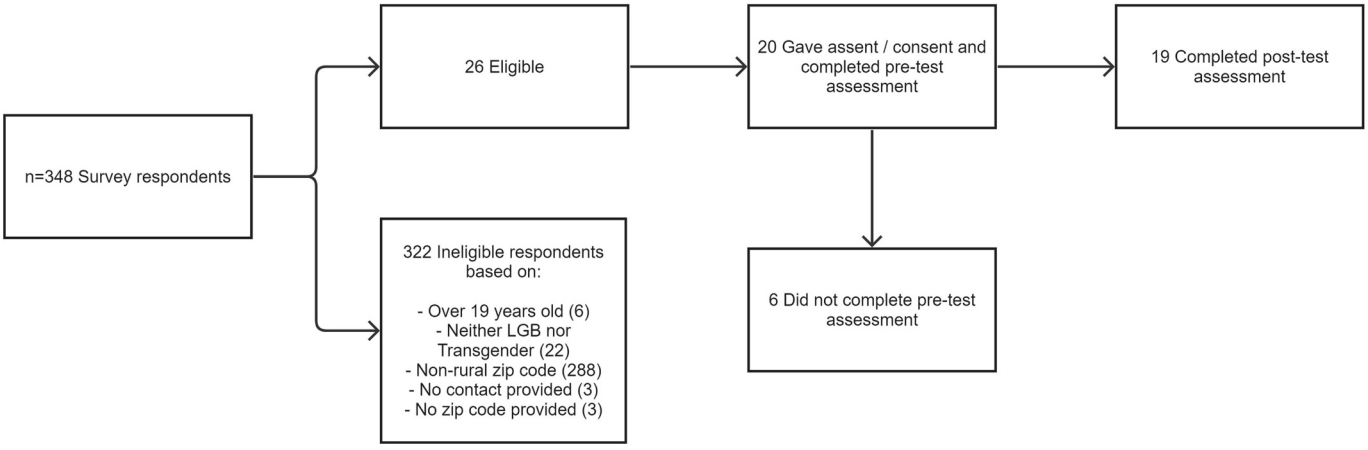


Fig. 1. Study Participatns Flowchart

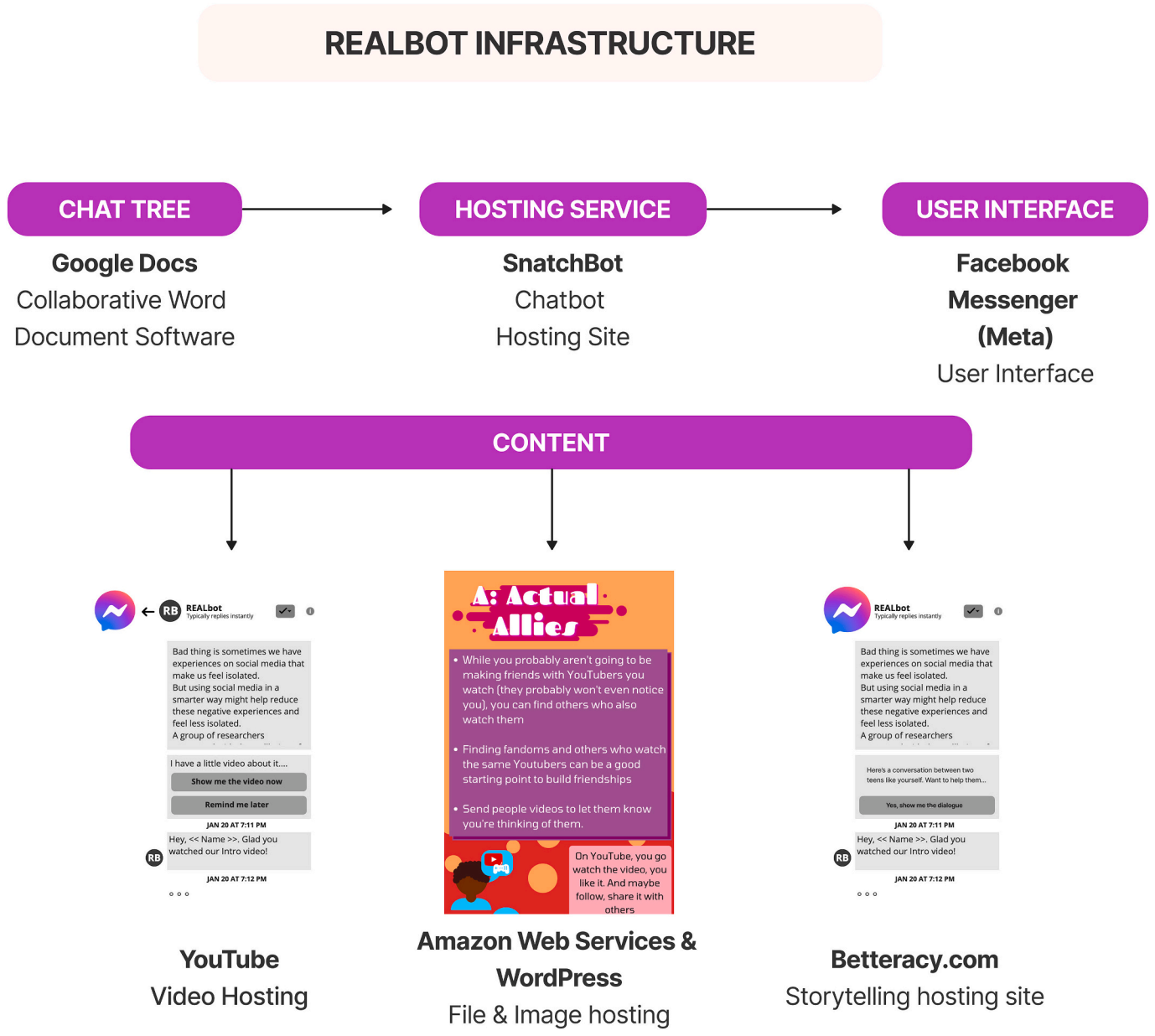


Fig. 2. Infrastructure of the 'REALbot' chatbot

calculated by subtracting the time of the first message sent by the user in a single day from the time of the last message sent by the user.

Social media self-efficacy and perceived isolation were assessed at both pre- and post-test surveys and included: (1) social media self-efficacy with two items asking about perceived overall social media skills and perceived ability to find content on social media (Hocevar et al., 2014), (2) perceived isolation with the 8-item PROMIS Social Isolation Scale (Patient-Reported Outcomes Measurement Information System, 2015), and (3) depressive symptoms using the eight-item Patient Health Questionnaire adapted for adolescents (PHQ-A), a self-reported measure of depressive symptoms (Johnson et al., 2002; Kroenke et al., 2009).

2.6. Study procedures and participants

A study staff contacted assenting/consenting youth using their preferred method (i.e., text message, phone call, or email) to describe the study, asked them to use REALbot at will over a period of seven days and fill two surveys, one before using the chatbot and one after. Then, we sent (1) link to a pre-test survey and (2) instructions for initiating an interaction with the chatbot on Facebook Messenger. During day seven, we sent the link to the post-test survey to each participant; we sent a single reminder 24 h later to those participants who did not fill the post-test survey. Participants were asked to provide ongoing assent/consent before completing both the pre- and post-test questionnaires. Participants who completed the pre- and post-surveys were compensated for their time.

2.7. Data analysis

We compared pre- and post-test scores of social isolation, self-reported depression, and social media skills with standard univariate statistics (matched-pairs t-test or Wilcoxon signed-rank test when data failed the Shapiro-Wilk normality test). Tests of significance were two-tailed with $\alpha = 0.05$. Given the exploratory nature of the analysis, we did not adjust for multiple tests. We report effect sizes (Cohen's *d*) in addition to statistical significance. Means and standard deviations were calculated for usability, acceptability, and satisfaction with REALbot after the intervention. Pearson's correlation coefficient was calculated

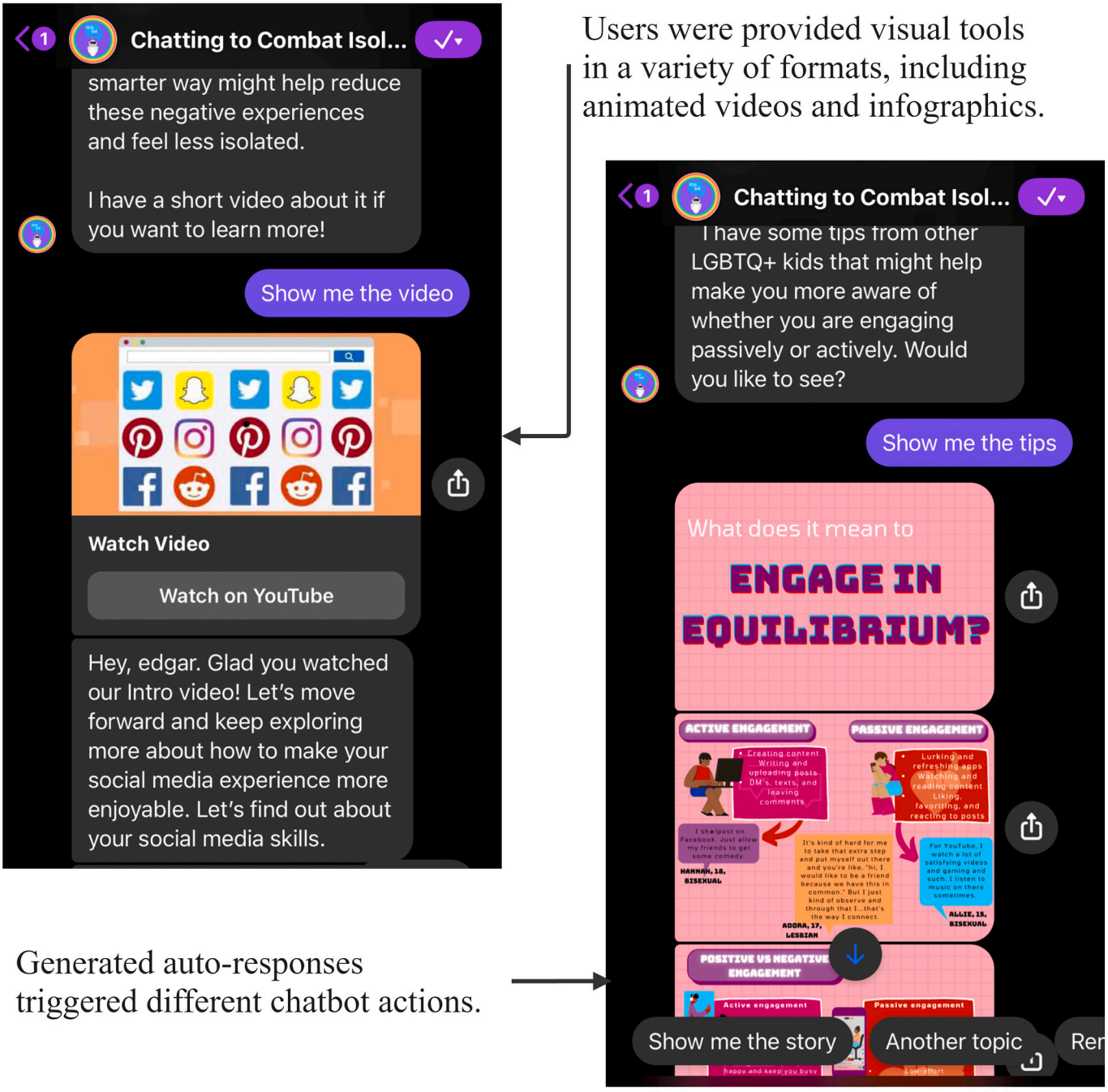


Fig. 3. Examples of interactions between the user and the 'REALbot' chatbot

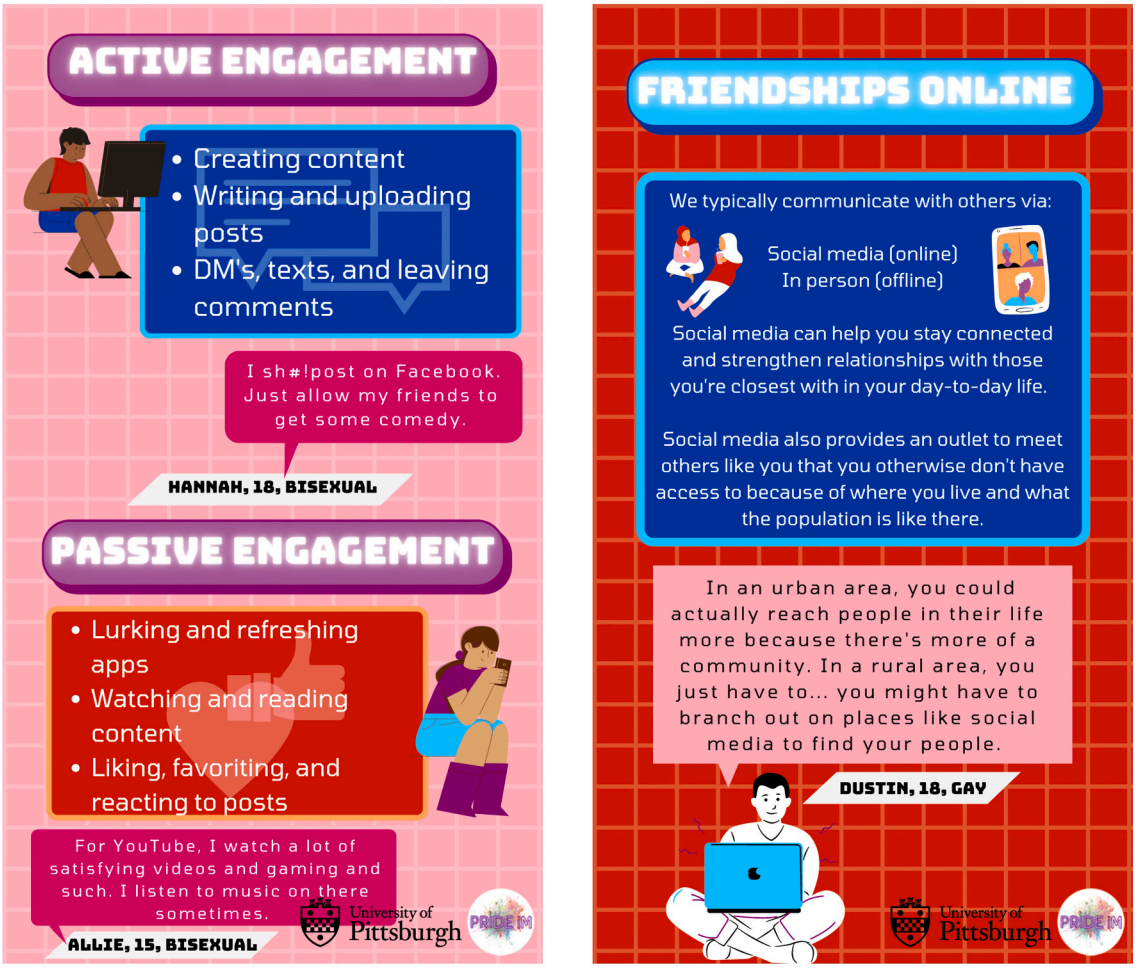
for the relationship between time spent on REALbot and change in scores pre/post intervention.

To analyze the responses to post-test open-end questions, we used a content analysis approach (Hsieh and Shannon, 2005). We categorized feedback (both likes and dislikes) according to whether it related to chatbot usability or content provided. Usability pertained to comments related to user's interface, perceptions on the responsiveness of the system, and efficiency of the functions. Content provided comprised aspects on whether the chatbot offered relevant and interesting content related to social media and perceived isolation. Two co-authors coded an initial set of five responses, compared their initial codes, and resolved disagreements. Inter-rater reliability was excellent (k = 0.80) (Landis and Koch, 1977). After an agreement was reached, they coded independently the remaining responses. Next, we reviewed coded excerpts and after triangulating with the other co-authors, we identified and described emerging themes.

3. Results

3.1. Participant characteristics

As shown in Table 1, 20 adolescents ages 14–20 years old who lived across the United States participated in the study. Half identified as transgender and 35 % as cisgender gay/lesbian. They were mostly white (75 %), lived with a parent or guardian (90 %), and were still in high school (80 %).



Mobile-formatted infographics could be downloaded or screenshot for later reference.

Fig. 4.. Examples of infographics that users were able to download from the 'REALbot' chatbot

3.2. Acceptability and usability of REALbot

The chatbot received high user satisfaction with CSQ (M = 24.9, SD = 5.4). As can be seen in Table 2, across all domains, participants rated the acceptability of REALbot 5.3 out of 7 (SD = 1.1) using the UEQ-S. Scores on each domain ranged from an average of 4.6 (SD = 1.6) to 6.0 (SD = 1.3). While only 25 % of participants described the chatbot as exciting or leading edge (score of 6 or 7 out of 7), 40 % to 75 % of participants gave higher scores (6 or 7) to the other domains. Eight participants (42 %) interacted with REALbot for two or more days. They spent an average of 35.6 min on the chatbot (standard deviation [SD] = 59.2, median = 15), range 1.4 min to 4 h and 21 min. They received an average of 62.6 messages from REALbot (SD = 57.5, median = 39, range 8 to 202) and they sent an average of 49.3 messages to the chatbot (SD = 43.6, median = 30, range 6 to 162). REALbot received high usability scores on both the CUQ (mean score (M) = 78.0, SD = 14.5) and PSSUQ (M = 86.9, SD = 25.2).

3.3. Qualitative user feedback

A total of eight themes emerged. Four were related to usability and four themes were about content provided by the chatbot. Below, we provide details of each theme, their frequency (in brackets), and example quotes.

3.3.1. User 'likes'

Related to usability, two main themes emerged. *(1) Pleasant chatbot design and interactions [8/19]*. In general, participants thought that REALbot had an attractive design for teens. For example, one participant (15 years old, male, AMAB, bisexual) liked that the chatbot was specifically "designed for rural queer teens like me, and even gives you state-specific resources." Youth thought the chatbot was respectful during chat interactions; another participant (15 years old, male, AMAB, bisexual) particularly liked "how the chatbot asked me for my name instead of reading it off my Facebook because I have to use my dead name on Facebook, so it was nice having the bot ask me what my name was and continue to use my chosen name throughout the interactions". A third participant (18 years old, transgender, AMAB, gay or lesbian) mentioned that the chatbot was welcoming during the chat but also quick to respond with very little lag time. *(2) Ease of use and interesting features [11/19]*. Participants concurred that it was easy to access and start using the chatbot. One participant (19 years old, transgender, AFAB, bisexual) liked that REALbot did not require installing any additional app and it was easy to start interacting with, and they "also like[d] that once you chose an option to get information about, it spaced out each text or image a bit, instead of sending everything at once."

Table 1
Participants demographic characteristics.

Category	Description	Participants ($n = 20$)
Age	Mean years (SD)	16.6 (1.5)
Sex at birth	Male	7 (35 %)
	Female	13 (65 %)
Gender identity	Transgender	10 (50 %)
	Non-Transgender	8 (40 %)
	Don't know/not sure	2 (10 %)
Sexual orientation	Bisexual	11 (55 %)
	Gay/lesbian	7 (35 %)
	Not Sure	2 (10 %)
Race/ethnicity	White	15 (75 %)
	Black/African American	2 (10 %)
	Asian/Asian American	1 (5 %)
	Hispanic/Latino	1 (5 %)
	Middle Eastern/North African	1 (5 %)
Educational level	Jr. High School (7th–8th grade)	2 (10 %)
	High School (9th–12th grade)	16 (80 %)
	Some College/Tech School	2 (10 %)
Employment	Student	16 (84.2 %)
	Unemployed	2 (10.5 %)
	Employed for wages	1 (5.3 %)
Living situation	With Parent/Guardian	18 (90 %)
	With Friends	1 (5 %)
	Other	1 (5 %)
Relationship status	Single	16 (80 %)
	Member of unmarried couple	3 (15 %)
	In polyamorous relationship	1 (5 %)

Regarding content provided, themes included *(3) Interesting range to topics covered [12/19]*. Youth thought that the chatbot offered content in a variety of topics and these were interesting and important. For example, one participant (16 years old, male, AMAB, gay) liked that "REALbot did provide very good advice on how to deal with problems surrounding sexuality and components of social life" and another participant (15 years old, not sure if transgender, AMAB, bisexual) thought "it was very informative and helpful when it came to advice looking for resources in my area and advice about social interactions." *(4) Comprehensiveness of information provided [7/19]*. Participants mentioned that REALbot offered a good number of references and sources of information, such as links to videos; one participant said that they "liked the way that the chatbot explained things, it was easy to comprehend, and having videos and pictures in it will surely help others with engagement."

3.3.2. User 'dislikes'

The main challenges related to usability centered around *(5) Chatbot felt robotic and not smart enough [12/19]*. Youth coalesced around the idea that even though REALbot was friendly during the interactions, it still seemed robotic and limited in its ability to remember and use information that was already entered by the user and making it part of a cohesive conversation throughout successive interactions. One participant (15 years old, transgender, AFAB, bisexual) thought it was tedious to have to re-enter their information for every interaction. Another participant expressed frustration because "you have to completely restart the conversation each day you talk with the bot— it does not remember past information like name/age" (17 years old, female, AFAB, not sure of sexual orientation). *(6) Limited number of platforms where chatbot is available [5/19]*. Several youths mentioned that the bot should be available more widely, in several platforms, to boost opportunities of interactions with the user. "You could continue to have this on Facebook messenger but could also have it on Instagram for example" (14 years old, transgender, AFAB, bisexual).

Related to the content provided, two themes emerged. *(7) Insufficient content on social media interactions and ways of delivering said content [6/19]*. While participants thought the content related to being mindful of negativity on social media and focusing on connecting with real allies was important, some youth disliked the lack of more practical, directive instructions on "how much time to spend on social media or how to stay away from it" (17 years old, transgender, AFAB, bisexual) and others wanted more in-depth discussion and conversation about the topic. Participants also wanted content to be delivered using voiceover for the infographics and the text that appeared on videos. One participant mentioned that voiceover will help the user concentrate more on the content. *(8) Lack of content on other topics important to LGBTQ+ youth [9/19]*. Some participants felt bored with the focus on only social media interactions at the expense of other topics that are important to rural living LGBTQ+ youth, such as how to develop healthy relationships with friends and romantic partners, as well as how to cope with discrimination, and "advice on how to come out and how to deal with homophobic family members and friends".

3.4. Pre – post evaluation of the chatbot

Pre- and post-intervention scores for social isolation, self-reported depression and social media skills are displayed in Table 3. Participants reported non-significant changes in scores of perceived isolation ($p = 0.44$, d = − 0.36), depressive symptoms ($p = 0.08$, d = − 0.36), and social media self-efficacy (overall, $p = 0.17$, d = 0.18; ability to find content, $p = 0.002$, d = 0.77). Small non-significant correlations were found between social isolation ($r = -0.27$, $p = 0.27$), self-reported depression ($r = -0.33$, $p = 0.19$), overall social media skills ($r = 0.23$, $p = 0.38$) and time spent on REALbot. While not statistically significant, change in scores were in the expected direction (i.e., the more engaged with REALbot the better social media skills users reported, and the less social isolation and depression). The correlation between ability to find

Table 3
Pre/post intervention scores.

Outcomes	Pre	Post	Test	df	P	d
Social Isolation M(SD)	30.2 (7.5)	28.8 (9.3)	z = 0.77	–	0.44	−0.36
Patient Health Questionnaire M(SD)	14.3 (5.3)	11.6 (7.1)	t = 1.88	18	0.08	−0.36
Social Media Self-efficacy M(SD)						
Overall skills	5.6 (2.2)	6.2 (2.4)	t = −1.44	16	0.17	0.18
Ability to find content on social media	5.3 (2.3)	6.9 (1.7)	t = −3.77	16	0.002	0.77

Table 2
Post-intervention assessment of the acceptability of REALbot.

REALbot is	1	2	3	4	5	6	7	M (SD)
Obstructive/supportive	1 (5 %)	0 (0 %)	0 (0 %)	2 (10 %)	5 (25 %)	8 (40 %)	4 (20 %)	5.5 (1.4)
Complicated/easy	1 (5 %)	0 (0 %)	1 (5 %)	2 (10 %)	1 (5 %)	6 (30 %)	9 (45 %)	5.8 (1.6)
Inefficient/efficient	2 (10 %)	0 (0 %)	0 (0 %)	3 (15 %)	3 (15 %)	3 (15 %)	9 (45 %)	5.5 (1.9)
Confusing/clear	0 (0 %)	0 (0 %)	2 (10 %)	1 (5 %)	2 (10 %)	6 (30 %)	9 (45 %)	6.0 (1.3)
Boring/exciting	0 (0 %)	0 (0 %)	2 (10 %)	4 (20 %)	7 (35 %)	4 (20 %)	1 (5 %)	4.6 (1.4)
Not interesting/interesting	0 (0 %)	0 (0 %)	3 (15 %)	2 (10 %)	6 (30 %)	4 (20 %)	4 (40 %)	5.1 (1.5)
Conventional/inventive	2 (10 %)	0 (0 %)	0 (0 %)	3 (15 %)	5 (25 %)	4 (20 %)	6 (30 %)	5.3 (1.8)
usual/leading edge	2 (10 %)	0 (0 %)	2 (10 %)	3 (15 %)	8 (40 %)	4(20 %)	1 (5 %)	4.6 (1.6)

content on social media and time was negligible ($r = 0.02$, $p = 0.94$).

4. Discussion

4.1. Summary of evidence

Rural living LGBTQ+ youth are at compound risk for perceived isolation, depression, and other mental health concerns (Holt-Lunstad, 2020; Monteith et al., 2021). This study detailed the development and evaluation of a social media–based, chatbot-delivered educational intervention for optimizing social media experiences and reducing perceived isolation among rural living LGBTQ+ youth. Our findings suggest that REALbot deployment is feasible, the chatbot is acceptable among youth, and participants who interacted with it reported higher scores at follow-up (compared to baseline) in social media self-efficacy. Importantly, qualitative participants' feedback provides a roadmap for necessary improvements related to both usability and desired content that LGBTQ+ teens consider important for their lives and mental well-being.

In terms of engagement, participants received an average of 62 messages from REALbot and sent an average of 49 messages to the chatbot. Recent studies of digital mental health interventions delivered via chatbots reported lower user response to the chatbot, from an average of 17 responses of 46 days of interaction among youth with depression (Dosovitsky et al., 2020) to 116 messages over an 8-week long study with a chatbot for anxiety and depression among college students (Klos et al., 2021). While our study was only 7-day long and we had no comparison group, the level of participant interaction with REALbot was encouraging and it echoes findings from qualitative research that rural living LGBTQ+ youth have an urgent need for LGBTQ+ specific resources (Steinke et al., 2017) for reducing perceived isolation (Paceley et al., 2019).

Forty-two percent of participants engaged with REALbot two or more days during our one-week exploratory study. However, given the limited content that our chatbot covered for this study, it is likely that the average 35 min of actual engagement was enough for participants to go through the entirety of the available topics. This resonates with teens' feedback about the chatbot feeling robotic, with limited content and ability to engage in conversations. These findings are in between similar studies that found both shorter (Anmella et al., 2023) and longer (Luk et al., 2022) user engagement with other chatbot-delivered interventions. Despite the relative low engagement, REALbot received good acceptability, usability (with two different scales), and satisfaction scores. Interestingly, the lower scores in two of the acceptability subscales (i.e., boring/exciting, usual/leading edge) were also mentioned in youth's qualitative feedback. These findings highlight the importance of keeping an adequate amount of intervention content to boost engagement with digital health interventions. Moreover, our participants' qualitative feedback asking for content related to how to deal with discriminating family members and friends is a clear reminder that managing these difficult interactions is an important factor for feeling lonely and isolated for rural living LGBTQ+ youth (DiFulvio, 2011).

Although not the larger purpose of the study, REALbot did appear to have potential for increasing social media self-efficacy and for reducing perceived isolation and depressive symptoms from pre- to post-test among LGBTQ+ teens. Changes in the ability to find content on social media were statistically significant, and the effect size of all pre/post scores ranged from small (social isolation, depressive symptoms, and social media overall skills) to medium (ability to find content on social media). Given the sample size in our study, non-significant results are somewhat not surprising; effect sizes, however, are independent of sample size (Sullivan and Feinn, 2012). The effect sizes of our intervention on perceived isolation and depressive symptoms are in line with those of other interventions for loneliness and isolation among LGBTQ+ people (Smith et al., 2016, 2017). The chatbot had considerable effect on users' ability to find content online, which is one aspect of social media self-efficacy (Hocevar et al., 2014). This finding aligns with youth's positive qualitative feedback related to the chatbot's ability to provide links to location-based state and local mental health resources available to LGBTQ+ teens. At the same time, the effect on youth's overall skills to manage their social media interactions was small. This also correlates with qualitative feedback in that youth wanted more in-depth content related social media use, including specific suggestions on how to limit their time on social media. More research with REALbot and other, similar interventions comparing different content or delivery modalities (including delivery via peer support or counseling) is necessary.

4.2. Limitations

This is study had several limitations to consider. First, given the study design, we did not have a comparison group, thus limiting our ability to make any inference about the cause of the changes found after using REALbot. Second, given that our one-week study was conducted at a time when the COVID-19 pandemic, though receding, was still ongoing, we cannot rule out that some of the changes our participants showed were due to contextual changes along the course of the outbreak (e.g., schools re-opening). Additionally, the small to medium score changes that were detected could be due to the short duration of the study, or the positive evaluation of the attention given to this socially isolated group. However, most schools had already re-opened at the time we conducted our one-week exploratory study (November 2021 – February 2022). Third, our measure of social media self-efficacy included only two items (i.e., overall skills and ability to find content and information on social media). While overall social media skills might relate to perceived ability to curate a safe online environment, and ability to find content on social media might relate to finding resources and other forms of support, we did not directly assess these outcomes and future research should include a more detailed examination of the different aspects of social media self-efficacy. Fourth, we did not assess changes in youth loneliness. While the constructs of loneliness and perceived isolation overlap to some extent, we cannot rule that some cognitive aspects (that were not assessed with our measure of perceived isolation) changed over the course of the study, therefore impacting the measured outcomes. Finally, our small sample size and the lack of more objective outcome measures (such as assessment of number of positive and negative social media interactions) limit our ability to fully examine REALbot's efficacy.

Our study suggests more research is needed to understand the potential benefits of interventions such as REALbot. For rural youth, one potential advantage of REALbot is that its entire content was delivered online; given the increasing constraint for providing effective in-person preventive mental health services, automated interventions delivered via existing online platforms, such as social media, offer a potential implementation path that warrants further research. This is even more important given that while LGBTQ+ people are highly acceptant of social media–based interventions (Gilbey et al., 2020), there are few of these interventions focused on youth mental health (Escobar-Viera et al., 2021).

5. Conclusions

REALbot deployment on a social media platform was feasible; users found it acceptable, usable, and were generally satisfied with the content. Nevertheless, users enumerated a series of dislikes and targets for improvement, both in terms of interactions with the chatbot and the content provided within it. Study participants reported changes from pre- to post-test in all the outcomes of interest (social media self-efficacy, perceived isolation, and depressive symptoms), and effect sizes were small to medium. Additional development and a formal evaluation of feasibility and engagement with behavioral targets are warranted. Further research is also needed to incorporate new topics and new

intervention targets responsive to rural living LGBTQ+ youth who are in high need of interventions to support their mental well-being.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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