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10.4103/jehp.jehp_1761_22

Development and pilot testing of an online training program for better use of internet to learn about depression and anxiety (BUILDA)

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Abstract:

BACKGROUND: Depression and anxiety are common issues among college students in the United States. Although college students routinely use the Internet for information regarding their mental health, they might lack the digital health literacy required to search, evaluate, and use Internet resources.

MATERIALS AND METHODS: A web-based short training program with four modules aimed to improve mental health literacy and digital health literacy for Better Use of Internet to Learn about Depression and Anxiety (BUILDA). BUILDA was tested in a pilot study with 10 undergraduate students who completed the program and provided feedback via online surveys and exit interviews. Participants completed a pretest and a post-test, which included health literacy instruments and realistic case scenarios to assess student knowledge and ability to search and use Internet information on mental health topics. Descriptive analyses and paired *t*-tests were used.

RESULTS: Increased knowledge about mental health topics was observed in pilot participants, with improvement in mean values of depression literacy ($P = .01$) and anxiety literacy ($P = .019$) from pretest to post-test. Better Internet search performance was also observed as the number of participants who scored >90% in case scenarios increased from two pretest to five post-test. Students used more valid and reliable Internet resources after training, citing more government health agency websites (20% in the pretest and 25% in the post-test) and scholarly resources (6% in the pretest and 30% in the post-test). The pilot participants reported the BUILDA program was useful and provided minor suggestions regarding program improvement.

CONCLUSIONS: It was feasible to deliver a short training program via a simple website to help students develop mental health literacy and digital health skills.

Keywords:

Anxiety, depression, digital health literacy, eHealth, health literacy, information literacy, internet

Introduction

Depression and anxiety are the two most common health concerns reported by US college students and diagnosed by their clinicians.^[1] The 2021 national data showed that approximately 24% of students were diagnosed with depression (e.g., major depression, persistent depressive disorder, and disruptive mood disorder), 29% were

diagnosed with anxiety (e.g., generalized anxiety, social anxiety, panic disorder, and specific phobia), and 19% were diagnosed with both depression and anxiety.^[2] To address the growing mental and behavioral health needs of college students, a range of services and tools have been implemented, including on-campus mental health services at college counseling centers.^[3] Another tool with increasingly ubiquitous access available to college students is the Internet,

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How to cite this article: Gu Y, Kalibatseva Z, Song X, Prakash S. Development and pilot testing of an online training program for better use of internet to learn about depression and anxiety (BUILDA). *J Edu Health Promot* 2023;12:363.

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Received: 07-12-2022

Accepted: 21-04-2023

Published: 31-10-2023

which students already routinely use to find information about their health.^[4-6] The mental health resources on the Internet often focus on supporting users in self-help and encouraging them to seek professional help.^[7,8]

To make appropriate health decisions by using online resources, a range of competencies and skills (i.e., “literacies”) may be required, including health and information literacies.^[9] These competencies and skills have been referred to in the literature by various terms, including “eHealth literacy” (the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem)^[9,10] or “digital health literacy” (with the same definition as “eHealth literacy”),^[11,12] “health information literacy and competencies” (finding health information, evaluating health information, and understanding plagiarism),^[13] and eHealth information literacy (the ability to search for health-related information on the Internet and to evaluate the information quality before using the information to make health decisions).^[14] This paper uses the term “digital health literacy” that has been adopted by the World Health Organization^[15] to combine the abovementioned interrelated concepts regarding the skill set required to use the Internet effectively for health purposes. Gaps in the digital health literacy among college students have been reported, especially regarding the lack of health information search and evaluation skills, which may present a barrier to effective use of Internet resources for health improvement.^[10,13,14,16]

In a 2016 student survey at a US university, only 47% participants were able to use the Internet effectively to meet their mental health information needs, especially regarding depression.^[14] This study also identified two key predictors for effective use of online depression information as: (1) the student’s prior knowledge about depression and (2) their digital health literacy.^[14] These findings highlighted a need for systematic training to develop mental health domain-specific knowledge and digital health literacy skills to enable effective use of online information about mental health topics. To address this training need, we developed and pilot-tested a web-based training program to improve mental health literacy and digital health literacy for Better Use of Internet to Learn about Depression and Anxiety (BUILDA). Although mental health literacy education and information literacy skill-building have been advocated for school curricula (from K-12 to higher education systems) for decades,^[17-20] low levels of health literacy and digital health literacy are still prevalent. To address gaps in mental health knowledge and digital health skills, BUILDA was a short online training course to enable effective use of online information about mental health topics.

Materials and Methods

Study design and setting

The BUILDA program

The BUILDA training program aimed to develop student knowledge, skills, and self-efficacy that are required to use Internet effectively for the purpose of health improvement. BUILDA targeted both analytic and context-specific literacies (analytic literacies: traditional, media, and information literacies; context-specific literacies: computer, scientific, and health literacies).^[9] The BUILDA program development was based on social cognitive theory,^[21] theory of cognitive skill acquisition,^[22,23] and the knowledge creating theory,^[24] as well as Bloom’s taxonomy of educational objectives.^[25] For example, recorded lectures included step-by-step demonstration of how to search the Internet on health topics. The lecture focused on building tacit knowledge of general procedures for the Internet search task and then hands-on search exercises after the lecture allowed knowledge compilation and proceduralization, especially the internalization of knowledge.

Each BUILDA module had specific knowledge-based goals and/or skills-based goals. The BUILDA lectures focused on learning facts and procedures to build explicit knowledge on mental health and digital health topics. The lectures also included instructor demonstration on how to perform effective and efficient Internet searches on health topics, followed by how to evaluate the Internet information’s quality and how to apply the information to guide their own health decision-making. Each lecture was followed by hands-on exercises to solidify the acquired knowledge to facilitate knowledge internalization and to develop or modify the student’s existing tacit knowledge.

BUILDA included didactic lecturing and experiential learning activities such as answering quiz questions about case studies and hands-on Internet search exercises. The topics in BUILDA focused on mental health (i.e., depression and anxiety) and digital health literacy (i.e., improving students’ ability to search, evaluate, and use health information on the Internet). The BUILDA program consisted of four modules. Each module included a recorded lecture (between 30 and 60 minutes) and a few hands-on exercises. Total time commitment on each module was estimated at approximately an hour or less. Instructions at the start of the program recommended one module a week in sequence (i.e., Module 1, 2, 3, and 4) over the course of four weeks. All materials were available from the beginning of the program on the BUILDA website, which allowed participants to progress on their own pace and revisit materials if needed. In the pilot study, the BUILDA website was created and hosted on the Google Sites platform.

The overall BUILDA training objective was to improve students' knowledge, skills, and self-efficacy to use the Internet for solving health problems. The learning objectives of each of the four modules are included in Table 1. An example of the module page screenshot is included in Figure 1.

BUILDA pilot testing

To collect student feedback and improvement suggestions regarding the BUILDA program content, design, implementation, and usability, we embedded feedback questions in module-end exercises and post-test. Students also attended an exit interview after completing the program and provided in-depth perspectives based on their BUILDA experience. The students' knowledge and ability to search and use Internet information on mental health topics was assessed in two tests: one at BUILDA enrolment (pretest) and the other after the training (post-test).

Study participants and sampling

Taking a convenience sampling approach, the authors invited undergraduate students at a US public university to participate in the BUILDA pilot study via e-mail or in-person communications in 2021 and 2022. Participants were instructed to complete the BUILDA program, module-end

exercises, and pretest and post-test on the BUILDA website. All participants also attended a semi-structured exit interview at program completion. Participants received a \$20 Amazon eGift card via e-mail after completing the BUILDA program, tests, and exit interview.

Ten undergraduate students [nine women, nine reported racial identity (four White, three Asian, one Black, and one other), two identified with Hispanic ethnicity, seven majored in psychology or health science, eight juniors/seniors, seven reported annual household income <\$35,000, mean age = 20.1, mean Grade Point Average (GPA) = 3.52] completed the BUILDA program in the pilot study in 2021-2022. The baseline depression screening showed that half of the participants reported minimal depression symptoms, 40% reported mild symptoms, and 10% reported moderate symptoms. The baseline generalized anxiety screening showed that 70% participants reported minimal anxiety symptoms, 10% reported mild symptoms, and 20% reported moderate symptoms.

Data collection tool and technique

BUILDA pilot study key measures

The pre-BUILDA and post-BUILDA tests (available upon request) included case scenarios to assess

Table 1: BUILDA training objectives

BUILDA modules	Learning objectives
Module 1. Retrieve and Evaluate Health Information on the Internet	<ul style="list-style-type: none"> • Develop search strategy to retrieve health information: <ul style="list-style-type: none"> • What to search <ul style="list-style-type: none"> • Keywords—concepts in research question • Organize keywords, for example, by Boolean operators—AND, OR • Where to search: Cochrane? PubMed? MedlinePlus? • Assess the information (source) quality: <ul style="list-style-type: none"> • Dimensions of information quality • CRAAP test • Level of evidence
Module 2. Introduction to Depressive Disorders	<ul style="list-style-type: none"> • Recognize the symptoms of major depressive disorder • Learn about persistent depressive disorder • Learn the prevalence rate and gender distribution of major depressive disorder • Learn risk factors and causal factors for depression • Understand the impact of depression • Learn treatment options for depression
Module 3. Introduction to Anxiety Disorders	<ul style="list-style-type: none"> • Recognize the symptoms of anxiety • Learn about different anxiety disorders, obsessive-compulsive disorder, and their symptoms <ul style="list-style-type: none"> • Learn the epidemiology of anxiety disorders and obsessive-compulsive disorder • Understand the impact of anxiety disorders • Learn treatment options for anxiety disorders
Module 4. Use Information on the Internet to Improve Health	<ul style="list-style-type: none"> • Use good Internet information to improve health <ul style="list-style-type: none"> • Make sense of information <ul style="list-style-type: none"> • Comprehend and interpret information • Apply the information in decision-making <ul style="list-style-type: none"> • Make inference and draw conclusion • Identify solutions and resources • Seek help when needed (Take action!) • A brief introduction to the use of Internet as a communication tool • Review BUILDA skills

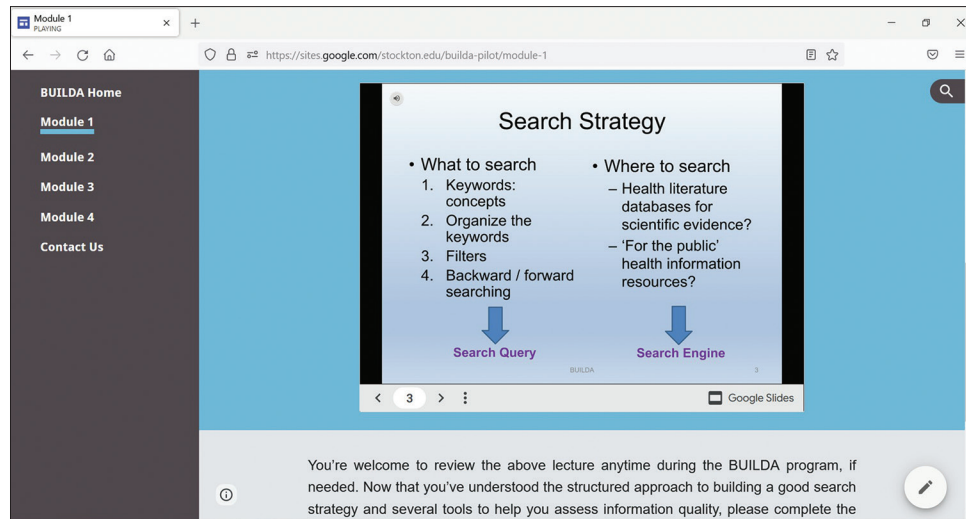


Figure 1: A BUILDA website screenshot – Module 1 lecture

students' ability to search the Internet for mental health information to solve problems and questions adapted from existing instruments to assess relevant knowledge and literacies. The key measures included in the pretest and post-test were:

Effective search and use of online mental health information. We designed eight realistic case scenarios in pretests and post-tests, with four cases in each test. The case topics included depression and anxiety screening tools, symptoms recognition, treatment, and help-seeking options. Students were instructed to search the Internet to answer questions relevant to these cases, including true-or-false questions and multiple-choice questions. Students were also asked to provide the URL that they used in answering these questions. The accuracy of student answers to the case questions and the adequacy of the URLs were used to assess the effectiveness of searching and using the Internet for mental health information. The URL adequacy examined whether a student used a valid, reliable, and relevant Web resource that provided useful and adequate information to answer the corresponding question correctly. The adequacy of each URL field was assessed by two authors independently and discrepancies in coding results were reconciled in discussions. Inter-rater kappa for URL coding ranged between 0.74 and 1. The overall effective-use-of-Internet variable demonstrated acceptable internal consistency in the pilot study ($N = 10$), pretest Cronbach's $\alpha = 0.60$, and post-test $\alpha = 0.85$.

Depression literacy,^[26] a 22-item scale including true-or-false questions to measure student mental health literacy on the topic of depression. It demonstrated good internal consistency in the pilot study, pretest Kuder-Richardson Formula 20 (KR-20) = 0.76, and post-test KR-20 = 0.88.

Anxiety literacy,^[8] a 22-item scale including true-or-false questions to measure student mental health literacy specific to anxiety (pretest KR-20 = 0.65, post-test KR-20 = 0.77).

Digital health literacy,^[14] a 14-item Likert-scaled measure to collect students' self-rated digital health literacy level. This instrument combined items from the eHealth Literacy Scale (eHEALS)^[9] and the Health Information Literacy scale.^[27] It measured participants' self-rated abilities to seek, find, evaluate, comprehend, and use health information from online resources to facilitate good health decision-making and problem solving^[14] (pretest Cronbach's $\alpha = 0.81$ and post-test $\alpha = 0.92$).

Patient health questionnaire (PHQ-9),^[28] a nine-item screening tool to screen for depression symptoms at baseline (pretest Cronbach's $\alpha = 0.84$).

Generalized anxiety disorder-7 (GAD-7),^[29] a seven-item screening tool to screen for anxiety symptoms at baseline (pretest Cronbach's $\alpha = 0.79$).

Data analysis plan

Combined quantitative and qualitative methods were used in this study. Descriptive analyses and paired t -tests were conducted with the pilot quantitative data. Qualitative data from the exit interviews (researcher notes and interview transcripts) were analyzed with a thematic analysis approach. URL adequacy coding was completed by two raters independently and any differences in coding were discussed and reconciled. Cronbach's α or KR-20 were calculated for each scale in the questionnaire to test reliability. Cohen's kappa coefficients were calculated to test inter-rater reliability in the URL analysis. Microsoft Excel and SPSS were used in the data analysis (at <0.05 significance level).

Ethical consideration

The study was approved by Stockton University Institutional Review Board (IRB#: 2021.144). Furthermore, informed consent was obtained online from the respondents before participating in the pilot study.

Results

BUILDA training effects

Paired *t*-tests showed a significant improvement in mental health literacy on depression and anxiety with large effect sizes [Table 2]. There were no significant changes in digital health literacy or effective use of the Internet [Table 2]. However, in reviewing changes for single participants, seven of 10 participants improved their scores from pretest to post-test in case scenarios indicating effective search and use of online mental health information. Similarly, two participants (20%) scored above 90% in the pretest and five participants (50%) scored above 90% in the post-test. Participants' pretest and post-test scores for "Effective use of Internet" are included in Table 3.

Moreover, Table 4 demonstrated the reduced use of commercial websites and increased use of valid and reliable web resources in the post-test, which indicates an increased awareness and ability to assess the quality of information on the Internet.

BUILDA pilot implementation experience

The pilot implementation experience suggested that a short training program focusing on mental health and digital health literacies via a simple website was feasible and usable. The exploratory training effect data suggested that such a program may help users develop and/or improve literacies and skills required to search, evaluate, and use mental health information on the Internet. Qualitative data collected in the BUILDA surveys and exit interviews showed that participants believed all modules were useful. Participants described learning about depression and anxiety disorders as "definitely helpful" and "really interesting". Participants also commented on BUILDA in general, "I think everything was useful." "I think it is a really good idea to have something like this, so people know what, where to look, and what information is going to help them the most when it comes to depression, anxiety, and the other mental health disorder[s]." Participants also provided valuable suggestions for

further improvement of the program, such as including additional interactive examples and exercises for each module. These suggestions were incorporated in the BUILDA refinement and the updated BUILDA is implemented in an ongoing multisite evaluation study of the training effect.

Discussion

The BUILDA pilot study demonstrated that a short online training program may help develop both digital health literacy and mental health literacy about depression and anxiety. Successful mental health literacy training programs for college students have been reported before, including those with a focus on depression and anxiety.^[30,31] Our pilot findings showed that, on average, participants' mental health knowledge and literacy improved after completing the course. These results are consistent with other online mental health information services and skill-training websites that focused on developing mental health literacy among young people.^[26,32,33] On the other hand, despite routine use of online mental health resources, evidence is insufficient to determine if these online resources effectively facilitate help-seeking for young people.^[32] The issue is multifaceted with a range of barriers to help-seeking actions, including a lack of mental health literacy.^[34] Although there have been advocacy efforts for health literacy education in the K-12 curricula,^[17,18] limited health literacy in the US population is prevalent.^[35,36] Therefore, health literacy education, including mental health literacy education, needs to become a priority in K-12 schools and higher education.

To enable students to use the Internet for their mental health improvement, we need to equip them with both mental health literacy and digital health literacy.^[14] Therefore, in addition to a focus on mental health literacy development, BUILDA also targeted digital health literacy skills. Previous studies already identified gaps in college students' digital health literacy, especially with low level of skills in searching the Internet for health-related information and in information quality assessment.^[10,13,14,16] Most students may have difficulty in conducting advanced information searches and/or are unable to judge the trustworthiness of health-related websites.^[10,13] Notwithstanding these recognized gaps, information literacy training has been an essential learning activity in US higher education for decades.^[19,20]

Table 2: Pre- and post- BUILDA literacy and skill measures

Measures (n=10)	Pretest (Mean, SD)	Post-test (Mean, SD)	Paired <i>t</i> -test <i>P</i>	Cohen's <i>d</i>
Depression literacy	15.3, 3.74	18.5, 4.38	0.010*	0.8
Anxiety literacy	13.4, 3.37	16.5, 3.69	0.019*	0.9
Digital health literacy	3.9, 0.45	4.0, 0.63	0.372	0.2
Effective use of Internet	74.6%, 14.62%	76.4%, 23.81%	0.759	0.1

Table 3: “Effective use of internet” pretest and post-test participant scores

Participant identifier	Pretest score	Post-test score
1	54%	70%
2	57%	18%
3	61%	76%
4	64%	70%
5	79%	64%
6	79%	94%
7	82%	91%
8	86%	97%
9	93%	91%
10	93%	94%

Table 4: Pre-BUILD A and post-BUILD A Internet search cited URLs

Main categories of cited URLs	Pretest	Post-test
Commercial websites	26%	8%
Government agency websites	20%	25%
Scholarly resources (e.g., PubMed-indexed article/book chapter)	6%	30%

There are also efforts made by federal government to provide free training modules and curricula to the public and educators on the topic, for example, <https://medlineplus.gov/webeval/webeval.html> and <https://allofus.nlm.gov/digital-health-literacy>. The challenge remains to collect robust evidence on effective training elements of the digital health literacy training programs. The 2011 Cochrane systematic review of interventions for enhancing consumers’ online health literacy found only one randomized controlled trial and one controlled before and after study reporting weak evidence of training effect on self-efficacy for online health information literacy.^[37] The BUILD A program suggested that a short online course combining topics on health and information literacies may help develop not only mental health literacy but also digital health skills. The small sample size may have deterred us from detecting statistically significant differences in self-reported digital literacy and effective use of the Internet. Yet, 70% of participants improved in their ability to use the Internet to identify symptoms and diagnoses in realistic case scenarios after completing the BUILD A training. We recommend such course curricula should include both lectures and practical exercises, ideally in realistic case scenarios. We believe that rigorous evaluation studies are needed to collect evidence on effective training elements in the effort to improve training efficacy of digital health literacy. Drawing upon the pilot study results, we have refined BUILD A and are assessing its training effects in a controlled before-and-after study to collect evidence on training efficacy.

Limitations and recommendation

The BUILD A pilot study took a convenience sampling approach. Due to the small sample size, the findings

of the pilot study may not be generalizable. Moreover, the small sample size may have affected detecting changes in digital health literacy. Despite the weakness associated with small sample size, the BUILD A program development was theory-based, and its pilot testing clearly demonstrated the feasibility and usability of delivering this short training course over the Internet. In addition, the pilot participants reported repeatedly it was useful. An evaluation study with rigorous research design and a large sample to assess the training effects is still needed—and a BUILD A evaluation study is ongoing with a multisite controlled before and after study design. Furthermore, self-report measure on digital health literacy was used, which may have overestimated students’ actual digital health skillset.^[10] Future research on digital health literacy might take similar approach to our pretests and post-tests with case scenarios asking participants to perform actual Internet searches, assess the retrieved information quality, and use the information to solve realistic health problems.

Recommendations and implications for educators: based on the BUILD A development and pilot experience, mental health literacy education and digital health literacy education may be combined in training programs that are short and focused. We recommend such course curricula include both lectures and practical exercises along with realistic case scenarios.

Conclusions

Targeting gaps in mental health literacy and digital health literacy among college students, we developed and piloted a theory-based BUILD A training program. Our experience showed that it was feasible to deliver BUILD A as a four-module short program via a simple website, and the pilot participants found it useful. The preliminary training effect data suggested that BUILD A may help students develop both mental health literacy and digital health skills. Future research is needed to establish the evidence base on digital health literacy training programs to guide higher education to address the gaps among college students on this important competency and subsequently enable students to use good Internet resources to improve their health.

Acknowledgments

The BUILD A research project was supported by the Stockton University Research and Professional Development Funding (R&PD) Main Round FY22 Award. Publication of this manuscript is supported by the Stockton University Scholarly Publication Cost Award. We would also like to thank Nikitha Mohan, Alexander Chen, and Mary Lou Galantino for reviewing the BUILD A program and providing valuable feedback. Also, we thank all the students who participated in the pilot study.

Financial support and sponsorship

The BUILDA research project was supported by the Stockton University Research and Professional Development Funding (R&PD) Main Round FY22 Award. Publication of this manuscript is supported by the Stockton University Scholarly Publication Cost Award.

Conflicts of interest

There are no conflicts of interest.

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