Code to Cope: Supporting Self-Care by Integrating Creative Coding and Coping Mechanisms

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Figure 1: Students' becoming a role model projects for unit 2 of the Code to Cope curriculum

ABSTRACT

Code to Cope is a STEAM curriculum for young adults designed to teach, develop, and encourage coping mechanisms while learning programming with JavaScript. COVID-19 restrictions, such as social distancing and remote learning, disrupted social development and identity formation in young adults, exacerbating mental health issues that remain unaddressed in existing STEAM curriculum. Young adults are vulnerable to psychological distress that adversely affects educational experiences and career path choices. The Code to Cope curriculum was adopted by the creative coding course at Louisiana State University from 2021 to 2022. We conducted interviews with four students in 2021 and empirical studies with 34 students in 2022 to evaluate the effects of the curriculum in terms of code, coping, and creativity. The results of the study show that the Code to Cope curriculum effectively teaches computational thinking, develops self-care practices, and engages and motivates students.

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CCS CONCEPTS

• **Human-centered computing** → **Interaction paradigms**.

KEYWORDS

Code to cope, coping mechanisms, creative coding, self-care, STEAM education

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1 INTRODUCTION

Code to Cope is a STEAM (science, technology, engineering, arts, and mathematics) curriculum for young adults designed to create, utilize, and maintain coping mechanisms while learning programming with JavaScript. Stress and anxiety are two common impediments to student academic performance [2]. Young adults, particularly those in low-income and underrepresented populations, are vulnerable to psychological distress that adversely affects educational experiences and career path choices [13]. Recent social constraints imposed by COVID-19 have exacerbated issues with stress, anxiety, and depression [25]. Studies show that students involved in programs that promote creativity learn to better cope with stress [4]. STEAM curricula are intended to foster self-expression and creativity among students by integrating arts [23, 28]. However, we find that existing STEM and STEAM curricula do not directly

address issues of stress and anxiety, instead focusing on improving academic performance and retention. Code to Cope aims to improve academic performance, retention, and well-being by addressing stress and anxiety through coping mechanisms that will improve students' ability to learn.

Figure 2: Maslow's Hierarchy of Needs

Code to Cope offers a theoretically grounded approach to increasing students' STEAM efficacy and ability through the combination of coding instruction and self-care practices. Students need to learn how to take care of themselves and manage their mental state before they can achieve their full academic potential. In Maslow's hierarchy of needs from the humanistic theory of personality (Fig. 2), lower-level needs should be satisfied in order to achieve higher-level needs [32]. In order to engage in learning, students must first have their basic needs met. Maslow's hierarchy of needs sets meeting an individual's potential as the pinnacle of experience that can only be reached when lower more fundamental components are present such as physical and emotional well-being. The fulfillment of fundamental needs contributes to well-being [12]. Students need to learn how to cope in order to learn academic subjects effectively.

Code to Cope focuses on psychological needs, the third and fourth stages of the hierarchy of human needs. The third stage of human needs is love and belongingness, i.e. a sense of connection. The fourth of human needs is esteem, which is an essential value for young adults as they build their identity. The Code to Cope curriculum aims to build positive self-esteem, confidence, engagement, and connectedness in order to scaffold the highest stage, self-actualization. Maslow described self-actualization as achieving one's full potential [32]. Each stage is not a rigid, independent, and fragmented process, but rather a flexible, organic process of learning that may appear differently depending on personal preferences, individual environments, or external factors.

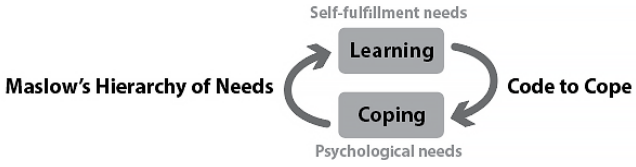

Figure 3: Iterative Learning & Coping Process

Coping through self-care can help students learn challenging topics (Fig. 3). In the broader scope of STEAM learning with computational thinking, learning can embrace cognitive learning and mental health improvement to influence students' behavior, decision-making, and critical thought process. The Code to Cope curriculum aims to build positive self-esteem, confidence, engagement, and connectedness in order to help students better cope with stress. The curriculum is an iterative process [18] of learning and coping in which students develop, practice, and maintain coping mechanisms as they learn to code. Students learn principles of computational thinking through programming exercises and apply what they learned to develop applications that help them cope. Then, they practice self-care using their own applications. We hypothesize that learning computational thinking and coping mechanisms at the same time will improve students' mental health, help them focus on STEAM learning, and promote their success in STEAM careers.

The Code to Cope curriculum is also influenced by Bandura's theory of self-efficacy and the importance of expectancy outcomes [6]. In this theory, an individual's belief that they can successfully change behaviors or complete a task influences motivation and success. Bandura hypothesized four sources in which people foster positive (or negative) self-efficacy beliefs – performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal. Performance accomplishments pertain to experiences of mastering parts of a task through task engagement and success with a task or parts of a larger task. Vicarious experiences include modeling a task by others. Verbal persuasion includes being encouraged that one can successfully complete a task. Emotional arousal pertains to how an individual learns from their own fears and anxieties; thus, conducting a task when in a low arousal state is more likely to produce success compared to high arousal, which is more likely to cue avoidance behavior. The Code to Cope curriculum helps students master basic coding skills while providing modeling of the completion of all major tasks, encouragement during initial learning, and the practicing of coping skills to help reduce emotional arousal prior to engaging with a new task.

In this paper, we begin with a review of related work. Next, we describe the Code to Cope curriculum which consists of three units and five projects. Then, we explain how the curriculum was employed over two semesters in a course on creative coding. We present findings from interviews and questionnaires with students participating in the course. We conclude with a discussion of learned outcomes and plans for future work.

2 RELATED WORK

2.1 Computing Education

Computing education is critical for students' success since computational thinking is a foundation for understanding the world through problem-solving, experimentation, and creation [54, 55]. Computational thinking not only serves as a core ability for analyzing situations and solving problems, but can also apply to all cognitive processes and physical behaviors in everyday life [54]. It is an important skill set for maximizing students' potential and can help students find careers in STEAM fields. The importance of computational thinking is increasing as the demand for computer and

IT occupations grows. According to the 2020 US Bureau of Labor Statistics report [51], job demand for computer and IT occupations is expected to grow by 10.5% through 2030, which is faster than the average of all other occupations.

Diversity and inclusion remain low in computing education. Women and minority populations are underrepresented in computer and information science (CIS), both academically and professionally, and the retention rate of minority populations in STEM education is low [45]. In an effort to correct this unbalanced representation, computer educators try to recruit minority populations for diversity and engagement [10, 33, 52]. For example, educators sometimes design computer science classes to appeal to female students [44] in an effort to bolster engagement. According to the National Center for Education Statistics, the percentage of bachelor's degrees awarded to women in CIS finally reached 20% in 2017-2018 and 21% in 2018-2019, after staying lower than 19% since 2004 [37]. Online platforms for learning programming such as code.org and codecademy (http://codecademy.com) enhance accessibility to students. Some of these online platforms, such as Girls Who Code (http://girlswhocode.com), and Black Girls Code (https://wearebgc.org/), target underrepresented populations. However, educational resources for mental health, self-care, and coping mechanisms while learning programming are lacking. Since mental health can heavily influence students' stability, capability, and success, it needs to be addressed in computing education.

2.2 Engagement in Computing Education

There are proposals for revitalizing computer science education such as offering more multidisciplinary classes for learning domain-specific skills, making computer science's image more fun and exciting, improving women's enrollment, educating high school teachers, and providing undergraduate computer science programs for a wider audience [30]. These proposals are closely related to the 21st century education movement, using the 'Four Cs' (critical thinking, communication, collaboration, and creativity) to lead students to success [38]. The 'Four Cs' can be promoted in computing education by integrating arts, crafts, design, and making into STEM education.

Several online platforms for in-class or after-school curricula – such as Scratch [35, 42], EarSketch [29], and code.org – have been developed to engage students in STEAM learning. STEAM learning kits for physical computing and robotics have also been developed such as Chibitronics [11] and Lego Mindstorms [24]. None of these, however, focus on nurturing students' mental health through learning. Mental health is important, especially for young adults, as their state of mind can heavily influence their focus, confidence, and engagement in class and their interaction with others in social situations.

A survey on future occupations for over 22,000 middle school students found that the overall percentage of students who want to be artists was twice as high as computer programmers and that the percentage gap between artists and computer programmers was higher for girls than boys [20]. One way to address this gap is to tailor computing education toward underrepresented populations by integrating elements of arts, crafts, design, and making. For example, LilyPad Arduino by Buechley et al. targets female students with the design of e-textile wearable projects that allow for students to express their creativity using microcontrollers and hardware such as LEDs or motors [8, 9]. The combination of craft, which many female students are already familiar with, can provide platforms for computing education that are more attractive to female students. Another STEAM example, EarSketch, by Magerko et al. focuses on African American male students by bridging music production and programming [15, 16, 29, 36]. They integrated music, an artistic domain, into STEAM learning to stimulate students' creativity and encourage collaboration and engagement.

Both LilyPad and EarSketch were designed to have low barriers of entry to target beginners without much computing, art, or music experience. Influenced by Piaget's constructivism, the 'low floor and high ceiling' metaphor was emphasized by Papert, who developed the Logo language, and later Resnick, who applied the concept of 'wide walls' to designing construction kits [41, 43]. Low floor means making processes open and accessible so everyone can learn easily even if they are novices. High ceiling means that students can develop complexity through iterations in order to develop increasingly sophisticated applications. Resnick's concept of wide walls provides diverse pathways to explore and develop projects. The wide walls metaphor is critical for students' motivation, engagement, and creativity in finding their own ways to complete the goals. However, we are still missing a fundamental step—mental health—for improving students' engagement. While researchers have sought alternative ways to help students improve STEAM skills, to our knowledge there have been no attempts to integrate self-care into computing education.

2.3 Mental Health

Mental health concerns are regularly experienced by students at colleges and universities across the country. Unfortunately, recent research indicates that the prevalence of mental health challenges experienced by students may be increasing. Lipson et al. analyzed mental health screening data collected from over 350,000 college students across 373 colleges and universities across the U.S. between 2013 and 2021 [27]. Results indicated that the rate of positive screenings for depression increased by 134.6% between 2013 and 2021. Similar results were found for positive screenings for anxiety concerns (109.5% increase), eating disorders (95.6% increase), past-year non-suicidal self-injury (45.5% increase), and past-year serious thoughts of suicide (64% increase). In the fall of 2021, of the over 30,000 college and university students who completed the National College Health Assessment survey, only 27.2% indicated low levels of psychological distress, with 50.8% indicating moderate levels and 22% indicating serious to severe levels of distress [3]. Additionally, 26% of the students indicated at-risk suicidal behavior.

These data show the mental health challenges experienced by college students are common and may be increasing. Given the increased rate of mental health concerns, it is not surprising that university counseling centers are being utilized at increased rates. For example, Lipson et al. [27] found that, of students who screened positive for at least one of the mental health concerns assessed in their investigation, therapy service utilization increased by 25.6% from 2013 to 2021 and utilization of medication to treat mental health concerns increased 33%. According to data compiled by

a survey completed by 562 college counseling center directors, the average number of patients and therapy sessions provided by counseling centers across the country increased by over 12% in 2019 than in 2018 [26].

Rising demands for mental health services among college students have led to an increased concern that universities likely cannot alone meet the demand for mental health care and a prevention-oriented model of campus mental health [7]. Prevention-based models of campus mental health focus on creative ways in which personnel and systems outside of college counseling centers can help foster positive well-being in college students. The current investigation, in line with the central tenants of prevention-based models of campus mental health, is a creative curriculum that attempts to teach positive mental health coping mechanisms. Code to Cope teaches students the competencies in software engineering and coping mechanisms needed to develop applications that support self-care. We hypothesize that having such competencies will foster adaptive coping capacity that is beyond the limited institutional capacity to help them.

3 CODE TO COPE CURRICULUM

Code to Cope teaches 21st century STEAM skills including the 'Four Cs' – critical thinking, communication, collaboration, and creativity [38]. Code to Cope uses diverse pathways reflecting the wide walls metaphor by Resnick [43] to achieve our goal of improving self-care through STEAM learning. With Code to Cope, students learn basic programming foundations, syntax, and logic such as variables, conditions, and functions using JavaScript. Students also learn how to draw with robots. Drawing is an artistic and expressive medium that can improve students' creativity and engagement. According to Ackermann, these students' playful, engaged interactions with tinkering can make students feel more confident with less fear of failure [1].

According to John Sweller's cognitive load theory, students struggle to understand excessive information during problem-solving processes, so instructors need to reduce cognitive burdens for novice learners [50]. Code to Cope builds knowledge through projects with comprehensive step-by-step guides. The Code to Cope curriculum includes examples, tutorials, and guidelines that allow novice students to find answers through the problem-solving process, while learning programming for the first time.

3.1 Coping Mechanisms

The coping mechanisms embedded in the Code to Cope curriculum were selected for their alignment with stress reduction programs such as mindfulness-based stress reduction [49] as well as positive psychological interventions that promote positive thinking and emotions [22]. Each class began with a five-minute practice of diaphragmatic breathing. In this coping skill used to reduce stress and anxiety [19], students deliberately breathed in for five seconds, held their inhale for one second, and then exhaled for five seconds.

Other coping skills used in the curriculum align with brief positive psychological interventions that demonstrate promise as important additions to traditional mental health therapies [22]. For example, when learning how to build augmented reality (AR) applications, students created positive self-portraits based on their strengths and values. This exercise in empowerment is akin to positive psychological interventions related to increased experience of positive emotions in which people imagine the best versions of their future selves [48]. Students in the Code to Cope curriculum also completed an activity in which they remembered an important, positive physical place in their past and created this landscape using their growing coding skills. This activity closely aligns with nostalgia inductions that increase positive emotions, such as spending time writing about positive past events and places [53]. Finally, each student developed their coding skills by programming a robot to draw their own designs. Creative activities in which individuals conceptualize and create something tangible such as this exercise are regularly used in the context of comprehensive care plans for adults struggling with cancer diagnoses [17] and are proposed to be important for reducing work-related stress [21].

3.2 Projects and Units

The Code to Cope curriculum consists of five projects. The projects were designed to be playful and creative in order to be more engaging. Playful design has become popular in gamification for enhancing engagement and motivation [14]. Malone suggested that challenge, fantasy, and curiosity are key for designing enjoyable user interfaces [31]. Play and learning are also inseparable from children's education [1, 39]. To encourage playful interactions, we integrated interactivity, body tracking, and arts and crafts materials into the curriculum. Students personalize their projects based on their memories or interests. They are tasked with drawing self-portraits, developing interactive animations of their role models, modeling memorable landscapes of their past, and creating collaborative drawings with a robot. Through these processes students learn and practice breathing, while engaging in reflective activities that promote positive emotions and well-being. We divide the five projects into three units (Table 1):

(1) interaction design through diaphragmatic breathing
(2) embodied experiences with interactive body tracking
(3) collaborative drawing with a robot

3.2.1 Unit 1: Diaphragmatic Breathing. The two projects in unit 1 involve designing characters and self-portraits. Students learn the basics of programming through the design of characters (Fig. 4 top) using p5.js [40]. After students are familiar with JavaScript, they develop more advanced skills by programming interactive self-portraits that respond to their diaphragmatic breathing exercises (Fig. 4 bottom). They utilize their breathing as audio input to control their characters. Until the end of the semester, students practice this breathing technique with their self-portraits as a breathing exercise at the beginning of every class.

3.2.2 Unit 2: Embodied Experiences. The two projects in unit 2 are exercises in 1) becoming a role model and 2) building memorable landscape scenes. In the role model project, each student develops an AR application in which they become their role model. When a student's face is detected in video feed, a representation of their role model is overlaid on their face so that they appear as their role model. (Fig. 1). In the landscape design project, students craft two different timelines of interactive landscape scenes representing a memorable location (Fig. 6). In both projects, interactions with

Table 1: List of projects and coping mechanisms

Unit	Projects	Coping Mechanisms
1	Character Design	
	Self-Portrait	Diaphragmatic breathing
2	Becoming a Role Model	Positive future self envisionment
	Memorable Landscape Design	Nostalgia
3	Robot Drawings	Creative exploration using art

Figure 4: Character design (top) and self-portrait (bottom) submissions for unit 1 of the Code to Cope curriculum

visual representations are performed through physical movements of the body using computer vision and machine learning. Students use pre-trained body parts with 17 key points using PoseNet, a deep learning TensorFlow model, to track the students' bodies in real-time using the machine learning library [34]. These projects attempt to increase positive emotions by 1) encouraging students to envision positive versions of themselves and 2) eliciting a sense of nostalgia for memorable landscapes or events. Fig. 5 shows students interacting with their projects in class.

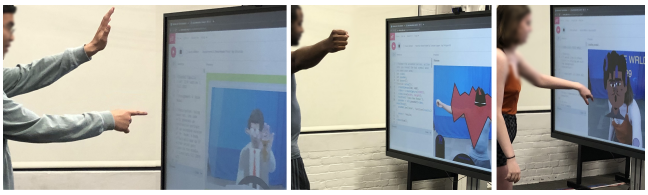

Figure 5: Students interacting with their projects in class

3.2.3 Unit 3: Collaborative Robot Drawings. The collaborative robot drawing project in unit 3 (Fig. 7) transitions from the creation of purely digital media to real physical artifacts – to drawings on paper. Students used the AxiDraw robot [5] for its ease of use. Collaborative drawing with robots on craft materials can contribute to the greater goal of developing a sense of creative personal expression similar to techniques used in art therapies [17].

4 METHODS

Code to Cope is taught every fall semester (6 hrs/week, a total of 16 weeks) at Louisiana State University for two sections of the creative coding class. We employed iterations [18] of the same Code to Cope curriculum for classes in 2021 and 2022. During the fall semester of 2021, we recruited five students. Of these, four students (one male and three female, mean: 19.5 yrs) completed the initial volunteering interviews. In 2022, we collected quantitative data through self-assessment questionnaires with 34 enrolled students (12 male and 22 female, mean: 21.1 yrs). Our university's Institutional Review Board approved procedures for both classes.

For the interviews in 2021, volunteering participants conducted Code to Cope activities for seven days, after the semester was over. They followed a routine of breathing and stretching every day for at least five minutes. Students chose the frequencies and times of activities. They interacted with their projects or other students' projects of their choice. After the routines, they wrote a short journal entry about their feelings each day. During the interviews, participants answered questions about what they liked and disliked about activities, how it differed when they interacted with their own work or other students' work, how much they learned about coding and coping, and how much they enjoyed the process. Among

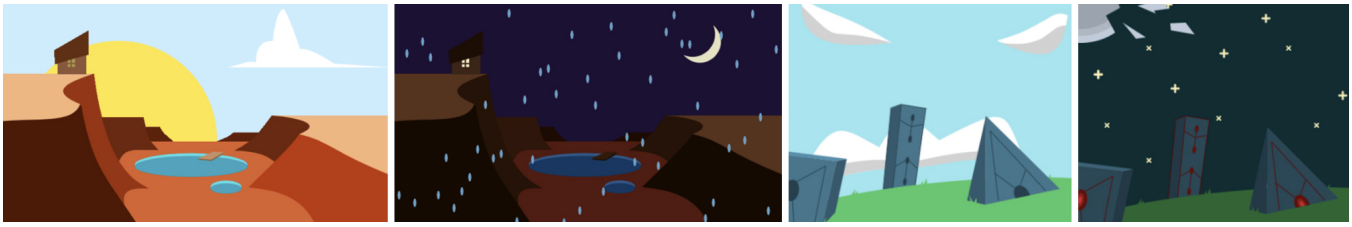

Figure 6: Outcomes from the memorable landscape design assignment for unit 2 of the Code to Cope curriculum

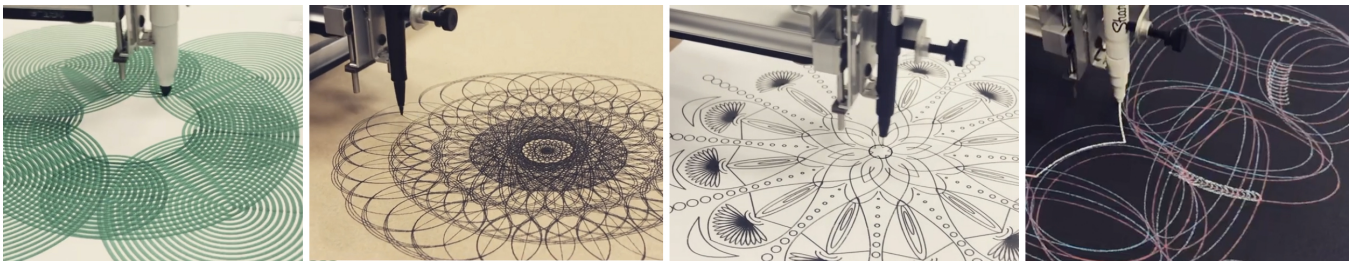

Figure 7: Drawings with an AxiDraw robot for unit 3 of the Code to Cope curriculum

the four participants, two students regularly visited the university's mental health center every two weeks to have a meeting with a therapist over the semester, while the other two students did not meet a therapist. In addition to the interviews, written feedback from emails and class evaluations were also collected.

We first transcribed recordings of interviews. Then, we familiarized ourselves with the data through reading and rereading transcripts. For each question, we noted common and unique responses as we formulated our interpretations of the data. Among the data, we found key themes such as learning, self-care, engagement, and self-expression. We report on our interpretive analysis of the data in the following section.

5 FINDINGS

5.1 Interviews

All four participants reported appreciation for and benefit from meditation and relaxation during activities.

> P1: "*The benefit was time to relax, forget about things, and focus on my mental health and maybe even my bodily health because stretching felt so good.*
>
> P3: "*I felt a lot less stressed whenever I was done stretching and deep breathing…I didn't know how much it would help, but it ended up helping a lot.*

Three participants reported that they felt more comfortable using their own projects than their classmates' projects. P3 specifically mentioned that it felt awkward to use others' projects since they were so personalized. However, participants enjoyed the diversity of other students' projects as it helped them avoid boredom.

> P3: "*I guess it felt weird [with other students' projects] because there are also other people's faces (Unit 1, self-portrait project) on other projects. I felt more comfortable with my own project.*"
>
> P1: "*Whenever I do mine, it was easier…but I would have gotten bored with my project.*"

All four participants reported positive learning experiences through the Code to Cope curriculum. When asked to self-estimate their learning experience from the beginning to the end of class, participants reported that they successfully learned to code (P1: 40%, P2: 1.6%, P3: 2%, and P4:12%). P1 mentioned the possibility of pursuing a STEAM career in the future.

> P1: "*I learned a lot and I even developed a good interest in it. It was a cool process of trial and error…I definitely feel much more confident after this class…I showed some of my projects to my parents and they said you could have a career on this.*"
> P4: "*If something is not working out, I will fix it. I will make it work.*

Participants' confidence extended beyond the scope of the class. P2 mentioned that she felt more confident about taking other related coding classes in the future.

> P2: "*In the next semester, I will take Unity class which involves scripting. I feel better going into that class knowing that I have a background and I feel I understand it very well.*"

However, two participants mentioned that they got stuck and struggled with coding issues, but through determination, they were able to get through their problems. With each project, they became more skilled at dealing with programming issues.

> P1: "*It's definitely very intimidating but after the first project, maybe even the second one, it was a lot more fun.*"
>
> P4: "*There was time when I was banging my head against the desk. However, I was able to get through it and it was still a fun process.*"

To overcome these challenges, the Code to Cope curriculum provides several examples and tutorials. Since p5.js runs on an open-source platform on the web, it was convenient for students to share their work with an online community.

> P1: "*They gave me ideas and options that I could add. The examples and the tutorials in between definitely gave lots of inspiration and help.*"

We understand this approach may not provide a permanent solution for students' mental health. In the interview, P3 mentioned that the coping effects were not permanent, but lasted for a significant time.

> P3: "*The effects were maybe not permanent, but they lasted for a while. Whenever I was stretching, I felt a little bit more connected to my physical body.*"

To continue the positive coping practices for the long term, P2 mentioned that she would like to keep using the coping mechanisms she learned in class.

> P2: "*It helped me build the habit of stretching and taking care of myself. I'll do my best to hold on to that… doing even just a little bit of activity consistently every day really helps.*"

In order to build engagement during assignments, Code to Cope provides several customizable projects that students can tailor to fit their own interests. Empowering students to develop their own stories motivated them to learn [46]. Participants reported that they not only grew more confident in programming, but also became more engaged through storytelling.

> P1: "*One of my projects was about my grandmother's garden in Costa Rica. My mom took a video of me doing it for my grandmother's scene. She was very impressed and they were amazed at the project.*"

Similarly, in collected feedback, students expressed how having projects that fit their personal interests made the course enjoyable.

> "*I enjoyed the creative coding class because all of the projects that were assigned… from my own interests and past experiences. Doing so made every project personal and enjoyable to work on.* "

Comments about teaching materials and programming learning included "I learned so much every single session", "*Despite being a relatively difficult subject, it progressed in a way that taught me a lot but wasn't too overwhelming*", and "*It was just a great class that made me pretty interested in coding, something I previously thought could never happen.*" A student also commented on the support provided by the curriculum:

> "*I also really appreciated how much emphasis she put on assessing our mental health during the pandemic. [She was] one of the only professors I had that actively tried to check in with us during the semester.*"

While learning outcomes are important, the nature of the curriculum can affect students' emotional state and sense of belonging. When a curriculum shows care for students, they can understand that they have institutional support and are able to perceive their school as a strong, supportive community.

5.2 Questionnaires

The questionnaires in 2022 assessed the effectiveness of the curriculum in terms of coding, coping, and creativity. The questionnaires used a Likert scale from strongly disagree (1) to strongly agree (5) with short written answers. Students scored how much the Code to Cope curriculum helped them to learn coding (4.29 out of 5), coping (3.38 out of 5), and creativity (4.20 out of 5). These results echo the interview findings from 2021. Students felt more confident to programming, meditated while doing diaphragmatic breathing and positive self-envisioning exercises, and enjoyed the class activities. However, the personal level of each participant's coping varied in intensity and length.

In the written comments, 29 out of 34 students mentioned that the Code to Cope curriculum helped them understand programming, although most of them did not have any prior knowledge of coding.

> "*Before this class I had never done any coding and it seemed so impossible, but once I figured out what I was doing, it all became very clear. It was still hard but it was a lot of fun and I typically found that once I started on a project it was so satisfying I couldn't stop.* "

In terms of coping, 22 out of 34 students mentioned that the class projects relieved their stress.

> "*It helped me deal with the stress of being a college student.*"
>
> "*I really liked the breathing exercises we did before class because this semester was very hectic for me and to have those minutes to just breathe helped a lot.*"

For the questions about creativity, 29 out of 34 students – the same number as for coding – answered they enjoyed expressing their creativity through their class projects.

> "*I really liked how some projects were open-ended and allowed us to express ourselves.*"
>
> "*I felt that I could express myself freely in this class. All of the projects felt personal… It was really fun.*"

In particular students mentioned that developing their own narratives motivated them to express themselves and made them more engaged in the project.

6 DISCUSSION

From interviews and questionnaires, we found that students improved their confidence in programming ability, meditated and relaxed, and enjoyed making creative projects through Code to Cope. When designing a coding curriculum to support novice students without prior programming experience, we recommend using a scaffolding model that gradually integrates coping mechanisms and coding techniques to support efficient learning [47, 50]. Although they struggled at the beginning of the class due to a lack of prior knowledge about programming, the students executed their projects confidently with guidance from step-by-step lectures and examples of coping practices. Determining the pace at which new concepts are introduced is a major challenge for scaffolding models. We find that introducing a new coping mechanism with each new project provides an appropriate pace for novice student learning. Students mentioned that they overcame their fear of programming,

enjoyed the process, and felt confident after one or two projects. Examples and tutorials helped to inspire students' projects and to solve some problems when they had unexpected program errors or bugs. Since iteration is important in the design process [18], they iterated and developed their projects constantly as they became more comfortable and confident with coding.

Open-ended projects also supported students' self-motivation and self-expression of the project. In the findings, they shared their experiences of how much they were motivated by the projects because these were related to their own interests and memories. Several students mentioned that they felt connected to the process of making a self-portrait in unit 1 because it contained their faces. Others mentioned that they enjoyed the memorable landscape project in unit 2 since they reflected on good memories and nostalgia with family and friends. This reflects how personally meaningful projects were important and motivational.

However, we understand that the influence of the Code to Cope curriculum depends on student engagement and may be temporary. In addition, the activities during the class and outside of the class are voluntary activities. The curriculum is not able to set the frequency and intensity of self-care activities. In the interviews, students indicated that right after certain activities, such as breathing and stretching, they were temporarily relaxed, but this effect may not last permanently. To overcome these limitations, we plan to integrate these coping mechanisms into online platforms, so students can use these self-care activities more conveniently and often.

Code to Cope teaches the students about self-care. After the class, they can continue these practices. Students expressed willingness to take more computer programming-related classes in the future and keep the diaphragmatic breathing and positive self-envisioning routines since they feel confident doing them. The results from interviews and questionnaires show Code to Cope can help students find their interests, inspire motivation, and build engagement for programming and self-care. Furthermore, the Code to Cope curriculum not only helps students, but is also beneficial for the instructors. The first author, who mainly led the class for two years, experienced stress relief and mindfulness after five minutes of diaphragmatic breathing exercises at the beginning of each class. Further, we posit that Code to Cope or any other curricula that incorporate coping mechanisms will be even more beneficial for upcoming entry-level university courses in which incoming students suffered adverse effects of the COVID-19 pandemic during the foundational stages of adolescence.

7 FUTURE WORK

We plan to develop a free online educational platform for learning STEAM topics while enhancing self-care for students. Further development of this application will include examples, tutorials, and galleries for sharing and viewing the work of other students. By providing accessible means to learn new techniques and share progress, students can increase programming literacy and improve self-care, while instructors can use this tool for STEAM learning and self-care in their introductory coding classes.

We plan to pursue the goal of continuous practices for learning and caring. We will create social interactions to maintain their coping activities and retain their interests in STEAM learning. This goes beyond browsing and looking at other people's creations. When students create, explore, share, and exchange their creations with others, they are more engaged in and connected to their outcomes as well as other participants. This curriculum can motivate students to continue to pursue new activities and practices, ultimately improving their adaptive coping capacity.

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