

Inclusive Web Design based on Gamified Learning and Color Psychology to Design Programming Learning Websites for People with Bipolar Disorders

Zijing Jin *

Department of Information Science and Technology, Hebei Agricultural University, Baoding, Hebei, 071001, China

* Corresponding author email: 2019234060121@stu.hebau.edu.cn

Abstract. Bipolar disorder is one of the top 20 causes of disability worldwide, and its symptoms are most common between the ages of 20 and 25. The objective of this study is to help BD patients who need to learn programming better through website design. The study was conducted using autoethnography and interviews. The research methods described above revealed that people with bipolar disorder who need to learn the program have great difficulty in learning to program. Therefore, in the design of the programming learning website, this study will be based on gamified learning, incorporating a game-like reward and encouragement mechanism, and breaking down large tasks into multiple small tasks that are easy to complete in order to maintain the patients' attention and interest and thus maintain the above-mentioned effects. By improving the learning environment and learning patterns it is hoped that normal learning can be gradually restored in patients with BD. This paper hopes to guide the design of learning websites for this group of patients, with a view to providing a reference for various learning fields. Learning disabilities are common among people with BD, and this distress can largely affect their future quality of life. With appropriate website design, it is possible to adapt BD patients to online programming learning and thus improve learning efficiency. And online programming learning websites derived from research methods of autobiographical ethnography and unstructured interviews as well as theories of gamified learning and color psychology can improve the programming learning experience of BD patients.

Keywords: Autoethnography; Gamified Learning; Bipolar Disorders; Color Psychology; Website Design.

1. Introduction

Bipolar disorder (BD) is currently one of the top 20 causes of disability worldwide, with symptoms most common between the ages of 20 and 25 [1,2]. Despite their mood disorders, this group of patients still need to learn every day, such as programming. The appropriate website design can benefit BD patients who need to learn programming. Because it is difficult for web designers to understand this category of patients through conventional research methods such as interviews and observations. The study will first apply the author's autoethnography research method to conduct the study, and then supplement it with interviews of relevant BD patients to analyze [3]. The method of study above indicates that BD patients are unable to concentrate continuously and lose interest easily. Therefore, in the design of the programming learning website, this study will be based on gamified learning, adding rewards and encouragement mechanisms similar to games, and breaking down large learning tasks into smaller tasks that can be easily completed to maintain the attention and interest of BD patients. This study hoped that through the improvement of learning experiences and learning patterns learning efficiency can be improved in BD patients [4]. The prevalence of bipolar disorder in the global population is about 1%. And appears to be similar in prevalence in women and men [5,6]. Because of lifestyle choices and side effects of medications, learning is commonly impaired in people with BD, which directly affects their future quality of life. Therefore, the learning needs of BD patients should be taken into account. However, the number of literatures focusing on the online learning experience of this patient population is little. Therefore, this study wants to conduct the factors affecting the learning experience of BD patients at different stages of their lives, such as their cognition, emotional feelings, and learning habits. In order to guide the design of programming

learning websites for BD patients, and to provide more inclusive strategies and practical references for the design of learning websites for BD patients in various fields.

2. User Experience Research

2.1 Autoethnography

Autoethnography is a qualitative research method [7,8]. It is also a form of self-reflection writing used across disciplines. In this paper, the author will tell his own story and experience, and relate this autobiographical story to broader social implications and practices.

I am a 22-year-old boy in my fourth year of college, studying software engineering. For the past four years, I have continued to suffer from intermittent episodes of mania and depression repeatedly. Before I turned 18, I loved many things, such as video games, basketball, movies, music, etc., and I was happy. Everything changed the year I turned 18. That year, I entered my junior year of high school and the pressure of school was overwhelming. The overwhelming number of exercises and quizzes made me lack enough rest. In addition, I always heard my parents arguing at home. As a result, something changed in me. I became always depressed, sullen and lacked energy. In terms of study, I could not concentrate in class and my academic performance dropped rapidly, making me feel worthless and I even had thoughts of suicide. Every day I felt depressed, nothing could interest me, and I felt like everything was terrible. I came home from school and spent my days lying in bed, doing nothing, having no appetite, and eating very little every day. Insomnia that always occurred caused me to have even less energy the next day. However, after this situation lasted for 2 months, my situation changed 180° and I suddenly became hyperactive, irritable and cranky. At the same time the desire to spend greatly increased, spending close to 50,000 yuan in 1 month. And I was very busy every day, rarely resting, and at home, I often switched repeatedly between the acts of tidying up my room, reading books, and walking around. During this phase, I was in high spirits, thinking quickly and feeling good about myself. My parents and I seemed to have endless conversations, and I told them about my "future plans", even though everything I said seemed so unbelievable to my parents. In that state, I was unable to socialize properly. After college, my parents took me to the hospital for tests and my symptoms were diagnosed as "Cyclothymic Disorder", which required medication such as mood stabilizers to alleviate the symptoms. After college, I enrolled in a software engineering program. My inability to maintain concentration, fatigue, irritability and lack of patience had a significant impact on my programming studies. Programming is a process that requires focus and patience; however, bipolar disorder prevented me from completing a board independently and completely, resulting in my inability to fully grasp different branches of programming knowledge, inefficient learning, and easy forgetting of what I had learned. I found that I was unable to master the skills I would need to survive in the future. I felt very frustrated.

2.2 Interviews

2.2.1 Participant

By interviewing A, a university classmate of the same major who also suffers from BD, the author tried to verify and supplement the findings of the autoethnography [9]. The research process was designed to take the initiative of both the interviewer and the interviewee and to create a relaxed interview environment that would lead to an in-depth study of the interview questions. The authors used unstructured interviews. The research process will be presented in the form of a dialogue, followed by an analysis to guide design practice.

2.2.2 Procedure

Author: "Hello, nice to meet you! "

A: "Hello! "

Author: "Recently I'm in a lull in my depressive episodes. I have been suffering from having no one to talk to, and this has been very frustrating for me. I am so happy that I can talk to you today. "

A: "Yes, it's almost difficult for us to socialize normally, which is also very frustrating for me. "

Author: "What kinds of behaviours did you engage in before you went to college? How did these behaviours affect you? "

A: "At first, I didn't know that something was wrong with my mental state, so I thought it was all normal. When I was in middle school, there was a lot of competitive pressure in my classes, which kept me in a constant state of mental strain. My grades were pretty good and my teachers and parents had high expectations of me. During a major school exam, I was overly nervous resulting in a poor final grade. I was so upset because I had failed to meet the expectations of my teachers and parents that I went home and cried for a long time. From then on, I became sullen and very depressed. At first, I was just not interested in studying, and later, there was hardly anything that could interest me. My mood became more and more fragile as I continued to deny myself. I ate very little food every day and often lost sleep at night, which took a toll on my body. "

Author: "I sympathize with your feelings because once I experienced some of these situations too. I even had suicidal thoughts, which was very scary. "

A: "I also had suicidal thoughts during the acute phase of a depressive episode, but my parents stopped me. "

Author: "So, after you went to college and chose to major in software engineering, did bipolar disorder cause you any trouble in programming studies? Why? "

A: "Yes, I was diagnosed with bipolar II disorder in high school. When I went to college, I would often feel drained and lacked energy. This resulted in my inability to consistently focus on the learning content at hand. Learning to program requires focus and, more importantly, constant practice. In class, I could barely keep up with the teacher's thoughts, I struggled to learn, and I was afraid to communicate with the teacher because I was not confident. So, I had to look for other ways to learn programming knowledge. Online learning is a good choice. But in terms of the learning experience, it took me 3-4 times more time to master what other students could master in 1 hour. It makes me feel like I'm useless. I am very worried about my future life. "

Author: "I can totally understand that feeling because I've been there. What kind of online learning sites do you think can help you learn to program better? "

A: "I think there should be a new learning model that is different from the traditional teaching model and suitable for BD patients. I think there should be a new learning model that is different from the traditional teaching model and suitable for BD patients and design unique interactive content for BD patients, including UI design. Make it easy for users like me to use."

Author: "Yes, thank you very much for your answer and time! It gives me more understanding about bipolar disorder."

From the above-unstructured interviews in the form of dialogues, it can be concluded that the authors' autoethnography is representative of the study of bipolar disorder. Patients with BD have a general impairment in learning, and this distress can largely affect their future quality of life. The appropriate web design can achieve the adaptation to online programming learning for BD patients, thus improving learning efficiency.

3. Design Strategy

In terms of programming learning website design, the core function of the website is to provide a unique learning experience for different onset cycles of BD patients by designing different types of functions, interactive content, etc. [10]. Bipolar disorder introduces bipolar I disorder, bipolar II disorder, cyclothymic disorder, etc. Different BD patients have different learning habits and onset cycles (e.g., Bipolar II disorder usually never has sufficient manic episodes, while cyclothymic disorder patients show multiple episodes of mild manic symptoms and multiple episodes of depressive symptoms). Gamified learning patterns and unique interactive content are designed to improve the learning experience of BD patients.

3.1 Functional Level: Functional Design based on Interactive Gamified Learning

Gamified learning is an educational methodology that is interesting and aims to encourage learners through the use of gamified design and game elements in the studying environment [11]. It aims to maximize students' learning enjoyment and engagement by drawing their interest and encouraging them to keep learning [12]. Since the 1700s, schools have offered students the opportunity to earn points by turning in assignments and completing tests, [13,14] which is a reward mechanism. The rewards (incentives) are also a core component of the game, providing a constant sense of satisfaction and accomplishment to give users the motivation to keep playing. It also gives positive psychological implications to adjust their mental status and make them put more efforts into the game. For gamified learning, the reward mechanism provides learners with learning motivation driven by spirit. At the same time, it can also encourage learners to persist in learning and not to give up easily. Starbucks' loyalty program is a gamification initiative, in addition to a number of software and web tools that promote healthy routines and improve exercise habits. For example, various check-ins offer rewards for reaching a certain number of days. Levels and achievements, encouraging users to make changes, and follow up on these changes on the web. Gamified education is related to these popular activities of the day, but focuses more on using game elements to promote learners' engagement and create motivation to study.

The "CodeGym" is a website that provides programming learning services.

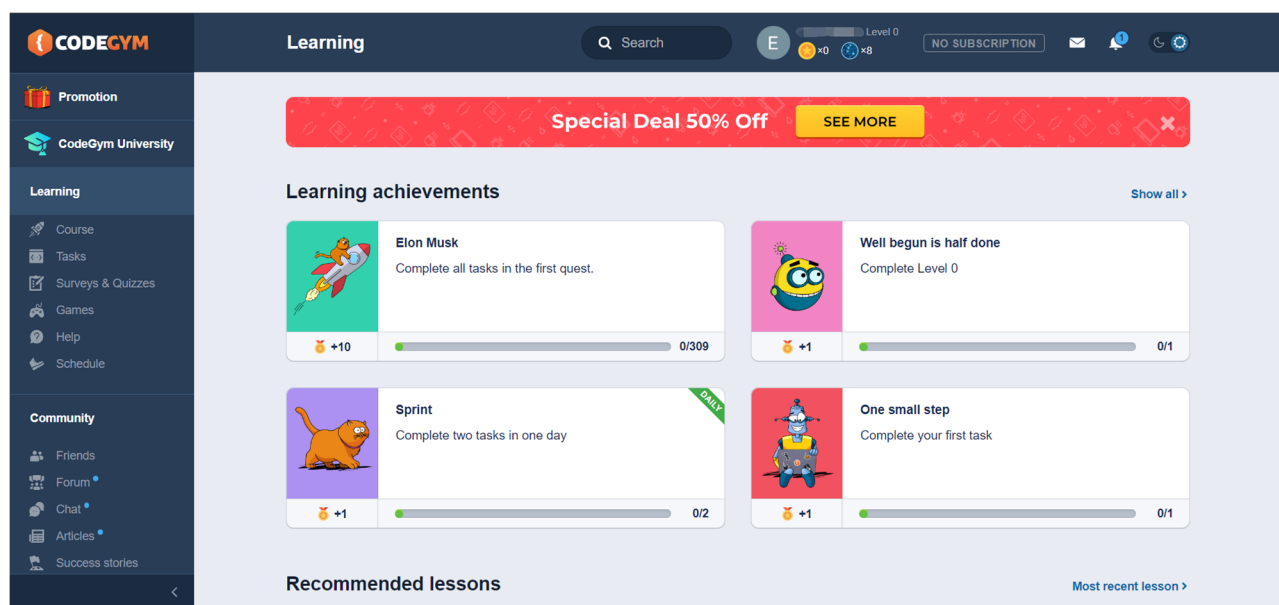


Fig 1. CodeGym

It is currently a representative online programming learning site and has some practical implications for people with bipolar disorder. Functionally designed, the site offers a gamified learning model, which is more suitable for people with BD as a learning method that can increase learner engagement. The model is similar to a video game, with game related content, mechanics such as levels and episodes. It also incorporates programming learning sessions. Based on research and analysis, refine the design of this website and similar websites to be suitable for serving BD patients.

Gamified learning provides a story that serves as a background for the learning activity, the plot. At the same time, the operating model of a TV series is appropriately borrowed, i.e., a suspense is left after each lesson to increase the interest of the users. Learning is the purpose of a gamified system. Sometimes the story is related to the content being learned, for example, in the case of an economic crisis, the economic situation can be improved by learning about economics. The context is the economic crisis and the purpose is to teach economics. In some cases, the story is irrelevant; for example, a physical education student learns physical education as a means to complete a track,

experiencing various challenges in the process; here the context is the effort to create music, and the purpose is to teach physical education.

3.2 Interaction level: Interaction Design based on Color Psychology

Color psychology is the study of colors that can significantly influence human behavior. Color can evoke certain emotions in people. The study has applications in many other fields, such as sports, medicine, hospital environments, therapeutic tools, and game design [15]. Carl Jung is considered one of the pioneers in this field, who studied the characteristics and meaning of color in human life. He once said, "Color is the native language of the subconscious." In interaction design, color is used to influence vision [16]. Examples include matching colors to navigation bars or matching behaviors to the most prominent colors in vision to increase audience attention and cause them to change their behavior.

A book called Color and Cancer created by Dr. Charles Ireland of Guy's Hospital in London in 1930, which recommended the use of concentrated doses of colored light to treat cancer [17]. In the 1930s, color began to be used extensively in hospitals, notably by the initiative of Faber Burren, who identified himself as an "industrial color consultant" in 1934 and suggested the use of soft green to create a relaxing environment for patients and to comfort them [18]. Bipolar manic patients prefer red and bipolar depressive patients prefer blue. After receiving treatment, cool tones (blue and green) rose and warm tones (red and yellow) fell in bipolar manic patients, and both cool and warm tones rose (blue and red) or fell (yellow and green) in bipolar depressive patients. The color preference of bipolar disorder patients is influenced by their emotional symptoms, and reasonable adjustment of cool and warm tones can help stabilize patients' mood.

4. Results

4.1 Functional Level

4.1.1 Learning Mode

Design a gamified learning model to enhance the learning efficiency of BD patients.

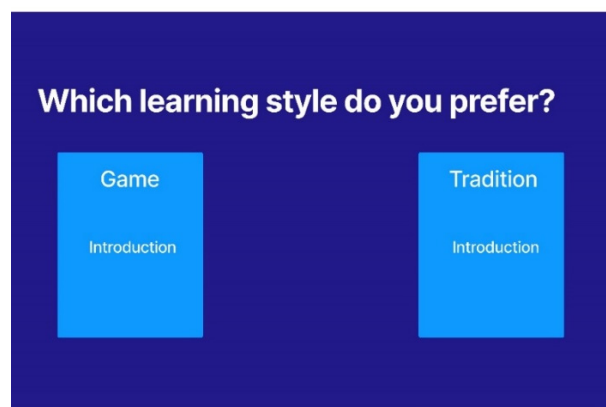


Fig 2. Learning Preference

4.1.2 Background Design

Game-based learning requires a global story as the context for each learning activity. Game-based learning can have many different story contexts (depending on the imagination of the designer and how the content will be introduced in the future). In this paper, we use the theme of "Alien Survival" as an example to introduce the construction of structured content for game-based learning. "Alien Survival" is a story context related to programming learning, which is outlined in this paper, but more details and content will need to be developed in the future. Game-based learning should include: background, description of the plot, introduction to the task, lesson instruction on the knowledge needed to complete the task, reward for the task, and an end goal.

The background of the "Alien Survival" theme tells the story of an astronaut who, in the distant future, takes the role of an astronaut and follows a team of spacefarers from Earth on an exploration mission to a galaxy beyond our solar system (at a time when science and technology already allowed humans to travel beyond our solar system). After several months of flight, the vehicle arrived at the target and prepared to land. It was an extrasolar terrestrial planet, and the goal of the mission was to explore the data of the terrestrial planet in order to carry out interstellar migration to solve the crisis faced by mankind after the depletion of energy on Earth. But the landing process due to the sudden changes in the planet's weather conditions, resulting in serious damage to the vehicle when landing, most of the equipment in the cabin damage has been unusable, and food bins have been destroyed, food for the entire crew for three days (the original amount carried enough to support the entire crew in the course of the mission to eat). The good news is that the astronauts were unharmed. Each astronaut had a robot with basic systems installed (only the most basic functions were supported, e.g., walking, allowing functions to be added through programming, etc.). Allowing the user to name them). Initially, the purpose of carrying them was simply to help the astronauts perform their missions better. At this point, these robots became the key to survival. Users need to program their robot's step by step to give them functionality (at this point, programming is added to teach content, e.g., code needs to be entered to enable the robot to recognize voice commands). As the user continues to learn, the robot's functionality is improved. The robot then goes on to explore the planet, measure data, collect samples, find food, and other tasks. Eventually, it works with a partner to repair the vehicle (providing the option to allow the user to choose whether to work with others on a particular code segment) and return to Earth.

Gamification episodes can be used in the form of video, text, animation, etc.

Content



Fig 3. Content

4.1.3 Voice Assistant

Played by a robot in the episode to enhance the immersive experience. Provide a voice reading function that supports adjusting the speed and volume of speech (auditory and visual working simultaneously helps improve concentration). Provides interactive features that allow users to communicate with the voice assistant. Voice assistant announces the content of rewards earned by the user through voice, level upgrade reminders, etc. Regularly asks users about their mood and physical condition via voice and asks if they can continue learning. Set up to remind BD patients of their medication on time. Set up for the voice assistant so that it can guide BD patients to use the website better.



Fig 4. Voice Assistant



Fig 5. Voice Assistant Button

4.1.4 Reward Mechanism

Take "Alien Survival" as an example, every time a user completes a part of the storyline, he/she should be rewarded with "Experience Value (Experience Value is used to upgrade the user's account level, not the relevant character level in "Alien Survival", the plot (the user needs to program their robot to upgrade), "Achievement Points (achievement points are used to upgrade achievement levels, achievements are mostly learning related, e.g. using a certain programming statement to successfully upgrade a robot and give it a certain function)" and "Titles (e.g. Master Programmer)", and a series of levels and achievement gradients. Quantify the user's learning results so that he or she can see his or her gradual progress, thus increasing his or her confidence and sense of accomplishment. Positive psychological cues are used to "upgrade" the user's efforts, thus increasing learning efficiency.



Fig 6. User Level & Title



Fig 7. Reward System

4.1.5 Community Functioning Switch

Stress (including school, work, and family stress) is the main cause of most BD patients, of which the author is one. Therefore, switch options for community functions such as comments should be provided for patients with different levels of symptoms. For example, for patients who, like the author, have study and work stress as the main cause of their disease inevitably experience stress and anxiety when reviewing community content or comparing with others. In severe cases, the condition may be aggravated. In addition, patients' self-esteem can also contribute to this phenomenon. However, some patients with BD want to enrich their learning with more community content, and they should be enabled to turn on the community function at this time.



Fig 8. Community Switch

4.1.6 Task

Instructional content needs to be moderate and should not be too difficult. Break down large tasks so that they are easy to complete. Ration daily tasks and allow users to choose whether to add new tasks after completing the daily learning tasks. For example, each chapter's large task is divided into 10 smaller tasks, and the user cannot see the content of subsequent tasks until the smaller tasks have all been completed. This prevents users from seeing many unfinished tasks and giving up on learning.

Task 1

Write a program so that it outputs: "Hello! Astronaut!" . Add voice functionality to the robot.

Enter your answer here

Submit

Fig 9. Task Example

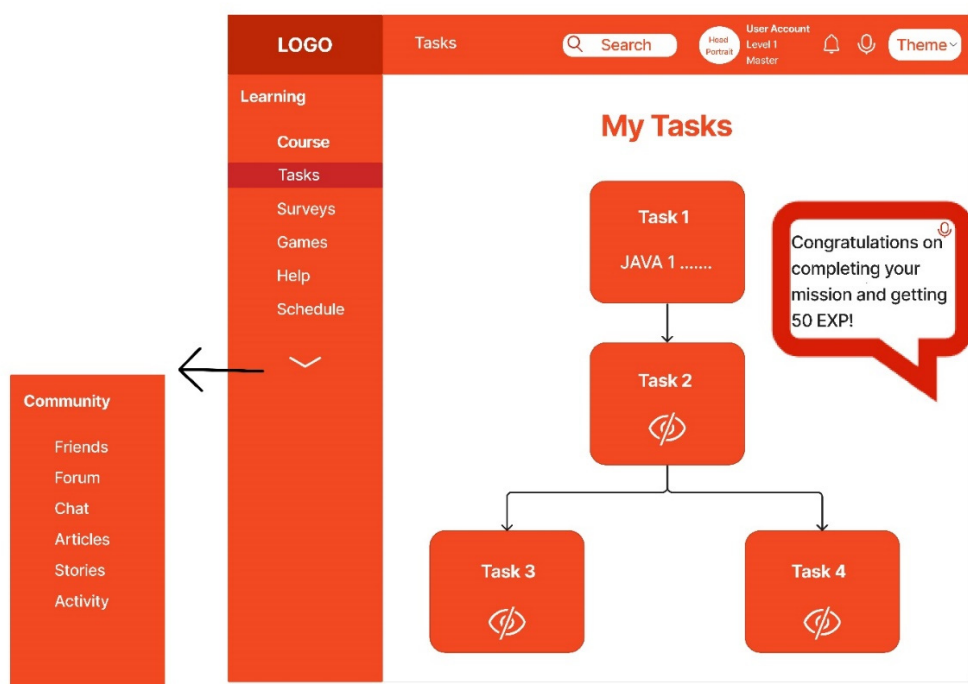


Fig 10. Task Section

4.2 Interaction Level

4.2.1 Layout Design

In view of BD patients' easy loss of attention and diminished abstract thinking ability, the website itself needs to be more concise, which can be achieved by, for example, reducing text, color types, options and navigation buttons, etc. The teaching content should be straightforward and concise, and explained in detail. Too much and too messy content will make BD patients unable to focus on the core content and waste their limited time to stay focused, and even strengthen the intensity of mental stimulation during manic episodes. Enlarging and boldening the font (highlighting the core content) and using common web fonts can also improve the efficiency of concentration.

4.2.2 Theme and Page Palette

The Sea theme is recommended for BD depressed patients. This interface mainly uses the blue color, which is preferred by BD depressed patients. After BD depressed patients receive treatment, they are recommended to adjust the theme color through the page palette. showed an increase in the preference for blue and red, and a decrease in the preference for yellow and green in depressed BD patients after treatment. For BD patients in the acute phase of depression, other non-learning content recommendations (e.g., videos and pictures related to travel, life, etc.) of the patients' choice were

provided during this period to suspend their learning and distract them, thus reducing the risk of suicide and self-harm. For patients with major depressive disorder, they should stop using the website and be hospitalized for treatment during episodes of illness.

Sunny theme is recommended for BD manic patients. This interface mainly uses the red color favored by BD manic patients. after BD manic patients receive treatment, it is recommended that they adjust the theme color through the page palette off. showed that after treatment, BD manic patients showed an increase in their preference for blue and green, and a decrease in their preference for yellow and red. Patients during severe manic episodes and during the acute phase of manic episodes should stop learning activities and be hospitalized for treatment.

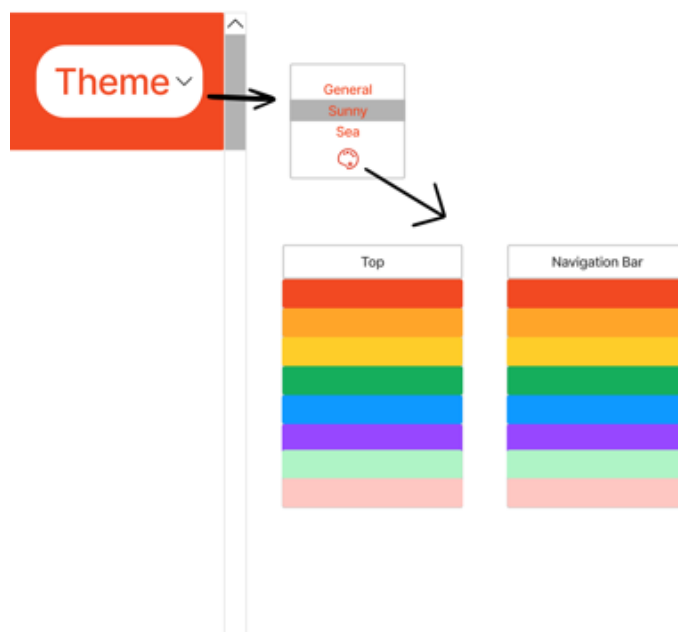


Fig 11. Theme & Palette of Sunny



Fig 12. Theme & Palette of Sea

4.2.3 Sea

With this theme, the page should have upbeat background music. Minimize the number of ads so that BD patients can focus on the learning content itself. When BD patients choose this theme, reduce the learning content appropriately, e.g., usually set 10 tasks per day, reduce it to 6 tasks under this theme. This prevents depressed BD patients from losing interest due to too many tasks. Set the voice assistant to shorten the voice greeting interval, so as to better understand the patient's situation.

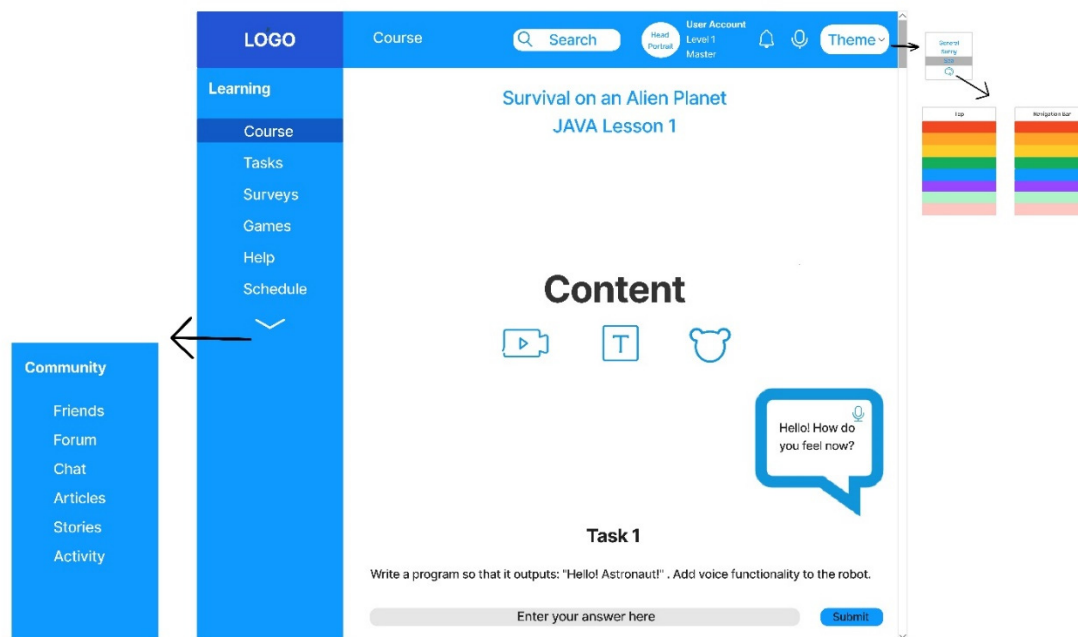


Fig 13. Sea Theme

4.2.4 Sunny:

Under this theme, the page should be set with soothing background music to reduce the volume of the web page. Thus, reduce the stimulation of sound to BD manic patients. When BD patients choose this theme to appropriately increase the learning content, fully utilize the characteristics of the patient's accelerated thinking speed during mania to appropriately enhance the learning efficiency of BD manic patients.

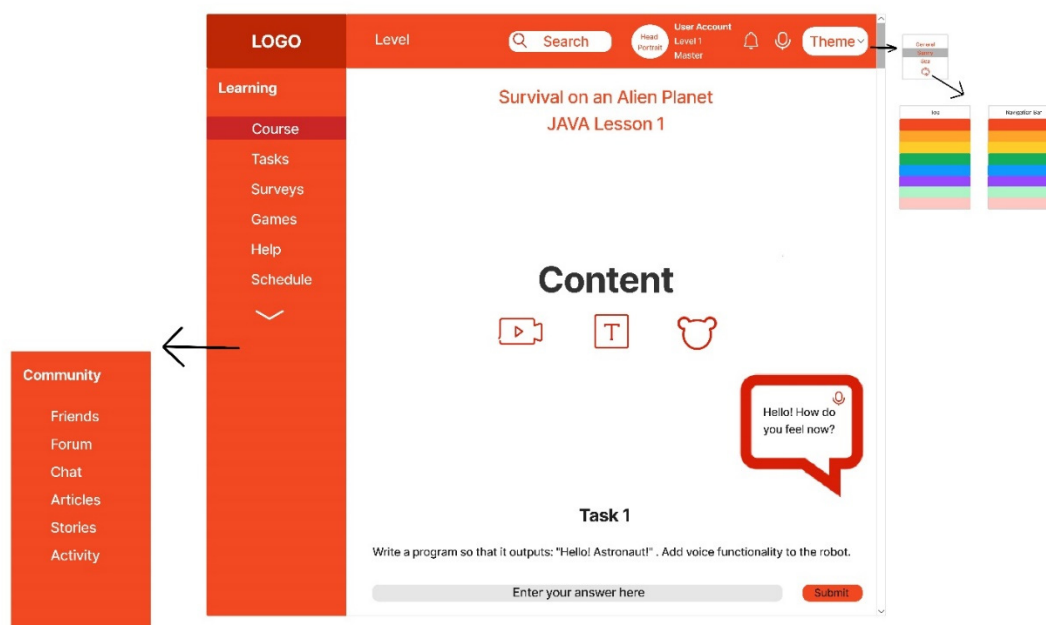
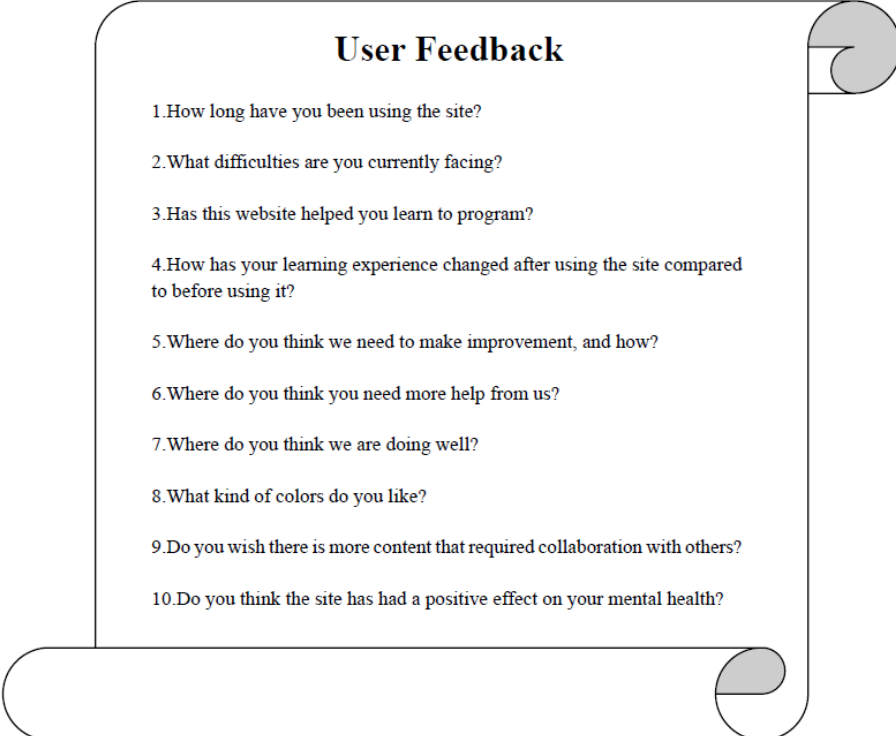


Fig 14. Sunny Theme

4.2.5 Design Feedback System

Receive feedback from patients on their use and provide them with guidance on adjusting their learning plans, visual design, and related services. Patients who have had a poor experience should be encouraged to make suggestions and be given the necessary assistance.



User Feedback

- 1.How long have you been using the site?
- 2.What difficulties are you currently facing?
- 3.Has this website helped you learn to program?
- 4.How has your learning experience changed after using the site compared to before using it?
- 5.Where do you think we need to make improvement, and how?
- 6.Where do you think you need more help from us?
- 7.Where do you think we are doing well?
- 8.What kind of colors do you like?
- 9.Do you wish there is more content that required collaboration with others?
- 10.Do you think the site has had a positive effect on your mental health?

Fig 15. User Feedback

5. Conclusion

The above design suggests that an online programming learning website derived from an autobiographical ethnography and unstructured interview research method as well as theories of gamified learning and color psychology can improve the programming learning experience of people with BD. However, the research process in this paper was limited to the autobiographical ethnography method and single-person interviews, and the sample size was relatively small and not widely representative. Therefore, in the future, we hope to conduct more studies on BD patients and color psychology and expand the research sample size to serve BD patients more effectively. This paper only provides a conceptual output on gamification design, and future empirical studies are still needed. And gamified learning can have more story content and story details that need further development in the future.

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