

Designing a Digital Aid to Help Adapt to a Type 2 Diabetes Diagnosis

Abstract:

This paper details the development of a Digital App to assist patients who are newly diagnosed with Type 2 Diabetes in making the lifestyle adjustments required to maintain their health. It was developed over the course of a semester long project in a graduate level Industrial Design studio class. The instructional goals were to introduce and refine skills related to collaboration with industry professionals, research and analysis from multiple sources, engagement with end users, and creation of functional prototypes to facilitate user testing and refinement. The nature of the project and the specific project requirements were defined so as to provide proper education of future generations of industrial designers for a more inclusive world.

1 Introduction

In the United States, more than 37 million people have diabetes, with 90-95% of them having type 2. With Type 2 diabetes, the body does not respond to insulin normally, resulting in abnormally high levels of blood sugar. Type 2 diabetes often develops in people over 45, but it is increasingly prevalent in children and teens (CDC, 2022). Successfully managing Type 2 diabetes requires a number of significant lifestyle changes. These changes can be difficult and lead to social or psychological problems that get in the way of a person's ability to self-manage their diabetes (Garrett, Doherty 2014). The need to perform glucose monitoring for example, has been described by adolescents as the least favorite task, leading some to avoid testing in social environments due the associated stigma (McCarthy, Ramirez, Robinson 2017).

Behavioral factors are an important component of successful diabetes self-management. There is a high prevalence of depression with diabetes and an opportunity to integrate mental health treatment with diabetes care in order to improve patient and public health outcomes (Ducat, Philipson, Anderson 2014). Generalized anxiety disorder and eating disorders have been found to be more prevalent in people with diabetes (Robinson, Luthra, Vallis 2013).

This paper presents a case study of a student solution for improved diabetes management. It was developed over a semester long project in a Master level studio course focused on healthcare design. It was sponsored by [Removed for review], who supported the project teams with funding and expertise.

Students in the course were provided a brief that outlined prompts for several different project directions. This was followed by virtual panels of industry experts who were made available for questions in order to help students identify a project direction to undertake. The team featured in this paper focused on a topic of ‘treatment of chronic diseases.’ Once identified, over the course of the project students were expected to engage in collaboration with industry experts, perform research and analysis from academic literature as well as from forums and end user information available online (referred to as netnography), develop and test evidence-based design solutions, and finally to generate a functional prototype to allow for usability testing, validation and refinement.

Industrial Designers routinely engage users to better understand design problems as it is not possible to truly solve a problem without this understanding. The goal of this paper is to present an overview of the design process used by students in the design of a Digital App intended to assist Type 2 Diabetic patients; specifically to highlight how user research and usability testing were used successfully in the development of a proposed design solution and its impact on student learning and design outcomes.

2 Method and Development

Several project sponsors pitched possible projects to the students at the outset of the semester, after which students formed teams of 2-3 individuals to address their choice of project over a full semester.

After reviewing project choices, two teams of 3 students chose to tackle problems relating to the “Treatment of Chronic Diseases”. Initially, both teams of students performed background research in order to better understand the problem, the needs of users, the nature of competitive and compensatory solutions and to identify appropriate design objectives and criteria for subsequent design efforts. As a part of this initial research, students identified stakeholders and the needs of users so that they could develop personas to help better empathize with the needs and concerns of potential users.

After this initial research into the problem, both teams decided to focus on the needs of Type 2 Diabetic patients but taking different avenues to assisting users. The team whose efforts are the subject of this paper chose to address the difficulties faced by newly diagnosed patients in making required lifestyle adjustments (i.e. diet, exercise etc..) to maintain their health.

A virtual interview was initially conducted with an expert from [Removed for Review] in which students learned that Type 2 Diabetes is difficult to self-diag-

nose and that 25% of the money spent on healthcare in the US is spent on treatment of Diabetes. They also learned that patients diagnosed with Type 2 Diabetes have more difficulties than those with Type 1 Diabetes in making required adjustments in day-to-day diet and exercise habits because Type 1 patients are typically diagnosed at a younger age. The reality is that making changes to an established lifestyle is difficult.

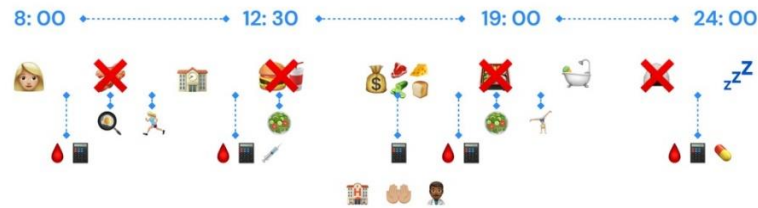


Figure 1. Journey Map of Lifestyle Changes Required by Type 2 Diabetes Diagnosis

Netnography and a literature review were conducted to research the emotional and mental effects of Type 2 Diabetes. Takeaways from this effort included the understanding that psychological and social problems affect roughly a third of diabetic patients, more prevalent than what would be found in the general population.

Working with family and friends, the team interviewed an elderly Diabetic patient with whom they were able to discuss challenges that she faced in treating her Diabetes. Insights from this interview that made an impression on the design team included (1) the understanding that the first three months immediately following a diabetes diagnosis is different from following phases; and (2) that adjusting to a healthier life-style "can be rewarding".

As the team was interested in developing an App to address the problem, 30 "competitive products" (Apps marketed to Diabetic patients) were evaluated to ascertain their particular strengths and weaknesses so as to identify design opportunities for the design of a new App. It was determined that the general approach of each app could be assigned to 1 of 4 categories: All-in-One Solution, Diet and Recipes, Community, or Blood Sugar Tracker.

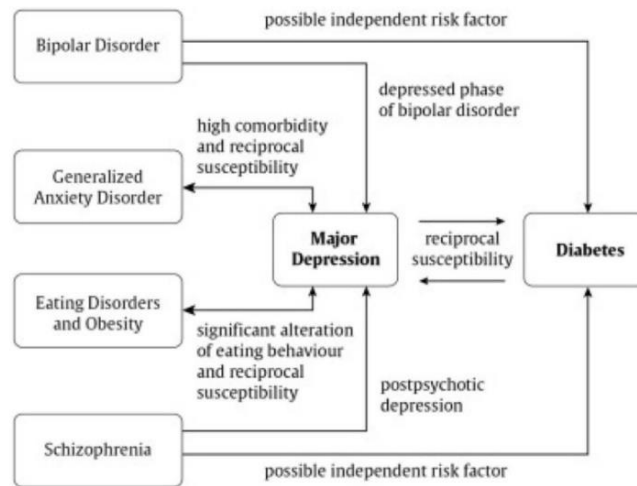


Figure 2. Correlation between Serious Mental Illness and Diabetes

After this evaluation of competitive Apps, the team noted that many products address issues of blood sugar measurement and lifestyle recording but that none address issues related to the psychological problems experienced by diabetic patients. This was recognized as a key design opportunity.

Initial research findings were analyzed, and design objectives and criteria were developed to guide subsequent design efforts. Teams presented a summary of their preliminary research and the resulting problem statements and design goals to the project sponsors to provide the opportunity for confirmation/correction.

The team that is the focus of this paper developed the following problem statement: “Diabetes patients are faced with huge lifestyle changes and are under stress, which are more likely to lead to emotional and mental issues. This will affect their treatment, attitudes and behaviors, making it a vicious cycle”. The stated goal was “to create a product that mitigates mental issues of diabetes patients in order to let them better focus on healthy lifestyle and diet, and better control their disease”. Specifically, the product should address issues of emotional support, adjustment to lifestyle habits, and provide an online community and treatment guidance.

At this point, student teams proceeded to generate ideas using a 2D ideation process. Several different brainstorming techniques were discussed in class and a variety of suggestions were made to help students generate as many ideas as possible throughout this process. Students were encouraged to approach the problem incrementally (i.e. break overall problem down into manageable pieces), from different POV’s (including generation of ideas that would make the problem worse...), to changing up their environment and activities to maximize productivity. (These strategies are based on the understanding that the range of ideas one can generate is necessarily limited by one’s experience and surroundings).

Ideas were initially sorted according to common topics or themes and subsequently were then organized into concept proposals using morphological matrices.

The initial App concept proposed by the team was envisioned as a “one-stop experience” that would permit patients to manage their daily life in key areas including diet, social life, exercise and medication - all previously identified as pain points for the newly diagnosed Type 2 Diabetic patient.

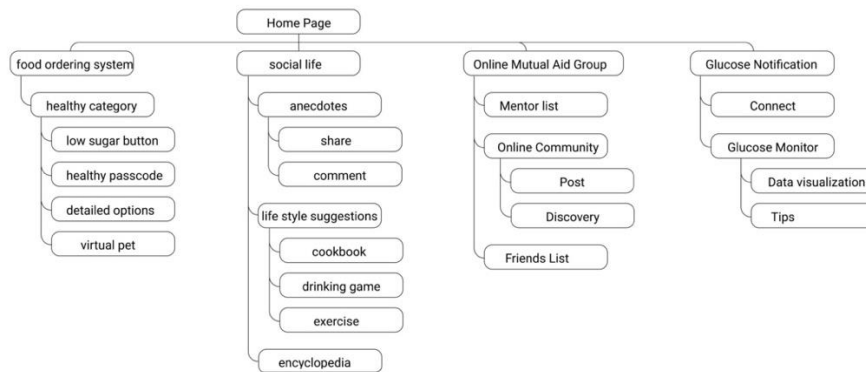


Figure 3. Key Features Needed in App Solution

In the case of digital solutions, wireframes were prepared to represent possible configurations for each App concept.

At this point, the team recognized that additional research was needed in order to better understand user needs. 6 interviews were remotely conducted with Diabetic patients. Most of these interviewees had prior experience with Diabetes support groups and the larger community. By organizing and evaluating the observations made during these interviews, it was observed that those patients with a generally positive outlook tended to offer more insights and exhibited more control of their outcome as opposed to those with negative outlooks, who tended to lack motivation, complained about the need to adjust their lifestyles and also exhibited poorer physical conditions. Respondents reported that the need for lifestyle changes and the inability to control their behavior had the most influence on negative outcomes. It was recognized that differences between individuals may make it necessary to provide both general and individual treatment strategies. It was also determined that patients typically need immediate results when testing for blood glucose levels after eating or exercising. Finally, it was also determined that there seems to be a causal relationship between a lack of medical knowledge and negligence in self-care.

After conducting these user interviews, the student team developed additional refined concepts that specifically addressed the pain points identified by interviewees. Some of these concepts included physical components in addition to the digital App functionality. The three refined concepts were evaluated in terms of their inherent “Pros” and “Cons” in order to identify the most promising direction.

After careful consideration a single concept was selected for subsequent development based on its “patient-centered” platform “that can provide all the information and support patients need to go through the tough transition period [immediately after a Diabetes diagnosis]”.

Refinements were made to all aspects of the chosen concept. Personas were developed to represent three different user groups, including mentor/guides, optimistic learners and negative patients. The intent of these personas was to help the team better empathize with users and to understand the interaction between and relationships among the different user groups.

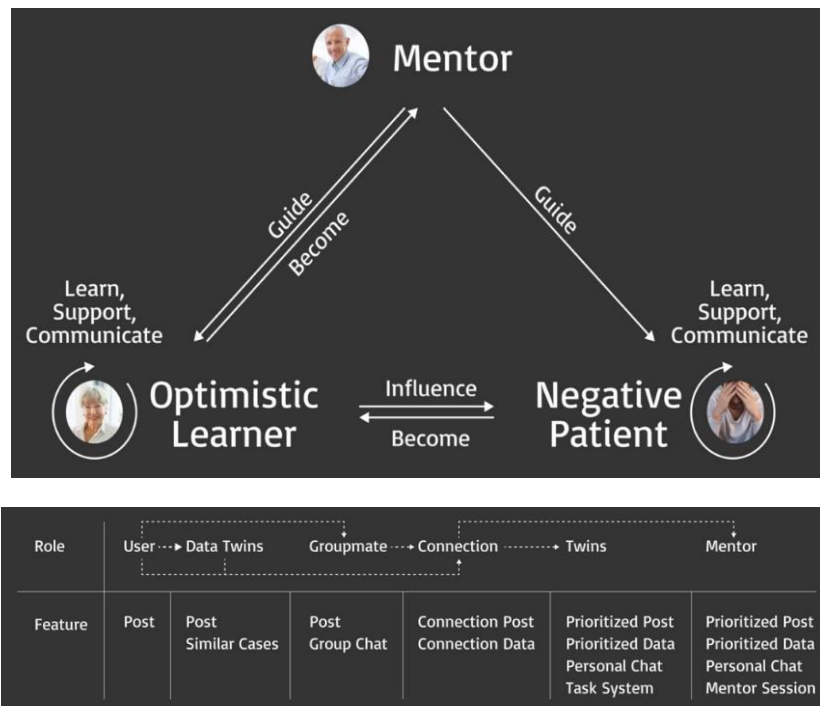


Figure 4. User Flow and Relationships Key to Final Concept Based on Analysis of User Interviews.

There are multiple relationships in which users can interact with one another as they transition between the “Negative Patient”, “Optimistic Learner” and “Mentor” roles - as shown in Figure 4. This led to the concept of users connecting with “Data Twins” and “Mentors” to ease the transition period after a Type 2 Diabetes diagnosis, a result that is innovative and central to the team’s approach to the problem.

The team then created a low-fi digital prototype of the refined App design. This prototype was tested with a group of four UX designers (shown in Figure 5), who were asked to complete a list of tasks. The completion time and rates were documented and analyzed to validate the usability of this App concept.



Figure 5. Usability Testing of Lo-Fi Prototype of Final Concept

The team then refined the final App design based on the results of this preliminary usability testing. As a part of this final refinement, the team developed a graphic theme that addressed the colors, icons and typography used in the final App design to provide a unified aesthetic. Given sufficient time & resources, the next step would be to test the refined App design with actual end users – newly diagnosed Type 2 diabetes patients to learn whether the proposed app could be an effective tool in making the required lifestyle transitions.

3 Results and Discussion

Using a design process that involved engagement of users during research and preliminary concept refinement based on limited testing of initial designs with users permitted the team to develop a more relevant solution to the identified problem. Students benefited from working directly with industry experts and interviewing potential users. The final solution developed by the team was refined in response to testing of a low-fi prototype by UX designers with expertise in the development of digital Apps. Clearly this process resulted in a more successful proposed solution to the problem(s) identified by the team. While user testing of proposed solutions was an educational requirement for this studio, the degree and effectiveness of testing varied substantially between the teams. Testing with actual users would ultimately be more meaningful.

The final solution developed by this team was particularly innovative in the aspects of the idea of “Data Twins” (users with similar characteristics) and creating mentors for the newly diagnosed (by “Becoming a Giver”). This concept was illustrated in the final presentation by the team through the analogy of a novice rock climber typically seeking guidance from a more experienced climber and the reliance of climbers upon one another during climbs (i.e. connected with climbing ropes). These aspects of their solution most certainly would not have been identified or pursued further had the team not engaged users during their research efforts or had the benefit of interacting with industry professionals.

4 Conclusions and Recommendations

The improvements in final project deliverables demonstrate the effectiveness of user testing and subsequent refinement and resulted in designs that were demonstratively more effective solutions to the problem. It is the admittedly subjective opinion of this author that only 3 of the 6 teams that participated in this project developed unexpected or particularly innovative solutions. 2 of those 3 teams employed significant user research and usability testing in developing their solutions.

The design team featured in this paper identified several action items to further improve upon their proposed solution in future efforts – including the need for usability tests with target users (i.e. evaluation by users who would be in the position of incorporating the Digital App into their lives while adjusting to a Type 2 Diabetes diagnosis vs. UX designers), developing a web-based version of the platform, developing a version for elderly users, as well as the identification of potential sponsors and technical support resources and ultimately developing a business model.

References

- CDC, 2022. <https://www.cdc.gov/diabetes/basics/type2.html>. Retrieved July 1, 2022.
- Ducat, L., Philipson, L. H., and Anderson, B. J. (2014). The mental health comorbidities of diabetes. *Jama*, 312(7), 691-692.
- Garrett, C., and Doherty, A. (2014). Diabetes and mental health. *Clinical Medicine*, 14(6), 669.
- McCarthy, G. M., Rodriguez Ramírez, E. R., and Robinson, B. J. (2017, June). Participatory design to address stigma with adolescents with type 1 diabetes. In *Proceedings of the 2017 Conference on Designing Interactive Systems* (pp. 83-94).
- Robinson, D. J., Luthra, M., and Vallis, M. (2013). Diabetes and mental health. *Canadian journal of diabetes*, 37, S87-S92.