Colorwill: An iPad App Offers A New Way To Learn Color Theory On Digital Devices

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Analysis

A. Background and problem description

Although a basic understanding of the color spectrum is easy to develop, the establishment of color theory is a complex subject requiring the foundation of both science and art. One of the first known theories about color is On Colors, an abbreviated written passage in ancient Greece. The passage was believed to be attributed to Aristotle and members of his Peripatetic school (Eskilson, 2012). Based on observations of how color behaves in nature, the text argues that all colors exist in a spectrum between darkness and light and that four primary colors come from the four elements: fire, air, water, and earth (Eskilson, 2012).

Isaac Newton completely redefined color theory based on the behavior of light. Rather than seeing light as a void of color, Newton discovered that white light is a combination of all colors across the color spectrum (Eskilson, 2012). For the first time, the color spectrum was represented by a circle and color mixing was explored and practiced.

Another significant progress of color theory was created by American painter Albert Henry Munsell in the early 1900's. Munsell's color system includes three dimensions: The hue determined the type of color (red, blue, etc), the value determined the brightness of the color (light or dark), and the chroma determined the saturation of the color (the purity of the color). (Eskilson, 2012) These dimensions are still used in the RGB color model.

The color theory and method used today to study color theory were based on Bauhaus school in the early 2oth century. The Art of Color by Johannes Itten and Interaction of Color by Josef Albers are the main foundation publications used in design school today. Itten's book

focuses on how color can be combined to invoke feelings in the viewer. Designers and artists must master the existence of seven color contrasts in order to know the effect of their color choices. Albers focused on showing how human tend to perceive a color based on the colors around it. Designers and artists should repeat the experiments in his publication to make educated decisions about color composition.

As the current demand for art and design on digital platforms increasing and overhauled those on traditional platforms, the requirement for artist and designer to have a strong foundation and sensitivity in color on digital platforms is a must. Moreover, constant practicing is the necessary to keep improving the skill and sensitivity in color application in design and art-making. Also, color exercises on digital devices is a more practical option due to space and cost limitation of practicing color usage in real life. However, the current color learning and practicing on digital platforms is very limited. The only two color exercising apps based on color learning curriculum are the Interaction of Color by Josef Albers and the Intro to Colors, by Montessorium. The Interaction of Color is an academic practice with the requirement of long-time color mixing virtually on iPad. The Intro the Colors sets the target learners as children 4+ but not training artists and designers so the exercises are mostly amateur color wheel, color ladder, and coloring book. There is a big gap in effective digital color training application in color exercises for designers and artists.

B. Target audience

The target audience of Colorwill are visual artists, visual designers, and other professionals that need to learn and improve their way of handling colors. The types of work that artists and designers create involving significant influence of colors include paintings, sculptures,

books, marketing assets, posters, album covers, videos, etc. During the process of creating works, artists and designers are required to create a color palette to help emphasize the message conveyed through their works. Therefore, each color palette is distinctive and crucial in each artwork or product that artists and designers create. Each artist or designer's ability and their ways of color application are different. However, as the need on digital arts and digital graphics is dominating over traditional media, like paper, print, plaster, etc. artists and designers' knowledge on creating works on digital medium is much needed. The current learning model of color theory and application is still based on traditional media. Artists are expected to learn by doing and acting together, whereas the current learning model and platform can't nurture artist and designer to create on digital tools natively. In Jyrämä and Äyväri (2005)'s research, they interviewed artists for a better understanding of the knowledge-creation process in art training. Their analysis indicates that practices are best learned by doing. They also proposed that many learning processes can take place through virtual and collective means nowadays. In order to transfer the knowledge of the book to one's artistic practice, artist and designer need to reflect upon it and use it in context (Jyrämä & Äyväri, 2005). Moreover, one establishing an identity as artist or designer should not be only in one's own eyes but also in the eyes of other (Jyrämä & Äyväri, 2005). Thus, community activities including giving and receiving feedback to and from artist and designer community as well as collaborating with artist and designer community are crucial.

C. Learning Context

Medium - iPad

Even though the use of digital media tools on learning has increased over the past two decades and arts and design have incorporated a significant use of digital tools, their role in teaching and learning arts and design has remained under reached. The significance of the use of non-digital tools for teaching and learning in art and design is largely based on sketching. Bilda and Demirkan (2003) indicates that traditional tools could better form the perception of visual-spatial application in art and design. In addition, they argued that traditional tools can better form the compositions and relations of design, enhance creativity in the conceptual stage, promote better conceptions of the design problem, assist the development of alternative solutions and make more effective use of time (Souleles, 2017).

However, thinking on paper is not always the best place to start. Using traditional design tools might limit designers' thinking and treatment of abstraction, due to the limited working space and lack of redo or modification options available (Souleles, 2017). In addition, using traditional tools might limit the ability to make a detailed design as efficiently with digital tools. Furthermore, the increase of students, who are more familiar with digital tools makes it easier to build art and design on digital tools (Souleles, 2017).

With these disadvantages of traditional tools in teaching and learning art and design, using digital tools is much needed. Souleles (2017) conducted an experiment that compared two groups of students, using paper and pencil or iPad and digital pen as accompany to a same graphic design class. The result shows multiple advantages of iPad with a digital pen, including more functions, easy to develop ideas, portability, ease of use, transferable knowledge to other digital tools, and easy to work with colors. Souleles (2017)'s result shows that iPad is the perfect

platform for this project: it's portable; it has more function;s the familiarity of using iPad is transferable to other digital tools; it's easier to work with colors than on traditional tools.

Online Community

Feedback is essential for design process because it reveals gaps between designer's intention and audience's perception. Knowing where the gaps exist is crucial for artist and designer to iterate toward more effective solutions. In addition, from a creative cognition perspective, feedback can foster insight or unblock creativity because the feedback serves as retrieval cues that activate new memory items and thought production, which in turn, can spark new understanding and new solution approaches of a design. Crowdsourcing offers an emerging opportunity for users to receive rapid feedback on their works. Based on Xu, Huang, & Bailey (2014)'s research, four types of design feedback that would be helpful to artist and designer and would be able to be generated systematically. They are the visual hierarchy, the first impressions, whether the crowd understands the communicative goals of the piece, and assessing the piece relative to design guidelines, e.g. Contrast, proximity and alignment. The four types of feedback should be formatted systematically and intuitively in the mechanism.

D. Learning Goals and Objectives

The goal of using Colorwill is to help visual artists and designers improve the understanding and skill of color application through participating in daily exercise and community interaction. Daily exercises are designed based on three basic categories of color theory: the color wheel, color harmony and the context of how colors are used. The solid understanding of color wheel includes a mature application of primary, secondary colors, and tertiary colors. Color harmony is the goal of manipulation of color schemes. A color scheme can

be based on analogous, complementary, triad, split-complementary, tetradic, and square colors. Manipulating color context is applying the contrast effect that the same color could behave differently in relation to other colors and shapes. On top of the three basic categories, the reaction that the viewer gives to a color or color application is also crucial. Therefore, understanding colors and its symbolism is also a goal of the design exercises.

The improvement of the student's understanding and application of color will be monitored through the rating of each exercise by the community that is also using the app. Based on Xu, Huang, & Bailey (2014)'s research, four types of design feedback that would be helpful to artist and designer and would be able to be generated systematically. They are the visual hierarchy, the first impressions, whether the crowd understands the communicative goals of the piece, and assessing the piece relative to design guidelines, e.g. Contrast, proximity and alignment. Colorwill adopted these criteria in the evaluation of each exercise made by other community members. Through the daily usage of Colorwill, the learner is expected to have better rating in each components.

E. Review of competing (existing) project

Interaction of Color by Josef Albers

The Interaction of Color is a mobile app for iPad that includes the original book as well as exercises that allow the users to create and share their own. The diagram of the app is referred to Figure 1. Some beneficial features include 1) easily navigating between text, definitions, and examples; 2) tapping on an example to study its construction and colors in detail; 3) using digital tools to replace the experience of working with cut and colors paper; 4) seeing how the same color can look different on different grounds by simply lifting and moving the color pieces; 5)

easily pulling and placing swatches into user's designs; 6) collecting and exporting swatches; 7) sharing works by emails, Facebook, and Twitter; 8) audios of Albers and videos of other artist and designers discussing the texts and exercises.

However, there are some fields that the Interaction of Color app is missing. First, the app only includes the exercises that Albers designed, which are mainly focusing on how colors work with other colors. The exercises missed out the intentions of artist and designer creating the work and the impression that artist and designer want to make in real life contexts. Second, the app only allows users to share the work through emails, Facebook, and Twitter, which lack of a community giving crowdsourcing feedback for the work.

Methods of Analysis

To measure the student's improvement and the effectiveness of the app, qualitative data analysis is used as the method of analysis. The improvement of the student can be seen based on the average rating on his/her first assignment comparing to the feedback on his/her latest assignment. The rating criteria include the visual hierarchy, the first impressions, whether the crowd understands the communicative goals of the piece, and assessing the piece relative to design guidelines, e.g. Contrast, proximity and alignment. The four rating criteria were designed based on Xu, Huang, & Bailey (2014)'s research, these design feedback would be helpful to artist and designer and would be able to be generated systematically. In the section of evaluation for each exercise, each criterion can be rated as "great", "fine", or "bad". The app will record "great" as 3 points, "fine" as 2 points, and "bad" as 1 point. For example, one could rate a project have great first impression, fine visual hierarchy, fine design guidelines, and bad in being

understood by non-designers or artists. In the case, the rating of exercise one (E1) is equal to first impression (F1) plus visual hierarchy (V1) plus design guidelines (D1) plus understood by non-designers (U1). E1=F1+V1+D1+U1=8. The rating for the latest exercise is En=Fn+Vn+Dn+Un. By comparing En to E1, we can see if the user has improved his/her understanding and skills on color application. Another way to monitor the improvement of a user and the effectiveness of the app to a user is to view the user's trend of E1, E2, E3, ... En through a line chart.

To track the overall improvement of all users and the effectiveness of the app to all users, all users' E1 were added up and divided by the number of users that submitted their first exercises to generate an average of E1 of all users, and then generate an average of En of all users. By comparing the average En to the average E1 of all users, we can see if there's an overall improvement of all users.

Design Content Analysis

A. Content Analysis

Topics of the contents were chosen based on the chapter separation of two publications about the foundation of color theory in art-making and graphic design: The Art of Color by Johannes Itten and Interaction of Color by Josef Albers. The content were broken down to contrast of hue, contrast of value, cold warm contrast, complementary contrast, simultaneous contrast, contrast of saturation, contrast by extension, perception of color, and color theme. By breaking down the topics, we can better practice focusing

on different components of color application. Following is some examples of the design exercises:

1) Contrast of Hue: create a 12 square checkerboard of all these different colors plus white and black. After that,create an abstract painting by using only the 12 square checkerboard.
2) Cold and warm contrast: create six different colors in cold and warm colors. Then create a landscape where the cool colors are in the foreground, and the warm colors are in the background.
3) Complimentary contrast: make a portrait painting of a person in which the subject is the complimentary color to the background.
4) Perception of color: using simultaneous contrast create an abstract composition where the same color is used in different places throughout the composition but appears to be a different color when viewed overall.
5) Contrast of saturation: using one single color as a base make a painting based on a sketch or photo while thinking about which area should be the most saturated and which areas should be the least.
6) Color theme: first, create a landscape which has an overall color theme to it and then create a figure to put into this environment which is out of tune with the larger color theme.

B. Media Selection

Color Will is an iPad app that provides a more efficient way to practice color exercises for designers and artists on a digital medium. The reason Color Will is on iPad is due to its

advantages that iPad can be used with a digital pen, has more functions, easy to develop ideas, portability, ease of use, transferable knowledge to other digital tools, and easy to work with colors. Souleles (2017)'s result shows that iPad is the perfect platform for this project: it's portable; it has more function; the familiarity of using iPad is transferable to other digital tools; it's easier to work with colors than on traditional tools. During the exercise, theory review based on textbooks, inspirations, and examples will be given on the same panel for a more convenient environment to create work.

C. Project Description

Colorwill is an iPad app that provides daily pop-up color exercise that is complementary to color theory learning as well as sharing the assignment to an online community for showcase and feedback. The goal of using Colorwill is to enhance visual artists and visual designers' understanding and skill of color application through participating in daily exercise and community interaction and hence artists and designers can be more proficient and efficient in using colors in creating art or design. Each color assignment is designed based on instructional design strategies, through problem based learning, showcases and discussions, and using community support for learning progress. Besides the effectiveness of practicing color application based on carefully designed assignments and receiving supports and critiques from the online community, the app also offers a way to practice on portable digital devices so that users can practice regardless of circumstances and can save budgets on art supplies. Color Will can be a major practice tool for after-class assignments for online/in-person classes as well as daily practice for self-learners.

D. Instructional Design Strategy

The project uses Problem-Based Learning (PBL) as the approach. According to PBL, learning is driven by challenging, open-ended problems with no one correct answers. Learning by applying knowledge to real-life contexts will help designers and artists develop their own understanding and applicable skills on color theory. In PBL, learners are self-directed and active problem-solvers and learners give each other supports and suggest directions. In this case, teachers can play minimal role in the learning process. By utilizing the inquiry, student choice, reflection, and critique, individual's solutions for such problems can be found through implementation.

The following is one example of how Colorwill utilizes PBL. The exercise is to create six different colors in cold and warm colors. Then create a landscape where the cool colors are in the foreground, and the warm colors are in the background. This is an open-ended challenge with no one correct answers. The goal of this challenge is to learn the difference of cool and warm colors and how to apply them to complete a painting that echos the artist or designer's aesthetic. To achieve the goal of learning this subject, the student is applying the knowledge from reading textbooks and seeing successful examples and inspiration to this real-life context. In this case, the learners are self-directed and active problem-solvers in these exercises. After the learner submit the exercise to the community, the user can receive constructive feedback from the community. There will be no grading from the instructor. Instead, the learner will see ratings for each exercise from the community. There is no teacher in the online community because every user can give advices and receive suggestions from others. However, teachers in school or online classes can utilize the app as a facilitator for a more structured learning approach. By utilizing

the app, teachers can guide the self-learning process and promote an environment of inquiry and collaboration.

E. Discussion of the main features

The diagram of Colorwill is referred to figure 2 and the prototype of Colorwill is referred through https://projects.invisionapp.com/share/UJD7WA792#. The workflow of using this app has two routes: one is the user has not finished the exercise of the day, then the user will enter into the screen one, referred to figure 3. On this screen, the user will see today's exercise, highlights of the important information, the estimated time of finishing the exercise, the number of days they have persisted, an artboard on the bottom, and a logo as a button to enter explore mode on the top. The highlights of the important information are helpful to students when skimming the exercise. The estimated time and the number of persisting days are encouragement for students to take this exercise. The viewable artboard on the bottom also serves as an encouragement as well as indication of swiping up for more. The logo is served as a hidden button for students to escape the exercise screen to explore tab. The hiding of the button is to encourage students to focus on and finish the exercise before browsing others.

By swiping up, the user will see figure 4, screen two of Colorwill. There are graphic creating tools on top and three additional tabs , theory review, inspirations, examples for users to refer to when users have difficulties in creating work on the bottom, so that teacher's instructions can be eliminated in this step. During the creating process, the learners are self-directed and active problem-solvers in these exercises. After users finish the creating process, they can share their works to the online community.

By press the button, share to Colorwill community, or after the user has finished the exercise for the day and open the app, the user will see the explore screen, referred to figure 5. In screen three, the user can see other users' works in the explore tab, by filtering them through projects, most likes, and today. Through filtering, the user can view others' works based on the project so that the user can compare selves' work to others. In this case, the user is also improved his/her own ideas and skills through community rather than direct instruction.

After click into any work shown in screen three, the user enters screen four, referred to figure 6. The user can give constructive feedback based on the framework with rating criteria including the visual hierarchy, the first impressions, whether the crowd understands the communicative goals of the piece, and assessing the piece relative to design guidelines, e.g. Contrast, proximity and alignment. Through understanding the rating system, the user can review his/her own work through the same framework and make adjustments in future exercises.

On the bottom of screen three and four, there is a navigation bar that is not viewable in exercise mode, for better focus during exercise mode. In the navigation bar, the user can go back to the exercise, stay in explore mode, or go to personal dashboard or the "Me" tab in the app. On personal dashboard, the user can see his/her own the average rating and the rating trend on each criterion and the average rating and rating trend on the sum of all criteria. Through comparing the latest rating to the first rating, or view the trend of ratings, the user and/or the instructor can monitor and improvement of the student's understanding and skill of color application.

F. Implementation

Implementation of the app includes teachers guiding students in assignments and/or students through a self-learning process. The implementation targets could be teachers or directly

students. If the implementation process starts with teachers, there are three types of teachers I will reach out to—the first type is art teachers and design teachers in college/universities and graduate schools; The second type of teachers is art and design instructors in continuing education and professional development; and the third type of teachers is instructors of online art and design classes, for example classes on Lynda.com, Teachable, Skillshare, etc. The first and second types of teachers will use Colorwill as part of the assignments in substitute of traditional daily sketching and color palette designing. I will reach out to schools and programs to contact each instructor. The third type of teachers will use Colorwill to pair with different sections of the online class. In this way, people taking the online class can see other students' work even if they take the class in different time. When teachers are the stakeholders in implementing this project, teachers can design their own task and put it on Colorwill. Colorwill will not randomly select exercises to the registered students, but send the specific exercise pairing with the curriculum of the class. In this case, teachers will have direct contact with me for tutorial and training of using Colorwill from an instructor's perspective.

If the implementation process starts with students, the way to get in touch with them is to promote Colorwill through Behance and Dribbble. Behance and Dribbble are two largest communities of visual artists and designers. Artists and designers on these two platforms are constantly posting their projects for feedbacks and suggestions for improvement, therefore users on the two platforms are looking for improvement of their skills and Colorwill will be a good fit for them. Colorwill will not be used in classroom because Colorwill is designed to be a accompanied to the regular curriculum or self-learning.

G. Evaluation

Evaluation of the student can be monitored by tracking the rating of of each exercise. The rating criteria include the visual hierarchy, the first impressions, whether the crowd understands the communicative goals of the piece, and assessing the piece relative to design guidelines, e.g. Contrast, proximity and alignment. The four rating criteria were designed based on Xu, Huang, & Bailey (2014)'s research, these design feedback would be helpful to artist and designer and would be able to be generated systematically. In the section of evaluation for each exercise, each criterion can be rated as "great", "fine", or "bad". The app will record "great" as 3 points, "fine" as 2 points, and "bad" as 1 point. For example, one could rate a project have great first impression, fine visual hierarchy, fine design guidelines, and bad in being understood by non-designers or artists. The total of this project will be 8 out of 12.

Through long-term usage of Colorwill, on personal dashboard or the "Me" tab in the app, the user can see his/her own the average rating and the rating trend on each criterion and the average rating and rating trend on the sum of all criteria. Through comparing the latest rating to the first rating, or view the trend of ratings, the user and/or the instructor can monitor and improvement of the student's understanding and skill of color application.

In addition, by monitoring the average rating of all users to see if there are significant improvement, we can see if the app is effective. If there is no significant improvement overall, we should consider if it's the rating, the exercises, and/or the mechanism had not been effective enough. Therefore, the ratings and evaluation are also beneficial for the design of the app in a long term.

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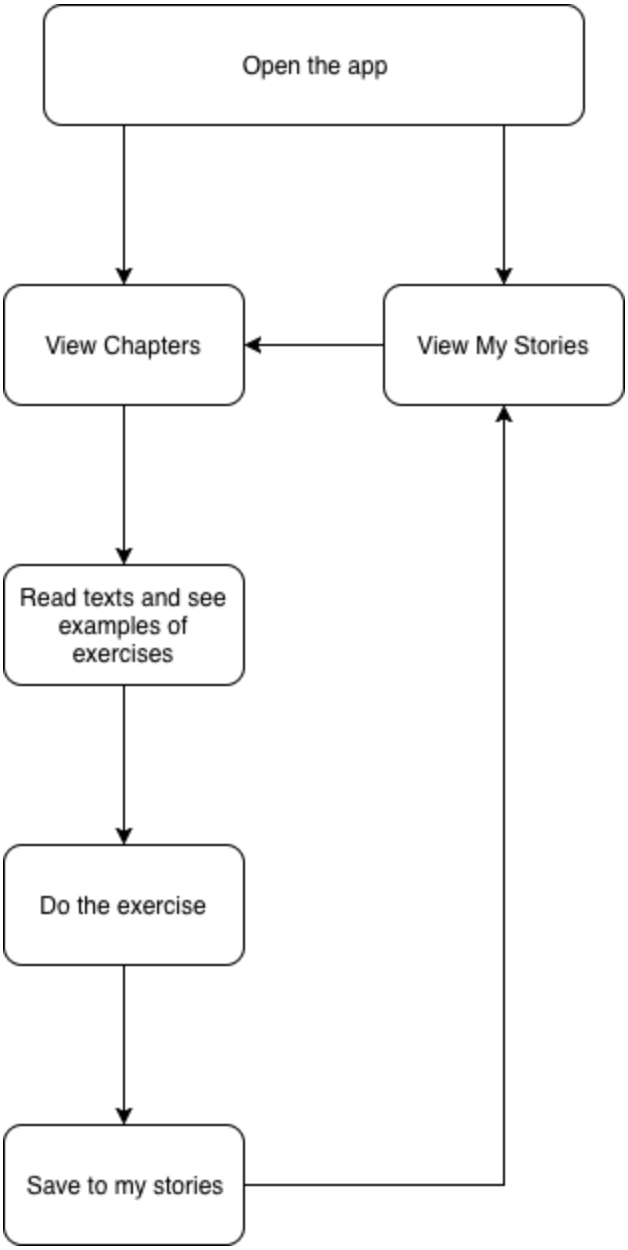

Figure 1. Diagram of Interaction of Color

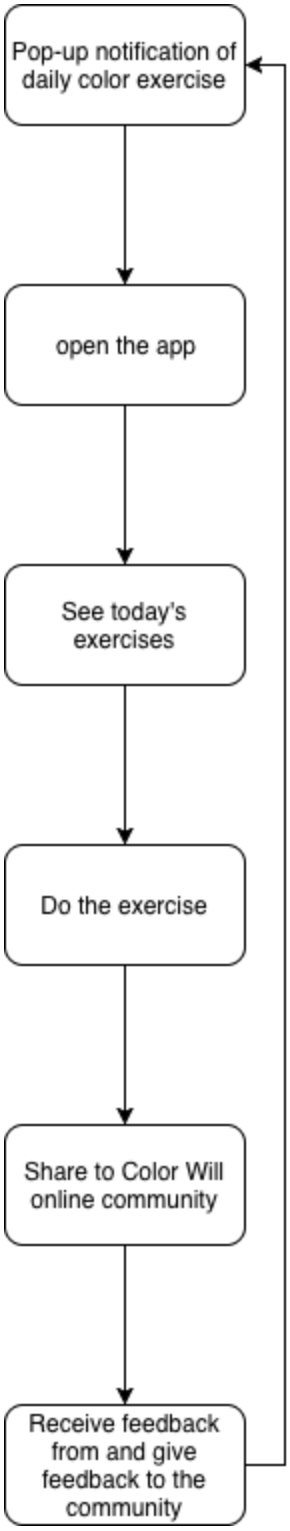

Figure 2. Diagram of Colorwill

Figure 3. Screen one of Colorwill

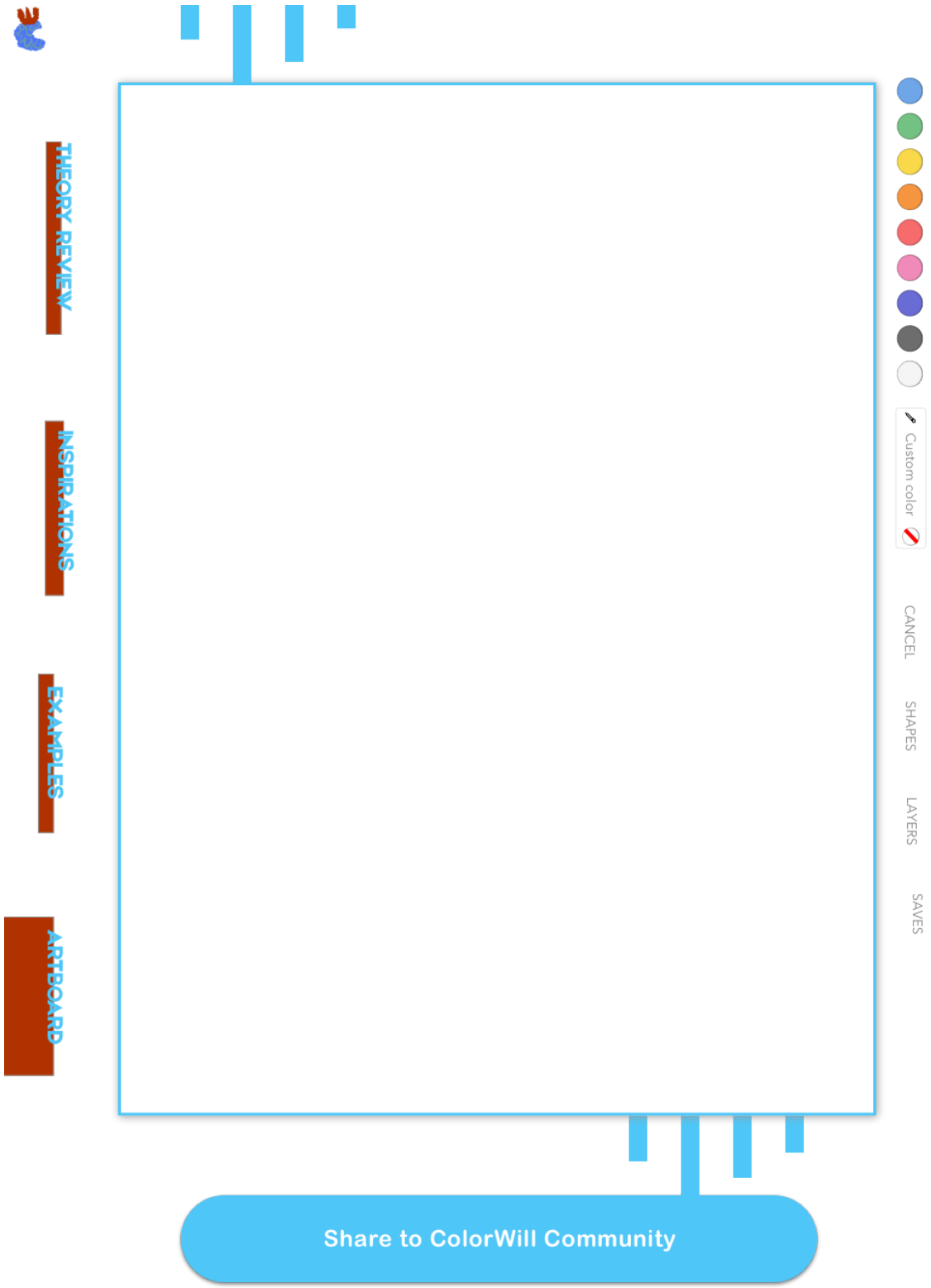

Figure 4. Screen two of Colorwill

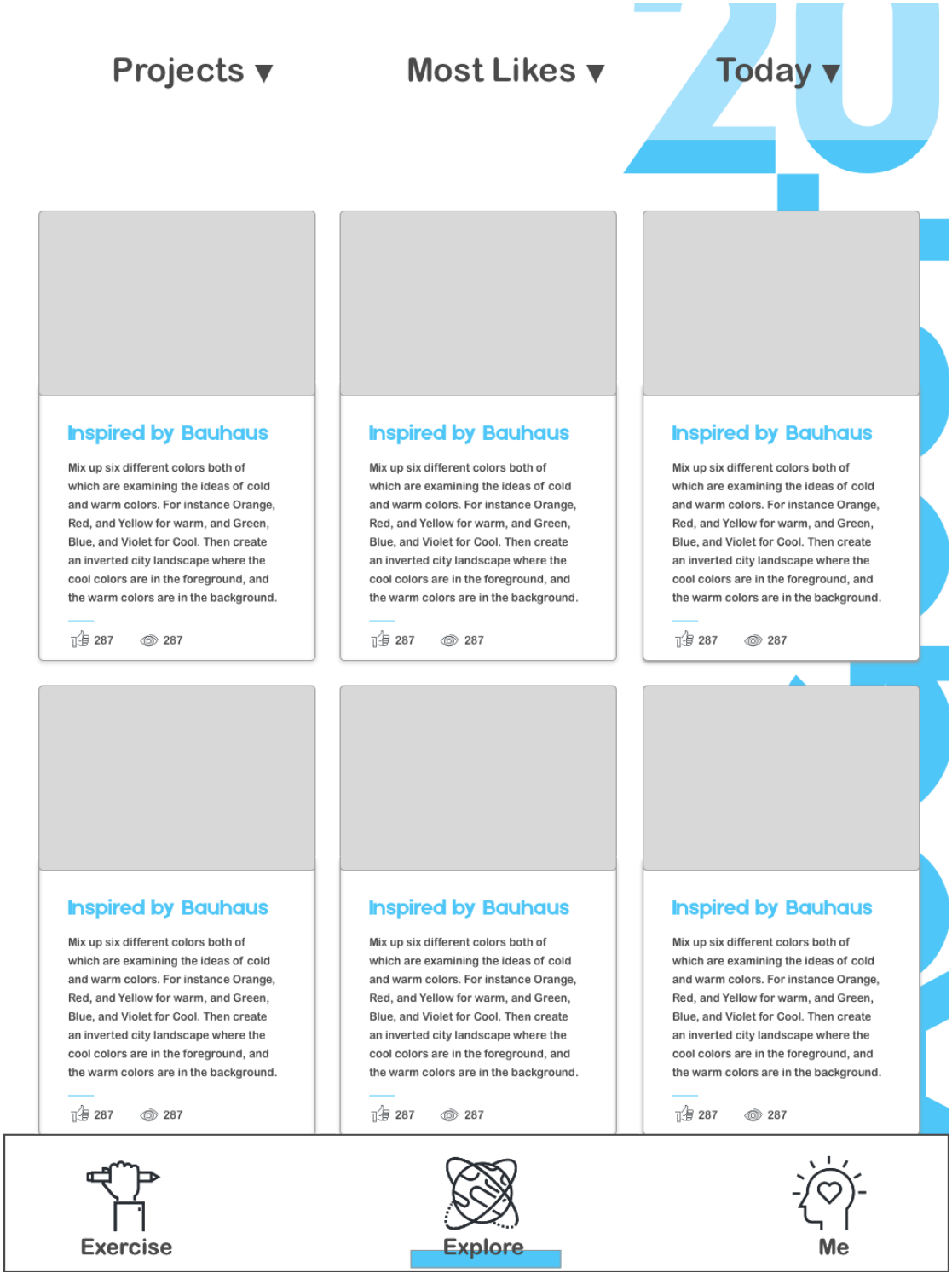

Figure 5. Screen three of Colorwill

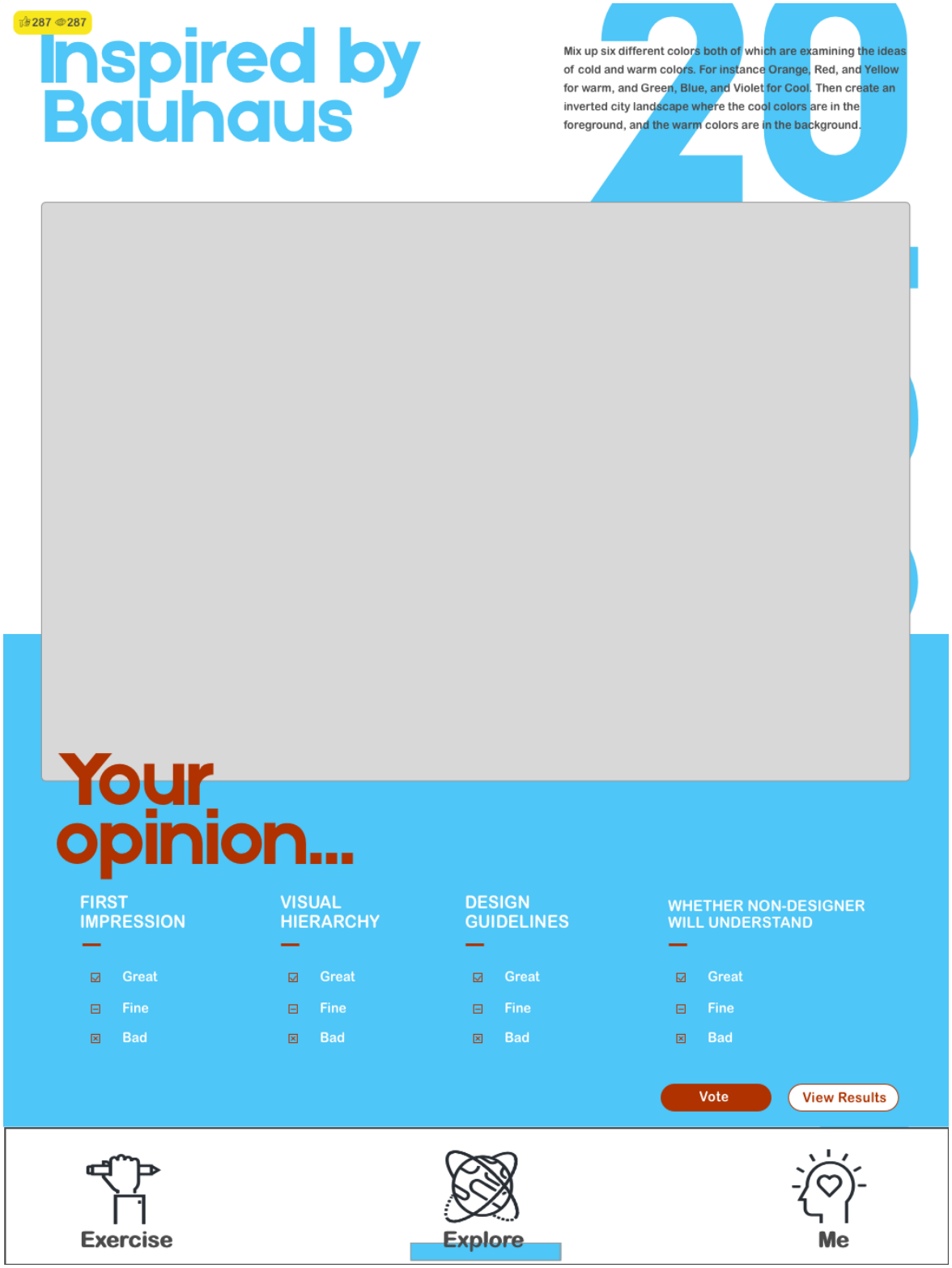

Figure 6. Screen four of Colorwill