AN INNOVATED COLOR WHEEL: TECHNOLOGY PACKAGE FOR INSTRUCTION

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ABSTRACT

This study aimed to develop a prototype and an instructional package of an innovated color wheel with multi-function capabilities and features for the following operations such as color mixing, color tint, color shade, and color tone, and color harmony. Effectiveness and acceptability of the innovated color wheel serves as main objective. Quality dimensions such as performance, reliability, durability, serviceability, economy, and safety were also the concerns of designing in terms of operation and storage of the innovated color wheel. The study used the descriptive method of research with the professors of drafting, drawing, and interior design as expert respondents and random sampling was conducted among selected drafting, drawing, interior design, and art appreciation students in the College of Technology and College of Education, of the Cebu Technological University- Pinamungajan Extension Campus. Revealed findings from all respondents who manipulated and utilized the prototype of the innovated color wheel especially the expert respondents in terms of features and its acceptability of different dimensions of quality formed the basis for recommendation for the utilization and implementation of the innovated color wheel among the drawing/drafting and interior design laboratories and art appreciation classes for instructional purposes of Cebu Technological University- Pinamungajan Extension Campus.

Keywords: *Drafting Technology, Color Theory, Descriptive Research, CTU Pinamungajan Extension Campus, Cebu, Philippines.*

INTRODUCTION

Rationale of the Study

Color remains one of the most challenging and contentious aspects of design. As the painter Josef Albers noted, "color deceives continually and presents itself in continuous flux, constantly related to changing neighbors and changing conditions."

Color is perception. Our eyes see something (like the sky), and data sent from your eyes to our brains tells us it's a certain color (blue). Objects too, reflect light in different combinations of wavelengths. Our brains pick up on those combination of wavelengths and translate them into the phenomenon we call color (Grimley, Chris, 2018).

The application and combination of colors has long been an intense area of study for scientists, artists, and designers. "Color theory is the art and science of color interaction and effects" according to Johannes Itten. In his *The Art of Color* listed several approaches to color theory:

1. The physicist studies electromagnetic wavelengths in order to measure and classify color.
2. The chemist, working with the molecular structure of dyes and pigments, seeks to produce highly permanent colors and excellent paint consistency.
3. The physiologist investigates the effect of color and light on our eyes and brain.
4. The psychologist studies the expressive effects of color on our mind and spirit.

An artist combines all these areas of knowledge. Like the physicist, the artist uses color wavelengths to create visual effects. Like the chemist, the artist must be aware of the safety and permanence of dyes and pigments. When using color to create the illusion of space, the artist puts into practice theories developed by the physiologists. And both communication and expression are strongly affected by the psychological impact of color.

Color can also be an extremely subjective topic: everyone has their favorite colors-colors that remind them of a place or time or that have specific emotive qualities. "In visual perception, a color is almost never seen as it really is- as it physically is. Thus, this fact makes color the most relative medium in art and so in design. If one says "RED" (the name of the color) and there are 50 people listening, it can be expected that there will be 50 reds in their minds. And one can be sure that all these reds will be very different," (Albers, Josef 1963).

Not only is color relative, but it is also symbolic, thus, adding to the difficulty of its nature is its meaning to different aspects of human culture. In *The Primary Colors*, Alexander Theroux writes:

"Blue is the symbol of baby boys in America, mourning in Borneo, tribulation to the American Indian and the direction South of Tibet. Blue indicates mercy in Kabbalah and carbon monoxide in gas canisters. Chinese emperors wear blue to worship the sky. To Egyptians it represented virtue, faith and truth. The color was worn by slaves in Gaul. It was the color of the sixth level of the temple of Nebuchadnezzar II, devoted to the planet Mercury. In Jerusalem a blue hand painted on a door gives protection, and in East Africa, blue beads represent fertility.In Hopi culture, colors symbolize spatial locations and geographic direction. Red according to these people represents southerly direction; white, the east or northeast; blue or green the west.

In Color Psychology or the study of hues and their variety of effects, color is more than a visual element. It can create optical illusions and make space look bigger, smaller, rounder. Color is also an experience that may bring up memories or cause you feel a certain way. Colors can project your personality or help establish who you are when making or meeting new acquaintances. Colors too have strong psychological effects when used in interiors (Island Paint, The Science of Interior House Colors);

1. Blue is one of the most popular choices for the bedroom as it produces a calm and cool ambiance. Blue is usually associated with trustworthiness, loyalty and strength.
2. Yellow creates a space of happiness, optimism, and inspiration. The color is a go-to for a reading room, study and kitchen where creativity is usually called for.
3. Purple combines relaxation and serenity, as it is a color of royalty, luxury and wealth.
4. Red is the color of passion and energy, and is usually used for rooms and spaces for pumped-up leisure and entertainment.
5. Green is also calming and relaxing, but with a subtle kick of energy and a touch of being grounded. An earth color studies says that those who like green believe in balance, stability and persistence.
6. Pink is commonly associated with qualities that are feminine, innocent and romantic. It is the most delicate and tamed in the red family.

7. Brown breathes security, simplicity, contentment and comfort, and is a popular color for lounges or where families usually gather.
8. Orange appeals to the appetite that's why its commonly used for kitchens and dining rooms. It demands attention but also promotes warmth and harmony.
9. White represents cleanliness and evokes a cool, refreshing feeling. Whites are not always cold. There are warmer shades of white that help make a room feel cozier.
10. Black is about elegance, mystery and power. A versatile shade, black can stand in the background or be the bold and dramatic focal wall in any room.
11. Gray works well with most colors. Classic and intelligent, gray creates lively and inviting spaces when paired with warm colors.

With the difficulty of mastering color as element of design given its many nature, this research of an innovated color wheel is thought to bridge the gap of understanding basic color schemes thus increasing color sensitivity among students in the academe.

And although, as "modern trend of culture nowadays is the excessive input of digital and visual information as the tools of voluminous information transfer at a single click of a button or by gestures," (Teich, Ah 2008), where computer soft wares are proliferating the internet providing tools for easy access on color schemes, these modern marvels however will only be in vain without the increased human sensibility necessary to properly design, develop and manufacture goods for human use, in this case-the proper use of color.

As modern technological advancements are proliferating, a student tends to neglect the traditional way of aesthetics in exchange of the easy access and spoon-feeding effect of technology. This diminishes the student's sensibility using his visual and spatial intelligence and personality development which are necessary ingredients for human creativity in design. A fine example for this is the Paletteon.com., a computer live colorizer accessible in the internet which application can automatically provide a wide range of colors according to a preset color scheme.

As one of the requisites of technological development, drawing and design, which color is largely a part of, is considered as the preliminary stage of development. Any product that is to be manufactured, assembled, constructed or administered to any other type of conversion process must be designed first. And more often than not, the application of color sometimes called color finishing, becomes the final phase of the designing process. Thus, in this aspect, color becomes the binding element of all aspects of design.

In learning the trade of visualization and presentation, a person must not only be knowledgeable in manual sketching, mechanical and technical drawing, and detailing of parts or designs using various instruments, but also the ability to incorporate color as the finality of design. In branding, people decide whether or not they like a product in 90 seconds or less, 90% of that decision is based solely in color (Decker, 2016). The ability to incorporate color to a design process can be best achieved among the students of Cebu Technological University-Pinamungajan Extension Campus if a certain tool like the innovated color wheel is readily available in bringing to students the interest about color and color schemes.

The researcher, upon observation of the students' aptitude in color and color appreciation and with the understanding of the deceiving characteristic of color, felt that there really is a need to bring to their level the interest for color and thus upgrade and innovate a traditional color wheel that is scarcely available even if commercially being sold in the market. Efficiency and productivity were the driving force which prompted the researcher to upgrade a traditional color wheel instrument to an innovated multifunctional device which combines most of its present operations that a traditional coloring device can perform but added with the very important

operation of six (6) basic color harmonies and at the same time, separating each color harmony into a single color wheel as to incorporate the result of an experiment by Josef Albers in his *Interaction of Color* (1963), about the deceiving qualities of color when put around other colors thus resulting to several color illusions such as optical mixture, after- image, and the Bezold effect to name a few.

Optical mixture is a phenomenon where instead of 2 or more colors changing each other, "pulling" or "pushing" each other into different appearances (toward both greater difference and greater similarity), here 2 colors (or more) perceived simultaneously, are seen combined and thus merged into 1 color. In this process, the 2 original colors are first annulled and made invisible, and then replaced by a substitute called *optical mixture*. From the impressionists painters as championed by Claude Monet, we have learned that they never presented, let us say, green by itself. Instead of using green paint mixed mechanically from yellow and blue, they applied yellow and blue in small dots, so that they became mixed only in our perception-as an impression. That the dots mentioned were small indicates that this effect depends on size and on distance.

After-image is a condition where a person if tasked to focus his eyes on a small tiny dot in the center of a red circle for a while and then transfer his focus on a tiny dot at the center of a white circle adjacent to the red circle, his normal eyes suddenly sees green or blue-green instead of white. This is green is the complementary color of red or red-orange. One plausible explanation is, on theory maintains that the nerve ends on the human retina (rods and cones) are turned to receive any of the three primary colors (red, yellow, blue), which constitutes all colors. Staring at red will fatigue the red-sensitive parts, so that with a sudden shift to white (which again consists of red, yellow and blue), only the mixture of yellow and blue occurs, and this is green the complement of red. The fact that the after-image is a psycho-physiological phenomenon should prove that no normal eye, not even the most trained one, is foolproof against color deception (Albers, Josef, 1963).

The *Bezold effect* demonstrates the profound influence of color interaction. Color theorist Wilhelm Bezold (1837-1907) realized that change in a single color can substantially alter our perception of an entire pattern. Apparently, there is so far no clear recognition of the optical-perceptual conditions involved (Stewart, Mary, 1952).

Knowledge for basic color schemes is a requisite for a student-designer. And such skill will never be outmoded in the real work when these students are already employed in real jobs involving designs and creativity.

The Cebu Technological University with the offerings of Bachelor of Science in Industrial Technology provides varied major fields of specialization such as; drafting, civil, interior design major and other fields with common competencies needed for color application. As a professor of the College of Technology, and at the same time an exhibiting visual artist who have attended several art exhibitions and art residency abroad, the researcher observed that there is a need to innovate a coloring device that is accurate and convenient of its basic functions, thus inculcating the love for colors to students. Also observed by the researcher is that there are many students having hard times in applying basic color schemes to their plates and other art projects. It is on this light that the researcher in his attempt to bridge this gap would challenge every student with the Innovated Color Wheel to constantly immerse himself with colors and develop-through experience- by trial and error- an eye for color. This means seeing color action as well as

feeling color relatedness. Safety and handy to carry is also a major consideration for this color wheel instrument with multi-features to address the problems most students encountered involving tools and instruments for their major fields.

The study for developing the innovated color wheel incorporates the color theories as first oberved by Newton and referenced by Itten color theories, the experiment findings of Albers and eventually the modern development of Munsell's color system.

Theoretical Background

Color is a physical phenomenon, and the range of colors stretches far beyond what the human eye is capable of perceiving. At either end of the visible spectrum of light are the imperceptible infrared and ultraviolet lights. In between is "human color space." This model is best observed when light is refracted in a prism and the eye identifies the resultant color wavelengths whose number is considered to be around 10 million- as a rainbow (Stewart, Mary, 1952).

Traditional color wheels used as guide for coloring have evolved over time. Many attempts have been made to establish methodologies to evaluate certain color combinations' advantages. Very early on, color wheels or color spheres were engaged to visually communicate the associations and range of colors and their relationships to each other. **Sir Isaac Newton** in his *Optiks of 1706*, split white light into seven (7) colors namely, orange, yellow green, blue, indigo, violet and red- arranged on a disk sliced proportionately in such that the spinning of the disk would result in the color white. In his attempt to develop a color theory, Newton was the first to understand that colors did not lay on a linear chart, but rather existed in a continuum.
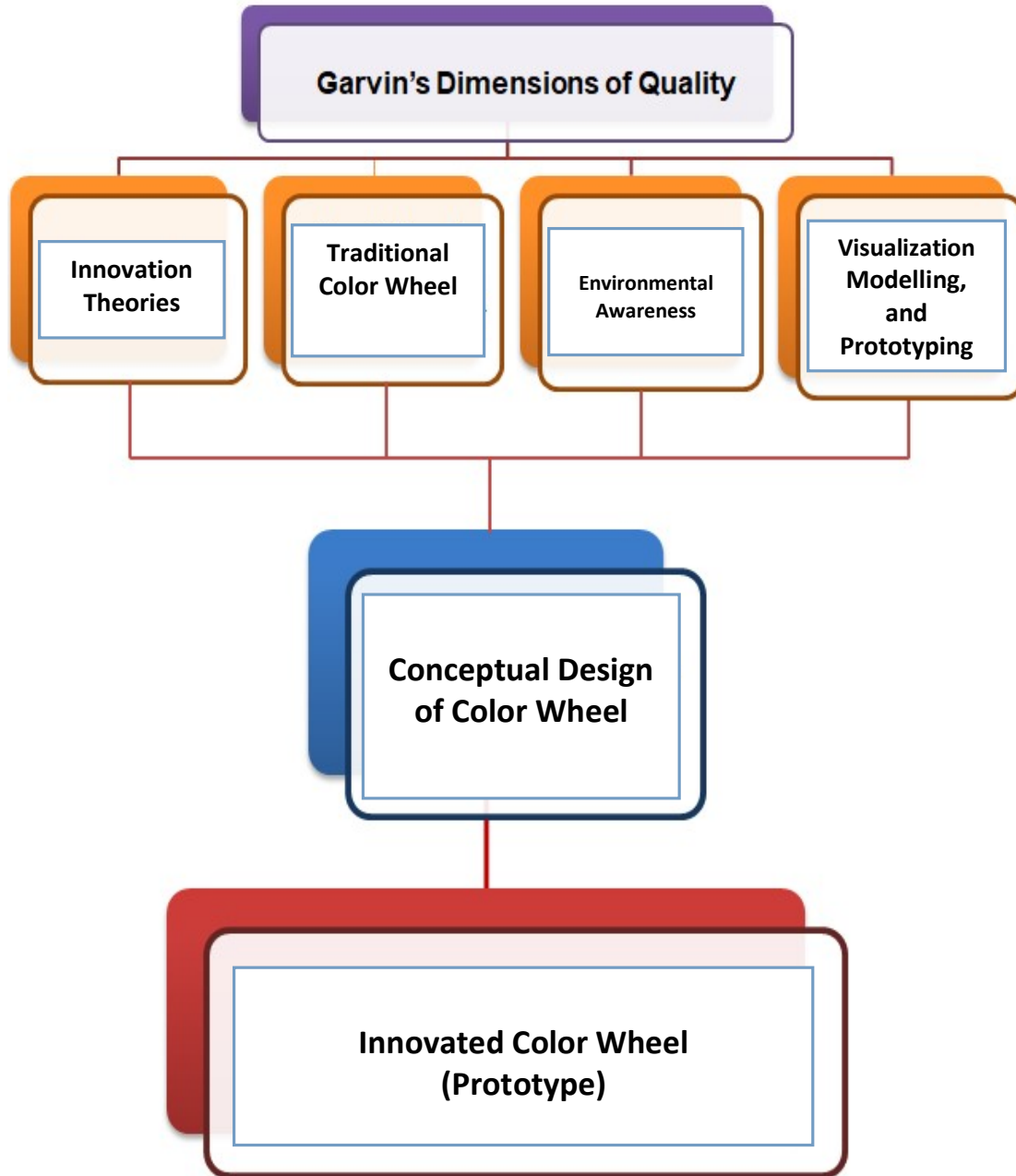
Figure 1
Conceptual Framework of the Study

In the early 20th century, two supportive theories of color emerged from the Basic Studies curriculum at the Weimar Bauhaus that continue to influence the way we understand color today. First to emerge was out of the teaching of **Johannes Itten**, who developed the 12-hue color wheel. He identified seven (7) rules of contrast that examined, in a scientific way, the subjective effects of color proportion, combination and harmony. **Josef Albers**, on the other hand, expanded on the instructional exercise of Itten's theory to further emphasize the notion that color and the interaction of colors were a discipline to be learned by experience. That is, constant training for the development of observation and articulation.

In the early 1900's, **Albert Munsell** developed a system of color analysis based around hue, value and chroma. These three elements form a three-dimensional model. Starting with a circular relationship of hues, Munsell established a decimal notational system to describe the transitional relationship as one color is identified from another. In Munsell's system, hue is arrranged around the perimeter of a sphere, value as it moves from the top pole (light) to the bottom (dark), and chroma as it moves towards the center. Munsell also developed nomenclature that made it easy to identify any color in his system. R5/10 would be red, value 5, chroma 10.

Munsell also have his color system nomenclature limited, orange being referred to as red-yellow to avoid confusion. Value, his second term, describes the color's light or dark qualities, on scale from 1 (dark) to 10 (light). His final term, chroma, identifies a color as it moves inward for the variation in strength of a color (red is considered to be twice as strong in chroma as blue-green), Munsell developed what he called the color tree.

These systems serve as starting point in understanding the complex relationships of balance, proportion, harmony, and effect that is produced when colors are combined. Each has its merits and applications for both art, architecture, interior design and other human practice that involve color. Furthermore, their translation to a two-dimensional surface and three-dimensional design space needs to be tested in-situ to observe results.

Although computers today replace the use of coloring references as by just a click of one's fingers, an array of color palettes will instantly be provided by a computer live colorizer like the popular Paletton.com., traditional coloring device such as the Innovated Color Wheel is still useful today for designing and inculcating among the students the love for color which will spur them to further immerse themselves in this element thus honing their eyes for color. The system never stops, color study is continuous.

Color sketching, color drawing, designing and pictorial presentations that utilize the use of color have long been utilized and performed by man since time immemorial. The prehistoric cave paintings found in Lascaux, France and Altamira, Spain proved that early man decipher the world around him in colors. As man's intellect evolved and developed further on, he learned to express his ideas through art and solve mundane to complex problems by his ability to design. Color then to man becomes the finality of his object. Not just an outer coating but an intrinsic element to his design. When paper became the medium of transferring ideas through drawing, from the 14th century to date, working drawings, both in black and white and colored, sketches and final development drawings, became productive with the aid of different coloring guides. With these development humans are trying to evolve coloring device, guides and instruments from simple to more complicated one such as CAD and SketchUp for drawing, drafting and architectural presentations and Photoshop for fast-paced colored visual design presentations and photo editing.

Colored perspective drawing is considered as a visual tool to convey ideas of the real form and shape of the proposed architectural project without using expensive tools like 3D printers and virtual simulations. With what technology we have in our hands now, manual instrumental drawing is still considered the basic method of relaying. And the use of the Innovated Color Wheel as coloring guide for students is a great help for them to develop an eye for color, thus improving their skills for visual presentation which is a must in communication to complete the process of design-build-use.

At present, color wheels are made available in the market, however, availability is scarce. These tools are devices used to assist professionals in making decisions concerning the use of color in design. The functions include color mixing, color shading, color tinting and color toning.

However, for the researcher, it lacks the function of a basic color harmony guide to facilitate application of color into color combination. Use of color have several categories and classifications of which includes artistic (painting and fine arts), technical and mechanical, and rendered presentations. There are also many methods of color application as there are shades and tones of colors available.

To achieve accuracy in the demanding world of design using color, some of the device and instruments which are critical to the efficiency and productivity were developed. Color wheels for example have long been available commercially. But it is not enough to rely on these traditional tools alone when it comes to color. Immersion of self is necessary through use of color by trial and error until one develops the skill and/or the eye for it. In lieu of this, the researcher sees the greater need to upgrade and develop the commercially available color wheel by fusing them into a package for multi- featured design.

With the advent of technology such as computer-aided design (CAD) and other visual design soft wares, the utilization of these color devices available are starting to decline drastically, especially in the design and construction sectors which demand productivity and efficiency through fast and reliable provision of color references.

Even in today's advent of paperless drawing and design technology such as CAD and other visual software applications which gain excellent acceptability and productivity in the market, basic skills in coloring and the eye for it are still useful ability to give ideas for easy understanding of the concept a person would like to impart. It is because no matter how efficient the computer provides all these color references, it still boils down to a person's (designer) decision as to which color to use, combine and manipulate. Therefore color to man is more personal than formulaic both in choice and practice.

As drawing is considered as the graphic language of industry where ideas that cannot be expressed in words to another person can be represented in a form of visual language, color presentations were made more possible by utilizing electronic media. But with these modern methods of presenting an idea, human as we are, we still need to harness our human instinct to design, maintaining the link between abstract knowledge to physical outcomes by the aid of technology. Technology in terms of innovative ways of enhancing human capability to understand color interaction and its significance to design.

Innovation Theory. (Praveen Gupta) Innovation is considered the foundation of all developments, may it be economic, political, social and can serve as the bearing of a level and stability of a country. Crucial emphasis will be highlighting the importance of innovation – may it be capitalism and management in the development, production, and the emergence of new technology and discovery– as a basis for growth and development. But, the ordeal to achieve and arrive at a very efficient and productive innovation which can solve even a minute portion of a social problem is still a challenge to those who pursue research. This challenge can be observed in developing countries rather than in highly industrialized countries were a scarcity of technology is observed.

The designing process, manufacture, and utilization of the color wheel are the focus of the study at hand. Further review of the literature relevant to the present study were exhausted in order to formulate a conceptual framework of the Innovated Color Wheel, to identify needed revisions, and future researches to be conducted. The procedures and reviews are then applied to the BIT and Education courses which have an offering of drawing, visual technique and art

appreciation as part of its curriculum to better understand the innovative process and environmental impact of the developed innovated color wheel.

Innovation is a hot topic of discussion in the corporate or industrial forum and is considered the top priority for every industrial and commercial sector. Not many innovators, however, know how to push the button of success and develop efficient and effective solutions to the demands of society in terms of services and products. There are different aspects of innovation, from creativity to productivity, processes and methodologies, measures and limitations, strategy and techniques, and of course, the types and kinds of innovation relevant to the needs of the time. In the study for Innovated Color Wheel, incremental, radical-based innovation served the researcher as its innovation theory.

Outcomes-Based Innovations. A classification of innovation, that represents radical, incremental, and universal purposes in the upgrading of products or services. *Incremental* innovation enhances the functionality of an existing product being developed. *Radical* innovation is done by replacement of the product to solve the problem encountered by the existing products. *General* purpose innovation is a novel way of development or a discovery of new things for a larger scope of effect to the costumers.

A suitable solution for a specific problem which is to develop a color wheel with specific function of a color scheme aid with the enhance capability of deleting the possibilities of optical illusions such as the after image, color mixture and the Bezold effect, is to innovate an existing commercially-available color wheel, thus, enhancing the functionality of an existing product.

Environmental Awareness. Greenhouse effect awareness must be disseminated for wise use of materials to be used for product innovation to protect our environment. Green technology must be the focus of innovation to heal the environment. We need to understand that we only have one home to live so we have to extend our share for the awareness of its importance for us. Application of environmental concerns during product development and participates in the preservation of nature through promoting green technology and fewer carbon footprints in the industry.

Environmental Considerations in Product Design. Designing for environmental concerns should be one of the integral parts of the product design and development process. It will be difficult to address environmental concerns after a product has been fully designed. The steps in product design for environmental concerns should include:

Product definition identifies the environmental attributes of a product. Everyone has to join the global initiative in designing to make a difference, to create products that have a significantly reduced impact on the environment.

Materials selection addresses issues such as toxicity, disposal, use of recyclable materials, etc. Quality assurance can be achieved through the proper use and handling in the assembly and craftsmanship of details and finish. Quality raw materials and proper selection of components are of the priority, environmentally sound and leaves less carbon footprint in the course of processing.

Materials processing addresses the need for new processes, environmental consequences of new processes, energy needs, etc. Manufacturing arm has refined its processes to reduce usage of materials, energy, and water and to minimize CO_2 output. All Vendor Code of Conduct

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follows fair labor practices, employee health and safety requirements, and environmental accountability. In every country, we must comply with or exceed environmental laws and regulations and energy standards currently followed in that region.

Product distribution addresses the environmental impact of material and product packaging and distribution.

Product use addresses how the customers' use, maintenance, and disposal of the product will affect the environment.

Product recycling addresses the recyclability of the disposed product and the impact of the non-recyclable material on the environment. Products are designed with longevity in mind. Without sacrificing performance or value, designers and engineers are constantly looking for better ways to maximize lifespan and energy efficiency to further minimize environmental footprint and ensure that product will provide pleasure time and time again.

One of the important steps in the design phase is also the testing of the prototype product before finalizing the design and going into full production. Including a test phase will help to assess the environmental and other potential hazards of the product and to make the necessary corrections in the final design.(source: http://www3.niu.edu/~c90mdk1/ems/environmental.htm)

Eight (8) Dimensions of Quality. David Garvin suggested that there were eight (8) dimensions to quality. Each dimension has its distinctive and self-containing quality.

Performance. This refers to a quality product that will perform as expected by the user and as specified by the manufacturer. If products do not do as buyers expect, users will be disappointed and frustrated. Worse still poor performing products get negative reviews and lose sales and reputation.

Features. These are additional benefits added to the product. They are either tangible or non-tangible benefit. For example, this could be after sales service or guarantees. Some features are present in all products but other features are only found in "quality" products. For example, all cars have wheels, steering wheel, gears, windows and seats but only some cars have heated seats, assisted parking and Bluetooth.

Reliability. It refers to the product consistency. Performs well over its expected lifetime and perform consistently. Many brands have developed trust with customers because of their reputation for reliability.

Durability. The wear and tear of the product after daily use must be met. Is the material used sturdy enough to do the task and will not easily break.

Conformance. The product must meet with any agreed internal and national specifications. Is the product safe to be used and conforms to the requirements of the operation. For example, like safety regulations and laws.

Serviceability. It is as easy as serving what it is meant to serve. Does the instrument offers multi-purpose functionality in line with different color concerns?

Aesthetics. Is it the product appealing to the eye? Design is important for many products; the color picked indicates certain things.

Perceived Quality. This is the quality perception that the developer wants to convey in their products. The price charge reflects the quality of the product. The brand name that is going to be used conveys a sort of quality perception.

The objective of this study is to come up with an Innovated Color Wheel with multi-function capabilities of most available color wheels fused into a single unit with added feature of six (6) color harmony guide. Specifically, it aims to serve as tool for users to learn basic properties of color. It may also help the students' convenience in manipulating the instrument for it has presets of the six basic color harmonies. It also aimed for accuracy as the main objective of the color wheel. It is also developed for serviceability purpose in utilizing for drawing, design and art activities and convenience in handling during travel from school to their home.

The innovated color wheel was conceived and developed for the purpose of   iating the way students regard color as an element of design, to achieve productivity and e   nental conformance adhering to the standards of the industry.

THE PROBLEM

Statement of the Problem

This research aimed to develop an Innovated Color Wheel for instruction in Drawing/Drafting, and Interior Design and Art Appreciation subject of Cebu Technological University- Pinamungajan Extension Campus, Cebu during Academic Year 2019-2020.

Specifically, it sought answers to the following:

1. What procedures were involved in the development of an Innovated Color Wheel in terms of:
   1.1 concept and design;
   1.2 supplies and materials;
   1.3 tools and equipment; and
   1.4 fabrication and assembly?
2. As utilized by the respondent groups, how effective was the Innovated Color Wheel as to the functions and features, such as;
   2.1 Color Mixing;
   2.2 Color Tint;
   2.3 Color Shade
   2.4 Color Tone
   2.5 Color Harmony
3. What was the degree of acceptability of the Innovated Color Wheel based on the following quality of;
   3.1 performance;
   3.2 reliability;
   3.3 durability;
   3.4 serviceability;
   3.5 economy; and
   3.6 safety?
4. Based on the findings, what Technology Package for Instruction of Innovated Color Wheel can be developed?

THE RESEARCH METHODOLOGY
Design

The study utilized the descriptive method of research by development of full-coat paper, eyelets, round head fasteners and simple tools to produce a prototype of the Innovated Color Wheel as basis for instructional utility for Drawing, Drafting and Design related courses offered in the university and for utility model and industrial design applications in the future.

RESULTS AND DISCUSSION

This section presented the general summary of results findings, conclusions, and recommendations.

SUMMARY

The objective of this study is to come up with an Innovated Color Wheel with multi-function capabilities for color mixing, color tint, color tone, color shade and color harmony put into a single unit. Specifically, it aims to incorporate traditional color wheels with varying functions. It is also developed for safety purposes during the operation and handling of the said Innovated Color Wheel.

Specifically, the study sought answers for the following: What procedures are involved in the innovation of the Innovated Color Wheel in terms of designing and concept, supplies and materials, tools and equipment, and fabrication and assembly? As utilized by the respondent groups, how effective is the innovated color wheel in performing its functions and features, such as; color mixing, color tint, color tone, color shade and color harmony? What is the degree of acceptability of the Innovated Color Wheel based on the following quality of; performance; reliability; durability; serviceability; economy; and safety? Based on the findings, what Technology Package Instruction of Innovated Color Wheel can be developed?

FINDINGS

The study was conducted to assess the effectiveness and acceptability of the Innovated Color Wheel. The expert respondents of the study were drawing/drafting professors and sampled population of drafting and interior design students of the College of Technology, and students of art appreciation subject of the College of Education of the Cebu Technological University-Pinamungajan Extension Campus.

The following were the findings of the study:

Effectiveness of the Innovated Color Wheel Board

For the validation of the respondents, the effectiveness of the instrument in performing the different capabilities are as follows:

The expert instructors, and student respondents such as; BIT-Drafting, BSIT Drafting, BIT- Interior Design, BTLED Art Appreciation students found the instrument to be Very Effective in performing its function in color mixing with an average weighted mean of 4.97.

The expert instructors, and student respondents such as; BIT-Drafting, BSIT Drafting, BIT- Interior Design, BTLED Art Appreciation students found the instrument to be Very Effective in performing its function in color tint with an average weighted mean of 4.90.

The expert instructors, and student respondents such as; BIT-Drafting, BSIT Drafting, BIT- Interior Design, BTLED Art Appreciation students found the

instrument to be Very Effective in performing its function in color shade with an average weighted mean of 4.81.

The expert instructors, and student respondents such as; BIT-Drafting, BSIT Drafting, BIT- Interior Design, BTLED Art Appreciation students found the instrument to be Very Effective in performing its function in color tone with an average weighted mean of 4.82.

The expert instructors, and student respondents such as; BIT-Drafting, BSIT Drafting, BIT- Interior Design, BTLED Art Appreciation students found the instrument to be Very Effective in performing its function in color tint with an average weighted mean of 4.97.

Acceptability of the Innovated Color Wheel

The acceptability of the Innovated Color Wheel was validated using the Garvin's dimensions of quality based on the following aspects: performance, reliability, durability, serviceability, economy and safety.

Performance Dimension

The acceptability of the Innovated Color Wheel in terms of performance dimension was Highly Acceptable as proven by the expert respondents with the average weighted mean of 4.92.

Reliability Dimension

The reliability of the Innovated Color Wheel in terms of reliability dimension was Highly Acceptable as proven by the expert respondents with the average weighted mean of 4.91.

Durability Dimension

The acceptability of the Innovated Color Wheel in terms of durability dimension was Highly Acceptable as proven by the expert respondents with the average weighted mean of 4.84.

Serviceability Dimension

The acceptability of the Innovated Color Wheel in terms of serviceability dimension was Highly Acceptable as proven by the expert respondents with the average weighted mean of 4.96.

Economy Dimension

The acceptability of the Innovated Color Wheel in terms of economy dimension was Highly Acceptable as proven by the expert respondents with the average weighted mean of 4.85.

Safety Dimension

The acceptability of the Innovated Color Wheel in terms of safety dimension was Highly Acceptable as proven by the expert respondents with the average weighted mean of 4.94.

CONCLUSION

Based on the findings of the study, the development of the Innovated Color Wheel is very effective and acceptable as an alternative instrument for drawing, drafting and interior design courses. Thus, the utilization of such instrument can help maximize time and promote accessibility for correct decision- making involving color schemes thus increasing efficiency and productivity. This study also helps the drive for green technology for its utilization of paper products which are highly recyclable and biodegradable, thereby, minimizing carbon footprints in fabrication.

RECOMMENDATIONS

It is recommended that the prototype Innovated Color Wheel, as an output of this study, be adopted for reproduction and utilization to serve as alternative instrument for drawing, drafting, and interior design courses. It is also recommended that the utilization of the innovated color wheel be implemented in drawing, drafting, and interior design laboratories for instructional purposes of Cebu Technological University- Pinamungajan Extension Campus. It is further recommended that the Innovated Color Wheel will be applied to intellectual property office for utility model/patented before it will be commercialized for utilization.

Recommendation for further study will be the conversion of innovated color wheel parts into a printed material without the visible cut and paste portions as recycled from the traditional color wheel. Consumer satisfaction impact study of the instrument relevant to educational trust in the academe and industrial applicability may be conducted. Effects on the utilization of the innovated color wheel for basic technical drawing, drafting, and interior design courses may be an avenue for further research. Further dissemination and presentation of the innovated color wheel may be given priority in research not only for the CTU Pinamungajan Extension Campus but also the other CTU campuses as well. Local enhancement and design development for upgrading and making this innovated color wheel more efficient in its functionality will be of great study in the future.

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