COLOR USAGE AS TOOL OF CODING AND CLASSIFICATION IN INTERIOR ARCHITECTURE

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ABSTRACT

Based on three main causes, this paper intends to motivate interior architecture designers to utilize color as coding tool to be more feasible. First cause: the potential capability of color as powerful element of interior architecture with distinguished relation between human and objects. Second cause: the rapid developments of our contemporary life, which generate enormous items that need to be classified. Third cause: the domain of using color as means of coding requires more awareness in spite of the numerous studies and application that cover many aspects of color use and explain the role color plays in our lives. This paper investigates the types of architecture spaces that are more compatible with color coding concepts, and expected to be implemented in interior architecture design like healthcare, educational facilities and industrial projects. It confirms the necessity of using color as coding tool in interior architecture.

KEYWORDS

Color coding; Classification; Interior architecture.

1. INTRODUCTION

It is known that color as element of interior design, has the capability to create obvious channels of recognition with objects, that apply to the wide spectrum of human, from children to elderly people. Interior architecture designers should promote the impact of color as dominant factor of designing to realize its practical functions with more feasible practices parallelly with its usage as aesthetic and moral factor. The usability of color coding to inspire and adapt our control of actions should be reflected through the design of architecture and interior spaces. No doubt that color affects our perception of space psychologically and physically, this trend should be taken with high priority specially when the design process belongs to spaces with special requirements like schools and hospitals. One of the recent environmental architecture design trends is the concept of environmental color design, this concept focuses on using color with more considerable attention to the practical activities in our environment to be more informative. This research intends to encourage and enlarge the concept of color coding and classifying through focusing on some experiments and treatments.

2. COLOR CODING: EXPRESSING AND FUNCTION

The process of recognizing space elements and components is a complex process, especially if we are looking from the aspect of architectural and interior architecture design, where designers need to deal with many types of environmental conditions, demographic situations and different project purposes. When the space contains elements and items in massive numbers, shapes and types (figure1) , characterized with magnification and complexity as in commercial malls (figure2), or when primary users are children as in the educational facilities (nursery - schools), or are individuals with special condition like patients or people with disabilities as in the healthcare facilities (clinics- hospitals), also in care places for the elderly.

For such cases, using coding and classifying techniques of color to distinguish information and objects in diverse conditions becomes an urgent objective. The designers need to consider vital views when they decide their color-coding plan, once the consideration must meet the status of user's age, gender and health condition in addition to the necessity of matching space functionality (educational - healthcare - athletic - commercial - Industrial - ext..).

"Although color-coding is being used more and more to help people to get around in official buildings such as hospitals, schools etc., there is only one study, in which the effect of color on cognitive mapping was investigated systematically (Evans, Fellows, Zorn, & Doty, 1980).These authors showed that an interior color-coded building eased the wayfinding behavior and the acquisition of spatial knowledge of adults: two groups of participants explored an unfamiliar university building with or without interior color. Participants in the color-coded condition made significantly fewer errors when finding the shortest way to three different destinations, located specific targets more accurately, and recalled more floor plans of the building than the participants in the condition without color. It is the main goal of our study to investigate the role of color coding for the wayfinding behavior, that means the performance to find a way and the strategies used, and the acquisition of spatial knowledge for children at school age and adults" (Jansen 2004).

Figure 1, massive numbers of components
leoneprincipessa.com ,2015

Figure 2, magnification and complexity
Flickr: 2011

3. COLOR CODE AND COMBINATION

Normally, codes are composed of a set of items, (color, shape, size, texture, ….). The overall code content and meaning is generated through combination and integration process, like verbal knowledge. In spite of color remarkable capability of recognition and distinguishability, color by itself is unable in many cases to carry out the informative message the design should convey, therefore color should be linked with other appropriate coding items to integrate the desirable meaning. Architecture and interior architecture designers can demonstrate visual components in a limited space with different types and several combinations of coding items if the design presented in harmonic accurate plan. "The possible color combination and effects are limited only by the skill and imagination of the designer", (Poore 1994). Color coding process requires accurate estimation of color role as a part of the entire combination. (figure 3), (figure 4). "A word has strong association with a colour when the colour is a salient feature of the concept the word refers to, or because the word is related to a such a concept." (Saif 2011).

Figure 3, Color within code combination
discovergranite: 2020

Figure 4, Color within code combination
amazon:2020

Recent research with title “The Role of Color Similarity and Color Codability (2107)” is based on several experiments that explore the role of color in comparison with other two attributes (shape and size). 63 students undertaken with mean age of 20 years and 10 months to perform these experiments as user of actual life. This research concentrates about the distinguishability and codability of color and its power of expression. The experiments are applied by testifying the object under similarity condition shared with surrounding objects (other objects in the scene). One of these experiments used a combination of (color, shape and size) organized in 4 panels, each contain 3 fixed shape objects, 2 of them varied in color and size to testify and determine the impact of color distinguishability and codability. the basic experimental conditions are:

- Each panel contain 3 objects, all of them presented in one shape. (Figure 5).
- The (shape) used with each panel just one fixed shape for all objects, (color & size) varied in order to investigate codability capability.
- One object presented in a particular color, the other 2objects presented in another color.

- Size arranged to be in 2 categories small and large, the difference between them defined by the longest internal straight line of each shape with percentage of 2:1, this percentage was fixed with all objects.
- (hicode) means high codability.
- (locode) means low codability.
- (hidiff) intended object colored with high difference degree of color in comparison with the other 2 objects.
- (hidiff) intended object colored with similar degree of color in comparison with other 2 objects.

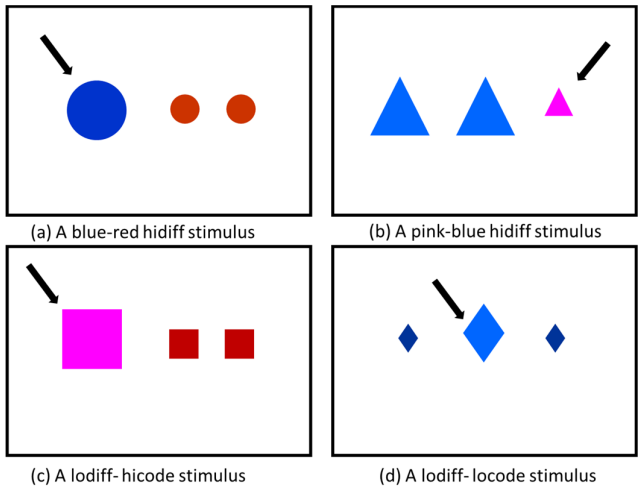

Figure5, The codability advantages of color
Viethen, 2017

The results and observation indicate that, most of students' choices refers to color with high percentage comparatively with the other 2 parameters (shape and size). This result confirms the distinguishability and codability of color and its power of expression.

4. COLOR CODING DOMAIN

Color coding concept and function expand over a wide range of implementation starting from the plan and the arrangement of slight items with small size and volume inside a work office or inside a residential building as its usage for coding starts with kitchen storage spaces (figure 6), to the range of entire building façade (figure 7).

In some cases, color coding is implemented for organizing the entire architectural planning of cities and share the overall environmental color design. Several patterns of cities with color coding characteristics locales in Greenland where no house numbers or street names, all buildings were one of five base colors (red, yellow, black, green, and blue), each color had a specific meaning. colours applied as indicator of buildings and streets, no house numbers or

street names, each type of building painted in specific color, commercial buildings as example recognized by red color and healthcare buildings were yellow and so on. This experiment dates to Greenland 18th-Century colonial era (figure 8).

Figure 6, Color coding with small size objects amazon: 2020

Figure 7, entire facadeColor coding with anarchitectures: 2017

One remarkable concept is environmental color design, this concept depends on color coding practices as one of its essential components in order to use color to match and adapt to the entire environmental space. Both natural component with its natural color, architecture and interior architecture color of building, public spatial colored elements, colors used in public events and activities, color of advertising boards and artificial lighting color are elements of environmental color design concept. In order to adapt and manage all these elements to be more informative and usable, keeping care about its aesthetic view, designer need to use color coding concepts.

Although color coding concept is preferable over specific types of building like schools and hospitals than others, the domain of using color coding almost has the capability to be applied for all types of buildings, spaces, and entire environment.

Figure 8, Greenland cities color indicated building function
MailOnline: Newton, J ,2019

5. INDUSTRIAL PROJECTS COLOR CODING:

Classifying hazardous areas is the main task of using color coding in industrial projects in order to separate workers from machines, moving equipment safely, establish traffic routes and designate storage areas.

Floor marking is a main component of industrial color coding that consists of lines and symbols, most commonly painted or taped on a floor (figure 9). In many cases the entire floor area divided into colored functional partition (figure10). Floor marking help worker and visitors to move inside and around a facility safe from hazards.

The process of color coding in industrial projects comprise (safety, water lines, waste water lines, chemical lines, other lines, electrical wiring color coding system). Using color coding in industrial projects is a vital issue, it is a matter of life or death. So, standards and consideration of coding plan that include color must follow restricted procedure.

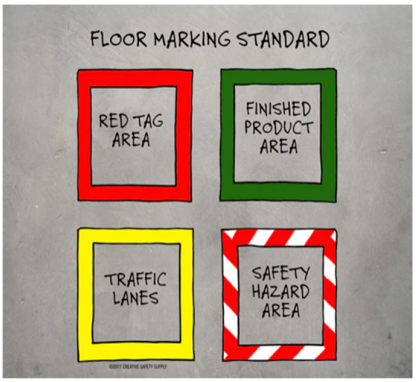

Figure 9, Color coding in industrial projects floor marking
5stoday: 2020

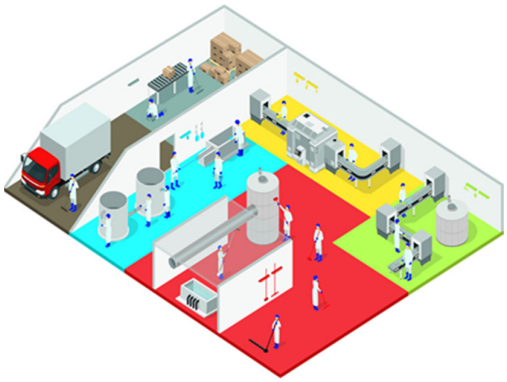

Figure 10, The entire floor divided into functional partition
Vikan: 2020

It is important to prepare charts, tables and documents that include a color scheme prior to work. It is also recommended to use the same color scheme consistently throughout the facility and be careful about the suitable width of floor marking lines to ensure maximum visibility. In many cases, there is need to use flags, traffic cones, barrels, and other similar methods to recognize color coding elements. Using color coding to identify pipeline type is considered of major use in industrial projects (figure11) (figure12). Many industrial organizations developed a comprehensive collection of standards that contain color coding as a major scheme with periodical changes to match the industrial development modulation; one of the major color coding standard entity responsible in the USA is the American National Standards Institute (ANSI).

"Language is no problem when color-coded floor markings makes the job as simple as matching colors. Mistakes are all too easy to make, anyway, and language problems just compound them. Now that we know how to get colored epoxy floor coatings down to stay, why not take advantage of them? Color coding pallet positions to correspond to color-coded conveyor belts is one way. Items coming off the yellow conveyor go to pallets on the yellow positions. Blue conveyor items go to blue conveyor pallet positions. Or you can mark red spaces for fire equipment and hose outlets, blue markings for water lines, and white markings for electrical panels and outlets. Why not a yellow path for traffic lanes rather than small taped lines? Following the yellow brick road worked for Dorothy and it can work for you", (Industrial 2013).

Figure 11, Using color for pipeline classification
Kamitopen: 2020

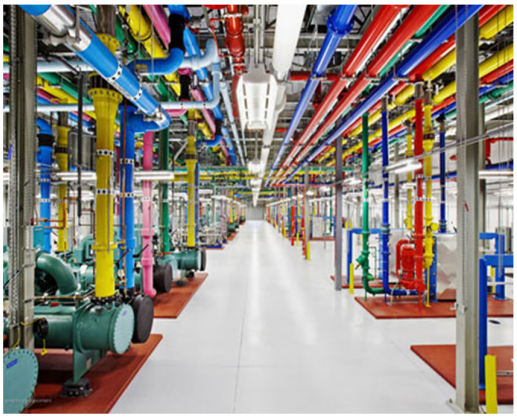

Figure 12, Using color for pipeline classification
design-milk: 2020

6. HEALTHCARE FACILITES COLOR CODING:

Due to the nature of hospitals and healthcare facility where patients, employees, and visitors undergo great stress at their work, need to recognize the place is a necessity and rapid localization need within healthcare facilities becomes a vital factor. (figure 13).

Figure 13, Healthcare rapid localization need
Fontsinuse: 2010

"Standardized code words for various emergencies are needed. Healthcare organizations use color codes, number codes, word codes, and a combination of these to announce emergency situations to staff. Most codes consist of a primary word and a secondary word, such as Doctor Red or Code Blue. If all facilities used common codes, misunderstandings and training time would be reduced, and emergency response would be more efficient. James Hanna, an emergency response consultant in Ontario Canada, spent years studding the use of emergency codes in hospitals. He concluded that color codes were more desirable than number codes because numbers require strict memorization, and they have no real relationship to the crisis. On the other hand, colors can be related to the type of emergency", (Colling 2001).

Figure 14, Several geometrical patterns as distinguish color coding concept
Fontsinuse: 2010

"Geometrical colored patterns guide visitors to their locations. Every level of building has a unique geometric colour design to be different from other levels (figure14), this allows visitors to recognize the intended location, the technique is distributed all over the hospital. Every section of the hospital has its large reception, given the code the opportunity to be more effective, many items are designed to give every section its own character. Wall areas covered with the same pattern are used through the entire level. Every section appears with its distinguished view due to the accuracy of color-coding system.

The waste of healthcare facilities is extremely dangerous, most of its items can cause infection. In addition, it is composed of many types of elements, consequently the need to use color coding system becomes an urgent necessity to differentiate between them. One of the remarkable usages of color coding in healthcare facilities the waste-color coding guide of UK department of health; the system simply allocates specific color for each type of waste. The system cover all types of waste and is fixed all over the country.

7. EDUCTIONAL FACILITES COLOR CODING:

Under normal conditions the entire environment of educational facilities from the domain of nurseries up to universities contains various architecture and interior architecture objects in colorful appearance. Using color as coding factor with proper and appropriate plan enriches the overall learning environment (figure15). The range of students age plays a remarkable role in using color coding concepts in educational facilities, particularly with early childhood education where color make them more sensitive to the impact of objects.

Figure 15, Types of educational facilities color coding
esty:2020 -123RF: 2020

The environment of educational facilities with its distinguished architecture and interior architecture stimulate designers to apply color codability. The dominant role of color codability and its informative features are to be reflected in the major aspects of design (educational - social - physical - psychological). Jansen, P. & Wiedenbauer, G. (2004) stated that: “The main goal of our study is to investigate the role of color coding for the wayfinding behavior, that means the performance to find a way and the strategies used, and the acquisition of spatial knowledge for children at school age and adults. We chose children at this age because there is ample evidence that children’s spatial knowledge of large-scale space

environments becomes more and more accurate over the course of middle and late childhood". There are many academic studies and experiments in investigating the role of color use, concluded that color play a crucial role in all aspects of educational facilities through supporting the overall learning environment. (figure 16).

Figure 16, Color coding supporting the learning environment
omgshockingfacts: 2019 - Aliexpress: 2020

Color coding is a recognized addition to any learning facilities if designers understand the educational environment. Color coding should be directed to match the emotions and behavior status of students once different colors have different notion. Color coding can be used as a skill development tool and help children to recognize the function of the different space areas, for example when the designer uses a set of green chairs in a specific corner to familiarize children to use them for reading and relaxation or assign specific red table with suitable dimension to be used for play in a free space. The architect and the designer of interior architecture should use each item with codability advantages according to the environment of the educational space, (chairs, doors cabinets, carpets, corridor, entrances, gates and all wayfinding components, etc...), with creative ideas (figure 17), (figure 18) to benefit from color coding capability and features through a well-balanced integration of coding in order to perform more informative and feasible design. Color coding can play a distinctive role in children classroom interior design, designers by using some ideas as dividing the space in a classroom into several functional areas (read and write area, activity area, toys store area ,…), can use color coding to introduce easy navigation and recognition of its areas. Thus, using color coding promotes the performance of children memory and provides them with more understanding regarding the space.

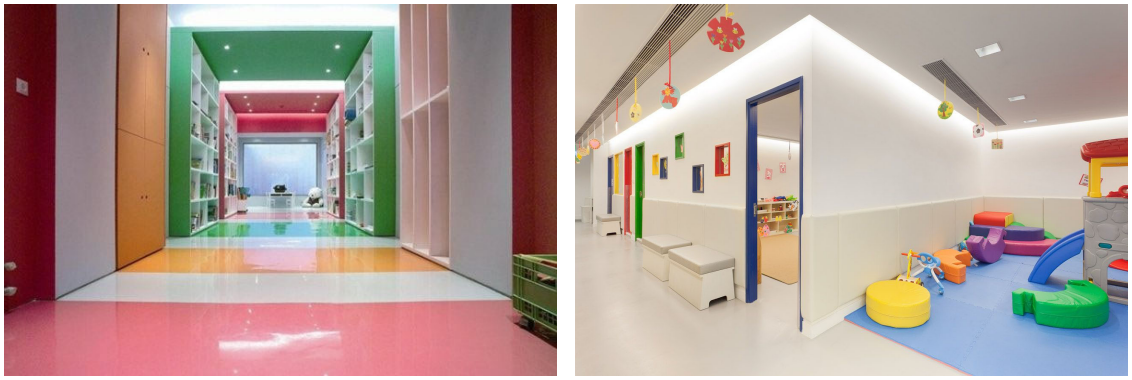

Figure 17, examples of color codability ideas in educational space environment
decor10: Ramon, 2015

Figure 18, examples of color codability ideas in educational space environment
Architecturesidea:2019

8. BONINGTON SCHOOL OF ART CASE:

The school of art and design at Nottingham Trent, University in Bonington UK, developed a simplified and colorful way finding coding system that reflects the creativity of Art and Design as an aspect of using color as main part of coding process. The different users (students, staff, visitors) of the building have been taken into account. The system consists of colors, signs, symbols, shapes and numbers, consequently, developing a visual coding language. The coding system elements expanded over all departments with clearly visible and recognizable design using color as the main component. (figure 19)

Floor levels are represented in map with color-coded shapes and icons. Each floor is broken up into colored parts for easy navigation. Each floor map positioned in key locations of its floor all around the building, (figure20).

The reception presented the primary key of the coding system located in the front wall depending on the impact of color coding as main part with appropriate size and height that maintain clear visibility. At the main entrances of each department icons with strong color effect and suitable size placed, (figure21).

Figure 19, Nottingham coding system with essential use of color
Bonington way finding: Chloe Morris, 2020

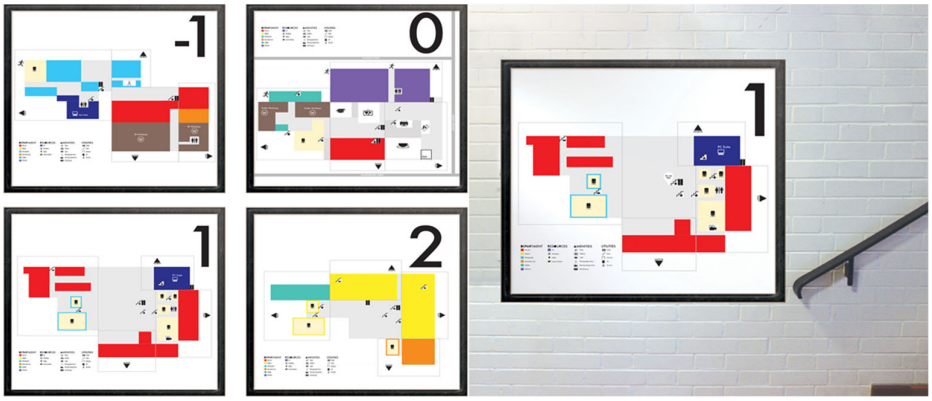

Figure 20, Floors map represented with shapes and icons
Bonington way finding: Chloe Morris, 2020

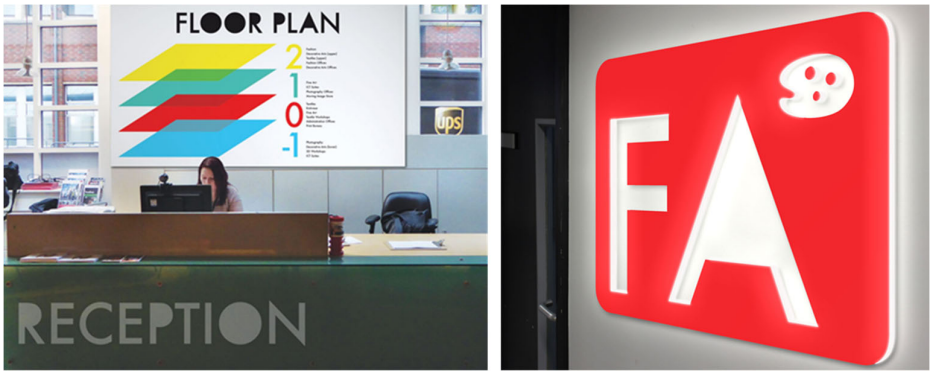

Figure 21, Main entrances and each department contain color coded elements
Bonington way finding: Chloe Morris, 2020

The information about school coding system prepared in a fold map (booklet) used as user guide. User can find this map at reception. User can simplify and quickly reach their intended level with its plan drawing, once the map is divided into 4 parts each part represents one floor, (figure22).

Sign with geometric shapes represented in a bright theme colors for easy visibility, located in a carefully selected location. Numbers of staircase coded by color and other informative data used as additional supporting guide, (figure23).

Figure 22, Map booklet with a dominate color coding factor
Bonington way finding: Chloe Morris, 2020

Figure 23 Ideas for using color coding concepts
Bonington way finding: Chloe Morris, 2020

9 GENERAL CONSIDERATIONS AND RECOMMENDATIONS:

- Use as few colors as possible, to make it easier for remembering the intended meaning of each color, human can distinguish and recognize a limited number of colors in the same time.
- Color code as a decision should be used consistently throughout the space in order to confirm the meaning of the code, it is recommended to strengthen the expression through several means like brochures, digital services, signs and audio awareness assistant.
- Ensure that code pattern makes sense for different categories within all environments and conditions (culture level - geographical features - outdoor and indoor requirements - users age, gender, physical, psychological and social situation).
- Avoid using similar colors with low color codability impact. High color codability easy to express the function, people with visual impairments confused with similar colors.
- Consider the contrasting degree between colors used in code against its background.

- Designers must be aware about the functional characteristics and the positive impacts of colors they used in their codes like high readability features and the power to attract attention.
- Consider the consistency and compatibility between color and other elements within code combination (shape, size, texture, etc….)
- Consider the advantage of using color coding when the majority of space elements characterized with considerable ratio of similarity in shape, volume and size.
- When code contains standard logo, badge or symbol keep it with its standard colors to make it easy to understand, maybe other alteration disrupts the meaning.

9. CONCLUSION:

Considerable applications of color-coding are used in most of architecture and interior architecture sectors particularly in healthcare facilities, industrial projects, educational facilities, residential housing, and commercial buildings. Space perception is a complex process that depends on many factors and is positively influenced by a remarkable color-coding. Critical considerations and important recommendations must be taken by the designer to avoid some deficiencies. There is a remarkable gap between the architecture and interior architecture usage of color coding in the developed countries like UK and our local practice regarding range, variety, and concept. Many efforts should be made to improve the usability of color coding over encouraging academic studies and practical application. There must be a clear existence and application of architecture color coding in projects standards and specifications particularly intended for healthcare and educational facilities, industrial projects.

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COLOR USAGE AS TOOL OF CODING AND CLASSIFICATION IN INTERIOR ARCHITECTURE

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الملخص

ســـاهمت ثلاث دوافع رئيســـية في الاقدام على اعداد هذا البحث، أولهما: ما يتمتع به عنصـــر اللون من خواص لا تتوفر للعناصر الأخرى كقدرته على تحقيق التواصل والادراك السريع بين العنصر البشري وما يمكن ان تتضمنه الحيزات من مكونات اخري، ثانيهما: التطورات والتغيرات الســـريعة التي تتطلبها الحياة المعاصـــرة والتي تســـتحدث عناصـــر جديده تتطلب من مصـــمم العمارة الداخلية القيام بالمزيد من المســـاهمة والاســـتخدام لأدواته وافكاره لتمكين مســـتخدمي المنشـــآت المعمارية للتعامل بأكبر قدر ممكن من الأدراك والتمييز والتصـــنيف لمحتويات الحيز الداخلي والتي غالبا ما تتباين من حيزات بســـيطة وواضـــحة الي حيزات مركبه ومتشـــعبه ومتعددة المحتوي، ثالثهما: الندرة النســـبية للأبحاث التي تتناول استخدامات اللون في التكويد والتصنيف في مجال العمارة الداخلية.

تكون البحث من عدة نقاط تناولت التذكير علي الإمكانيات الكامنة لعنصـــر اللون فيما يخص مفهوم التكويد والتصـــنيف في مجال العمارة الداخلية، والدور الوظيفي المميز للون داخل الاكواد المركبة (اللون - الشكل - الحجم- اللغة - ...) وهو ما تم تأكيده من خلال تجارب عمليه ودراســـات أكاديمية اثبتت تفوق اللون من حيث القدرة علي أداء مهام التكويد علي كل من عنصري الشكل والحجم كما بين البحث اتساع نطاق استخدامات مفهوم التكويد والتصنيف في مجال العمارة الداخلية حيث يوظف بالتطبيق علي المحتويات الدقيقة كالأدوات التي تكون بغرف اعداد الطعام ومكاتب العمل مرورا بالاســـتخدامات المنفذة في المشروعات المركبة كالمنشآت الرياضية والمجمعات التجارية التي تتضمن العديد من المكونات داخل حيزاتها وتتطلب طبيعتها الوظيفية التعامل مع العديد من المستخدمين مما يستلزم الاستفادة من استخدام الكود اللوني بكثافة, كما تناول البحث مختارات من اكثر المجالات المعمارية استفادة من استخدام الكود اللوني وهي المشروعات الصناعية حيث يستفاد من الكود الوني في عمليات تقسيم وتصنيف الحيزات والارضيات وتمييز وتصنيف خطوط الانابيب, كما تعتمد معظم إجراءات السلامة والأمان الصناعي علي إرشادات التكويد اللوني، وتناول البحث مجال المنشآت الصحية حيث تزداد أهمية استخدام عمليات التكويد لتيسير استخدام الحيز لكل من المرضي حيث تتطلب ظروفهم الصحية سرعة وصول المعلومات والارشادات وغالبا ما يكون من بينهم نسبه من أصحاب الاحتياجات الخاصة وكذلك الطواقم الطبية والعاملين والمترددين والذي غالبا ما يتعرضوا لضغوط بدنيه ونفسيه نتيجة لظروف عمل المنشأة، وتعرض البحث لاستخدامات التكويد الوني للمنشـــآت التعليمية حيث يمتلك للون خواص تعليميه وادراكيه مميزه تتوافق مع العديد من الاســـتخدامات في تعزيز الجوانب التربوية وخاصـــة في المراحل العمرية للطفولة كرياض الاطفال والمراحل الاولي من المدارس الابتدائية ، كما تعرض البحث الي حاله عمليه تم اســـتخدام الكود اللون فيها بالتناســـق مع عناصـــر التكويد الأخرى كالشـــكل والحجم والتعبيرات اللغوية وهي كلية التصميم والفنون بجامعة نوتنجهام ترينت (Nottingham Trent University) بالمملكة المتحدة بطريقه مميزه، كما تضـــم البحث مجموعه من اهم الاعتبارات والتوصـــيات العامة التي ترشـــد مصـــممي العمارة الداخلية عند قيامهم بالتعرض لمشروعات تتطلب استخدام المفهوم التكويد اللوني.

من اهم الاســـتنتاجات أهمية تحفيز الدراســـات الأكاديمية والتطبيقات العملية التي تركز على الاســـتفادة من الطاقات الكامنة لعنصـــر اللون في وظائف التنظيم والتصـــنيف والتكويد لمحتويات الحيزات الداخلية. الاستفادة من التجارب المحلية والدولية الناجحة. أهمية مراجعة المواصفات المعمارية وخصوصا في مجالات الصحة والتعليم والصناعة والتأكيد على ان تتضمن مقاييس واكواد تتمتع بالوضوح والمرونة والالتزام التنفيذي طبقا لكل تخصص.

الكلمات المفتاحية

العمارة الداخلية؛ الكود اللوني؛ التصنيف.