

Color Psychology in User Interface Design via Mobile Learning Applications



مقال
بحثي كامل

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تاريخ المقال:

- تاريخ تسليم البحث الكامل للمجلة: 15 أكتوبر 2023
- تاريخ القرار الأول لهيئة التحرير: 23 أكتوبر 2023
- تاريخ تسليم النسخة المنقحة: 23 مايو 2024
- تاريخ موافقة هيئة التحرير على النشر: 28 مايو 2024

الملخص:

Over the past few years, the world has gone through several Stormy crises, and one of the most severe of these crises is the coronavirus pandemic that swept the world despite the negatives it has caused. Despite the relative calm of this pandemic, it revealed a trend that is not new but has gained importance due to the increased need for people during it: communication via the internet in all its forms. This pandemic has led to a communication style that has evolved into a fundamental and significant role in public life. The research here focuses on the technological educational component. There has been a technological innovation surge in this field in recent years. This technological boom saw a significant increase in the use of mobile learning applications, and this success is only a reflection of the success of the user interface design for these applications. One of the most significant design elements is color because it conveys meaning. In this study, the researcher sheds light on the psychology of color in the design of the user interface for mobile educational applications in the early stages of education because it is critical to the establishment of the child's information awareness at this early stage of life.

الكلمات المفتاحية: Art - User Interface Design - Psychology of Color - Mobile Educational Applications - Interactive Design Theory.

Introduction: -

The world today is characterized by successive changes, which therefore requires preparing a child who has many basic skills, but almost necessary to deal with the changes of this age, which may pose a challenge to him in the future. That is why traditional methods of Education have appeared insufficient to form a mountain that keeps pace with the momentum of the modern technological revolution, which has already contributed to changing the nature of life. As the world went through the corona pandemic and the need for a social distancing policy appeared, hence the boom in various technological programs appeared and the scope of need for them necessarily expanded to include various aspects of life (Alashhab et al., 2021).

As computer and software companies competed to provide high-quality programs, due to this competition, user interface (UI) designs for various mobile applications have evolved. The development of communication and information technology has led to the emergence of innovative educational systems and in a short time they have become very important, and the research here sheds light on learning systems through mobile.

However, the child is the unit of building the future and the hope of tomorrow....

What is the situation of our children considering these accelerated technological developments?!

This question may seem to many people an ordinary question, but from a scientific point of view it carries many axes, headed by the psychology of the child based on the scientific method that follows observation, measurement and approximation ((Basal et al. 2016).

So here we are in front of two different trends in terms of nature, the material trend represented by the technological side with its successive developments and challenges, and the psychological trend of the data provided to the child through modern mobile devices and its advanced applications.

Hence, the role of art came to work on the balance between these two poles, and this is what the researcher will explain on the research pages here through an analytical study of some of the models for educational mobile applications.

The search problem: -

The problem of research lies in answering a number of questions, namely: -

1. How can art be a tool that creates a language of dialogue between a number of different fields (technological and educational)?
2. What is the reason for the success and popularity of one mobile educational application over others?
3. Has the psychology of color influenced the behavior and feelings of the user of educational mobile applications?
4. How can color be a double-edged sword in communicating the intellectual value provided to the child through mobile learning applications?

Additionally, from related research: -

- The user interface of the responsive website flat design and design material. The research here deals with the importance of design elements in the field of website user interface design and how to employ design treatments on the site in a way that achieves usability and provides a user experience with high efficiency to achieve user satisfaction. The

researcher agrees with this study in singling out one of the design aspects, but emphasizes its significance in the educational sphere.

- The impact of applying the principles and considerations of designing the interface of smartphone applications on improving the user experience. The research here focuses on the relevance of smartphone applications and their role as interactive methods in numerous aspects of life, which necessitates careful consideration of how to design the user interface.
- The researcher agrees with this research in that it sheds light on the importance of smartphone applications as an easy means of communication, as well as the research's uniqueness in focusing on one of the elements of user interface design (color) and its effectiveness in delivering information in the field of smartphone learning applications.
- New design features for UI/UX mobile applications for smartphones. The research here focuses on smartphones as a major tool in the modern lifestyle because of their applications' importance in facilitating life in general, and thus the importance of designing these applications so that the designer can attract the greatest number of followers. However, the researcher here emphasizes one of the design aspects (color) while focusing on the psychological aim in the educational field.
- Guidelines for designing mobile application interfaces to create the right user experience. The research here focuses on the importance of user interface design in the development of smartphone applications. Therefore, it goes over the criteria for creating an effective and simple user interface for smartphone applications. It also discusses some of the elements to consider while creating application interfaces for smartphones.
- The semantics of color in graphic design. The study examines the concept of importance in graphic design and what it entails in terms of vocabulary depth and topic-event appropriateness. This includes all design elements, and one of the most important expressive connotations is color connotations, where the energy between the psychological feeling, including from various meanings, the designer and the recipient interacts with it.
- However, in this study, the researcher reviewed the importance of color as one of the design elements and exploited this importance in delivering information through smartphone applications.
- The role of graphic design elements in improving the curricula of children's education on websites (at the basic stage). The research aims to study the success factors of graphic design for websites to educate children and the extent of developing their creative abilities by presenting scientific material in a modern way.
- But the researcher focuses on reviewing the importance of the psychology of color as one of the design elements in the delivery of educational material such as pre - basic education through smartphone applications.

The Research objective: -

The research aims to shed light on the importance of design elements, especially color, in the field of the educational process,

but through a formula that is in line with the innovations of this era. Where mobile educational applications of various types and the following developments in the world of user interface design, the research here concerns applications aimed at children from 4-7 years. It is one of the important years in the formation of the child's conceptual cognitive awareness and the correct anchoring of information.

The Research Significance: -

The use of color in the educational process is not for visual pleasure but has important scientific foundations that rise to be an important part in the educational process, especially in the early years of the child.

It is of constant importance, whether in the presence of a paper book or the presence of advanced educational technological technologies. Hence, there is an urgent need for integration in the relationship between the various design elements, especially here in the search (color element) for the user interface and the user experience to achieve satisfactory results for the recipient.

The Research Boundaries: -

The time boundaries of the research aim to study and analyze some versions of modern models for the design of the user interface for mobile learning applications since the invasion of the corona pandemic. As for the spatial boundaries, the research is in the process of targeting samples of mobile learning applications that are available on the play store in the Arab world and Egypt as a model.

The Research Methodology: -

The research follows the descriptive analytical approach in choosing some models for mobile educational applications and working on analyzing and describing the user interface for them.

The Research Terminologies: -

User Interface Design (UI): -

(UI) is an abbreviation for User Interface Design, it means the visual interface of the application that the user interacts with, which includes buttons, displayed texts, images and slides, that is, everything that includes the page format and how to move in the interface, that is, the user's interaction with the application interface is the responsibility of the user interface designer.

User Experience Design (UX): -

(UX) is an abbreviation for User Experience Design. This term expresses how the user interacts with an application in terms of the ease or difficulty of interacting with the user interface elements and the user interface designer responsible for its design.

Psychology of Art: -

It is an interdisciplinary science that studies sensory and cognitive perception of the characteristics of art and what is produced by understanding the human nature of the creative artist and the scientific nature of the creative process in the field of art.

Psychology of Color: -

It is the scientific study of how different colors affect the psyche and behavior of the recipient.

Mobile Educational Applications: -

This term refers to a software application that is developed to work on smart mobile phones and allows users to access the learning material simply and easily anywhere.

Interactive Design (IxD): -

It is a design that aims at user interaction through periodic and collaborative processes between people and technology.

Saturated color: -

It is the pigment of the color (hue) that is in the strongest concentration or intensity ratio, and the saturated color is defined as the pure color, i.e. the clearest process.

Theoretical framework of research: -

The research study was based on finding the link between several different axes, namely: -

(User interface design - mobile learning applications - the aesthetic value of the psychology of color).

User Interface Design (UI): -

This term is a new one of its kind and the need for it comes in sync with the continuous technological development of smartphones, as it allows the user to deal with various devices and programs in a smooth and fast way.

This term is used to refer to the application's image interface and usually consists of a set of buttons in the form of images, displayed texts, animated slides and all the elements that allow the freedom of interaction to take advantage of the application. Therefore, the graphic designer of the user interface is not an easy task, as it requires him to perfect his tools to attract the recipient of the application. (Khasawneh 2023).

Speaking of the user interface, we should touch on the user experience.

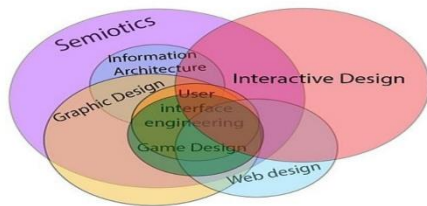
User Experience Design (UX): -

This process is an important and indispensable part when talking about the user interface, as it connects them with a symbiotic relationship. It means the practical part of the application where the user interacts with the tasks of the application easily. Therefore, it is the responsibility of the user experience designer to determine how the interface works and its responsiveness, and therefore how effective it is and how easy it is to navigate between tasks so that the work is completed with the configuration part to be owned by the user interface designer.

This brings us to a self-imposed question about the importance of the user interface in being the channel of communication between the digital application and the user, depends on the success and promotion of the application or not. For this reason, there was a need to develop the basics and principles of designing the user interface in a scientifically studied way. These principles are divided into a behavioral and another formative part (which is the subject of research). The process of designing an interface for an application on one of the smartphone devices (for example) is not random, but several considerations and many tasks come together.

Theory of interactive design: -

Interactive design can be defined as the design of interaction between the user and the product. As in figure 1.



The product here refers to software such as smartphone applications or websites. The goal of interactive design is to create applications that allow the user to access the product and achieve the highest benefit from it in the best way. The interactive design consists of several elements, for example color, movement, sound, and many others, and each of these elements is an attraction tool for the recipient in case the elements fit together. (Moll 2008).

It is noted the great overlap between interactive design and user experience design, where user experience design improves the use of the product and includes (User research, User Personas, User testing and Testing usability). As for interactive design, it is part of the user experience and focuses on the interaction between the user and the product by interface only (Designing Effective User Interfaces. [no date]).

As for the user experience design, it takes care of everything related to the entire experience. Therefore, the interactive designer's job is to design the interactions of the entire experience, that is, he is responsible for making all the elements on the screen.

Educational applications: -

There are many educational applications that are used through smartphones. The diversity of these applications is due to the diversity of the targeted category and its purpose. Education apps provide a mix between smart and systematic education. The entire content is arranged on an educational application in a way that increases the student's desire to learn more things in a systematic way. During the corona pandemic and the required social distancing, the demand for e-learning has increased, but over time, the application of education enables students to follow the lessons smoothly and logically without much effort.

On the other hand, the student can take advantage of free time and learn about various fields of well-known Sciences easily, and with the widespread use of smartphones because of its advanced technological features, education has become an increasingly important requirement with time. A good educational design is the cornerstone or real interaction of any educational program, as it considers the special features of the medium that performs the presentation and presents the educational material. Design principles are the turning point in the design of mobile learning environments. (Basal et al. 2016).

Most educational design models highlight the processes of analysis, design, development, and implementation, which are the basic processes in the design and use of an educational product. The evaluation phase comes at the end to follow up on the above and treat the defects that appeared during use. All models also emphasize the importance of performing the evaluation process, and in this they directly indicate the

importance of accurately determining educational goals. And we find here that all educational design models of various types revolve around these five main stages and all of them appear in the so-called General model of educational design ADDIE model. The difference in educational design models is limited by the expansion in the width of one stage without the other. As in figure 2



شكل (٢) النموذج العام للتصميم التعليمي

Figure 2: The general color model of educational design

The influence of graphic design in directing the consideration of smartphone application interfaces.

Graphic design is of great importance in the design of smartphone application interfaces helps to: -

Delivering a specific message with a purpose.

The graphic design elements that make up the interface, such as images or illustrations, decorations play an important role in making the user want to continue using the application (Tsvetozar and Evgenia 2009).

Changing user convictions.

The process of changing the user's convictions is a difficult process, involving several aspects such as the psychological aspect, when we use an image in the application that reflects a feeling of satisfaction or ease for the user. This reflects positively on the user's psyche and changes his conviction.

Promotion and marketing of the product or service.

When focusing on the promotion and marketing of a product or service through the interface of smartphone applications, we work to make the user feel completely satisfied with the service or product. As for the research topic, meeting the recipient's desire to obtain information in an interesting and smooth way to increase the demand for this application.

The user stays longer on the application.

The attractive and comfortable form of the application is one of the things that keeps the user longer in the application, increasing the period of communication or staying in the application is one of the most important indicators of the success of any application.

Discover the application features.

The Shape of the application interface gives an indication of what the application is. For example, a design aimed at a certain age group of children is different from the design of a bank in terms of different colors, threads, images, illustrations, and all these elements create the user's impression of the application interface.

Communication between the application and the user through graphic design (eye contact).

One of the most important criteria that affects the effectiveness of design is the principle of eye contact, and it consists of the

two types which direct eye contact, or indirect contact through meanings and messages carried by various design elements.

Principles of visual design in user interface design: -

One of the most important features of visual design principles is that they help direct the user's attention. The first thing the user notices is the shape of the interface, and here lies the importance of the graphic designer's role in showing the interface in the best way, to catch and attract the viewer's eye. At the same time, it is convenient for eyesight, in addition to directing the user's gaze to the most important part of the interface to achieve the desired purpose of the application. This is what the designer focuses on in the subject of visual transport, which is defined as: -

A relative concept on which all the principles of visual design are based on, and it compares between one element of the design with what is around. Some elements seem heavier than others in the interface layout, attracting more attention.

From the design elements affecting the visual transport are: -

Variation: -

It is the difference between the dark elements and the light elements in the design or the difference between the sizes, and the greater the difference between them, the greater the contrast, and this idea serves the visual transfer in the interface.

Depth and size: -

In the principles of visual design and its elements, the user sees the largest as close and the smaller elements as far away, so as a rule it is recommended to make the most important elements of a larger size than others.

The Color: -

Designers should understand the color theme, especially user interface designers, because color is one of the important and influential elements in the application interface (it is the focus of research). The designer who cares about the user experience completes the sketches in black and white because his first concern is functionality, but the aesthetic form is one of the concerns of the interface designer.

The Psychology of color: -

Colors occupy an important aspect in our lives and the importance of this aspect has become a science on which many scientific and philosophical studies have been conducted and the extent of their connection with each other. This study reveals to us how different colors affect human mood and behavior and this branch of science (psychology of color). It is one of the branches of psychology that is interested in how the emotional responses of a person are affected by color, as well as psychological responses, considering the age factor and cultural background.

So here we are in front of two directions, one of which is concerned with the symbolism of color, and the other is related to the meaning of color. Therefore, it is advisable to choose colors and their shades on a thoughtful basis with meaning and purpose, when the need to develop a special color scheme for the interface, colors are not chosen just for visual pleasure without a goal, but the choice should be made on a scientific basis.

Colors in user interfaces: -

Color is one of the most important elements of the design of the visual interface of the user now because it carries a strong

impression and influence on the interface and it is also a language of communication. (Banga and Weinhold 2014).

It is meaningful and a successful application is characterized by the success of the designer in how to employ color to emphasize and highlight the meaning when designing digital content. On the other hand, the presence of other elements must be considered when using color, such as text, logo, buttons, icons, etc. and their relationship with each other to maintain the shape and balance of the interface.

Common mistakes in using the color element during the design of the educational interface: -

The use of several colors: -

When we use many colors in the interface, we take more time trying to remember what this color means or what its significance is because this number does not correspond to what human memory is able to retain information on the short term of memories, which affects the degree of assimilation due to this dispersion.

The use of saturated complementary colors: -

Complementary and saturated colors are colors opposite each other in color calculations, these colors when they are completely saturated and placed adjacent to each other, they align with each other and make the degree of perception or concentration with them is difficult.

Over-saturation of tones: -

Highly saturated colors attract attention and it is recommended to use them moderately to attract the user's attention, but care must be taken when using multiple saturated colors with each other so as not to ally and make the process of their perception difficult.

The contrast between the elements is weak and insufficient: -

When the colors of the elements are different from the background color only in tone and similar in saturation or brightness, it is difficult for the user to perceive them. Therefore, it is recommended that the color of the main element be different from the background color in the degree of brightness and degree of saturation, in addition to the difference in tonal tone and text color, as well as with the background color for easy perception and reading. (Cooper and Reimann 2003).

Lack of attention to the topic of color blindness: -

Some people suffer from color blindness, therefore it is recommended to consider the use of red and green colors and their shades, especially when using or writing important information to support the communication process. Any colors used in the communication process are recommended to be different in brightness and saturation to make it easy for the user to distinguish between them.

Choosing a color system in the interfaces of educational applications for smartphones: -

Color plays an important role in the process of user interaction with the (educational) application, whether negative or positive, depending on the quality of color employment, so each application has its own color system that contains basic colors in specific proportions. When choosing a specific color scheme during the design of the interface, it is recommended to consider several things, including the colors of the visual identity, the colors of the surrounding environment and their impact.

There are several effective color schemes in the interfaces of educational applications for smartphones: -

Monochrome color scheme: -

This system is considered one of the simplest systems and can be used in the interface, where single colors of one color are taken from the color wheel in multiple shades and match each other to give a streamlined effect, which are comfortable colors for the eye, especially the blue and green colors and their shades. As in figure 3 and 4



Figure 3: The icon of the educational application (Nagwa classes)

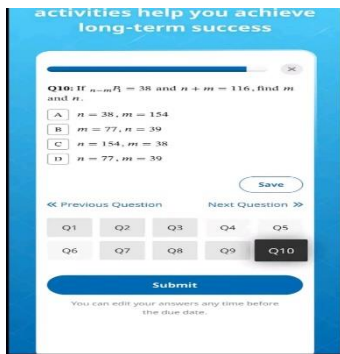


figure4 (a): Choose the blue color from the color wheel and apply it to one of the internal interfaces of the educational application (Nagwa classes).



Figure 4 (b): referring to the blue color.

Symmetrical color scheme: -

This system arises from the use of three identical colors next to each other on the color wheel of 12 colors, and one color is dominant and primary, and the other colors are auxiliary to the main color. This choice may seem easy at first, but the difficulty lies in choosing the right shades. As in figure 5 and 6

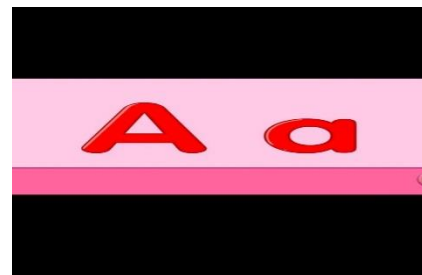


Figure 5 (a): The choice of warm tones converging from the color wheel and applied in the design of one of the internal interfaces of the application (starfall ABCs).



Figure 5 (b): the color wheel.



Starfall ABCs
Starfall Education Foundation

Figure 6: The icon of the educational application (starfall ABCs).

The complementary time system: -

The complementary color system is the colors that are located opposite each other on the color wheel, and there is a very high color contrast between them. Therefore, it is used to attract the user's attention, it is the easiest way to make an element noticed faster in the interface, considering use it carefully in the interface elements, as its frequent use makes the interface visually repulsive. (As in figure 7 and 8)



Duolingo: language lessons
Duolingo

Figure 7: The icon of the educational application (Duolingo: language lessons).

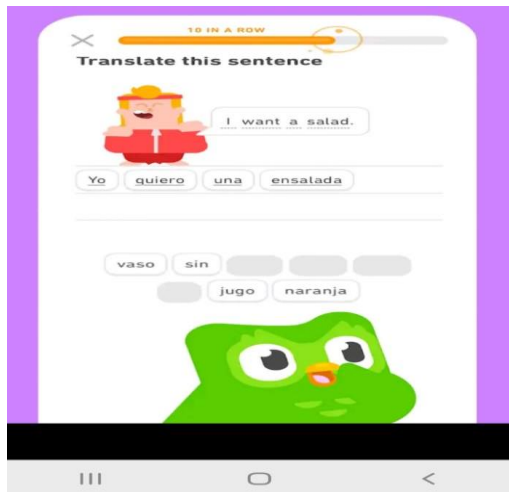


Figure 8: Choosing two opposite color tones on the color wheel and applying it in the design of one of the internal interfaces of the educational application (Duolingo: language lessons).

Custom color scheme: -

Designing a custom color scheme is not as complicated as some people think, adding a luminous color to a natural color range creates a visually attractive and comfortable color scheme. An example of this is what we observe in adding a degree of green in figures number 9 and 10 to the design of the application interface.



figure9: One of the facets of the educational application (English Pronunciation British) The work was done through a system of custom colors.



**English Pronunciation
British**
Study Center
Contains ads • In-app purchases

figure10: The icon of the educational application (English Pronunciation British).

Results: -

1. Educational smartphone applications help facilitate access to content and training on it.
2. A successful application is one that cares about the value of the user and the target category of it.
3. The Interest in studying the psychology of application interface design elements because of their impact on the user's first impression.
4. The psychology of color is a science that has many dimensions and enters many details of society, so it is of great importance.

Recommendations: -

1. Paying attention to the detailed study of the design of smartphone applications so that we can better keep up with rapid technological progress.
2. Focus on studying the design of smart phone application interfaces in line with the educational process to take advantage of technological advantages in educational aspects.
3. Not to lose sight of the vital role of art in all aspects of life.
4. Benefit from philosophical studies of design elements in the field of technological applications.
5. Checking accuracy when presenting scientific content to the child through smart mobile applications.
6. The expansion of the field of educational applications for smartphones because of their usefulness in eliminating the element of time and space, which affects the delivery of information to a larger base of users.

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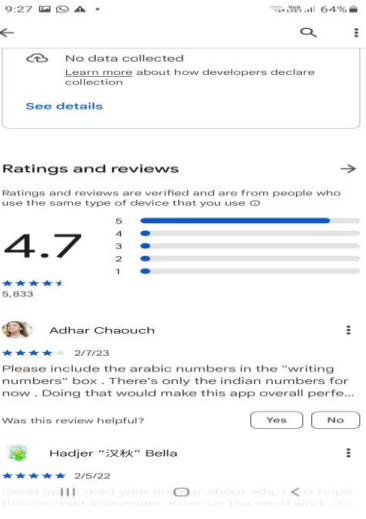
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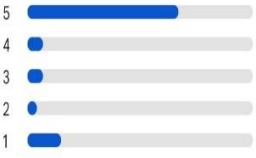

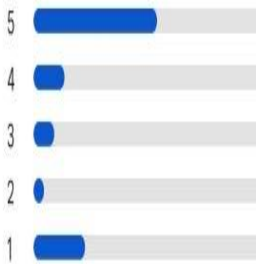
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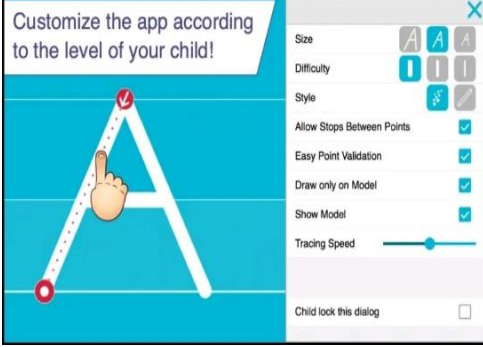





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Semantics of colors and their symbolism in the design of the interface of the educational application: -

Application Name	Evaluation through the Play Store	Its purpose	The psychology of color in the design of the application interface
<p>ABC Preschool kids Tracing.</p>  <p>Figure 11</p>	<p>Ratings and reviews →</p> <p>Ratings and reviews are verified and are from people who use the same type of device that you use ⓘ</p> <p>3.7</p> <p>★★★★☆</p> <p>4,081</p> <p>Figure 12</p>	<p>An educational application for kindergarten-age children to teach letters and numbers.</p>	<p>Cold colors were used in the background, ranging from Green to blue, and the designer chose a hot color in the foreground to highlight the information. However, it was not a good choice because the degree of brightness of the color in the background is stronger than the degree of brightness of the color, which made the attention to the background equal to the personality and this led to distraction.</p>
<p>To teach children.</p>  <p>Figure 13</p>	 <p>Figure 14</p>	<p>An educational application that combines learning and fun in an interactive way and motivates the child to learn (in Arabic).</p>	<p>Explicit colors were used in the design of one of the facets of the application, such as green and red, but with caution and care, as they are considered complementary colors on this Color Wheel in addition to using a white background, which increases the focus on the information and attracts the attention of the child.</p>

<p>ABC tracing and Phonics.</p>  <p>Figure 15</p>	<p>Ratings and reviews →</p> <p>Ratings and reviews are verified and are from people who use the same type of device that you use ©</p> <p>4.1</p> <p>★★★★★ 65,610</p>  <p>Figure 16</p>	<p>An educational application for Learning English letters in an entertaining way, aimed at kindergarten-age children.</p>	<p>The color design came in one of the interfaces of this application (ABC kids) symbiotically, where cold colors were used in the background, and the focus came on the character, which is (the letter) in red hot, which is one of the main colors most used in visual stimuli to attract attention.</p>
<p>Endless Alphabet.</p>  <p>Figure 17</p>	<p>Ratings and reviews →</p> <p>Ratings and reviews are verified and are from people who use the same type of device that you use ©</p> <p>3.7</p>  <p>Figure 18</p>	<p>An educational application whose purpose is to learn to read alphabets in a simplified form.</p>	<p>The researcher chose one of the interfaces of the application as a model to see the designer in the output of the work, noting here the use of many colors in the letters and in the characters as well, which causes distraction in attention. The strength of the colors and the large number of them came as a factor of weakness, not strength, and did not achieve its purpose in attracting the child's attention in the desired form.</p>

<p>Writing Wizard learn letters.</p>  <p>Figure 19</p>	<p>Ratings and reviews →</p> <p>Ratings and reviews are verified and are from people who use the same type of device that you use ☺</p> <p>4.0</p> <p>★★★★☆</p> <p>5,619</p>  <p>Figure 20</p>	<p>The purpose of this application is to learn to write English letters.</p>	<p>The bright blue color in the design of one of the interfaces of this application occupied the dominant part, and this is why this color carries such a degree of meaning that works on clarity of soul and mind. The signal also came to start writing the letter in red, and despite the limitations of the red color, it led to attracting attention through the white background, but on the other side, the choice came in shades of gray so as not to distract attention.</p>
<p>Study Cat: Kids learn Spanish.</p>  <p>Figure 21</p>	<p>Ratings and reviews →</p> <p>Ratings and reviews are verified and are from people who use the same type of device that you use ☺</p> <p>3.8</p> <p>★★★★☆</p> <p>1,175</p>  <p>Figure 22</p>	<p>An educational application to teach children the Spanish language in a fun and fun way.</p>	<p>It is noted in the design of one of the interfaces of the educational application that the use of color at an average degree of brightness in addition to the use of letters in white, which reduces the attraction of the child's attention to this Color group.</p>
<p>Learning Games Baby Games.</p>  <p>Figure 23</p>	<p>Ratings and reviews →</p> <p>Ratings and reviews are verified and are from people who use the same type of device that you use ☺</p> <p>2.8</p> <p>★★★★☆</p> <p>134</p>  <p>Figure 24</p>	<p>This application provides an interesting method for children at the age of three and four to learn shapes and colors.</p>	<p>The interface designer of this application provided a color range influenced by nature to a large extent, but the use of a brown color tone a lot with the small size of the shapes, and the lack of brightness of its colors worked not to attract the attention of the age stage directed to this application.</p>