THE ROLE OF MOBILE APPLICATION IN ADOLSENSCENT DEVELOPMENT. EXISTING METHODS AND GOOD PRACTICES FOR CREATING MOBILE HEALTH APPLICATIONS

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Abstract: *The use of mobile phones and tablets is becoming more and more widespread in people's daily lives. More and more applications have already been created for mental health interventions, for personal management and for motivating users to self-organize. The science of human-computer interaction emphasizes the understanding of end-user needs and is the first step in designing these types of technology-based interventions. In this article a profile of the adolescent and the accompanying problems will be made. The purpose of technology-based interventions and their use by adolescents will be described. Techniques, taxonomies and the application of behavioural design and behavioural models in the development of digital applications will be presented.*
Key words*: mobile applications, UX, adolescents, Behavioural Design, behaviour change, Behavioural change theory*

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1. INTRODUCTION

Continuous consumer desires for self-development and growth enable the end user to desire more products and services in which behavioural design plays an important role. Many people are interested in how they can focus on better wealth, health and happiness.

Digital technologies allow the transition from passive users to a specific experience to a flexible space that offers activity and creativity. Behavioural systems design can provide entirely new levels of impact.

Behavioural design, science, and analysis have evolved over the past decade and are used in many academic studies, economics, politics, design applications, and in many cases are used in industry. Behavioural design intersects with several policy areas, including healthcare, technology, business and research, leading to multidisciplinary collaboration in academia and industry.

Behavioural design has sparked a heated debate over the last ten years about the ethics of certain behaviour change techniques in public policy, the technology industry, and research design [3]. The last ten years have shown the enormous power of applied behavioural science with its advantages and disadvantages, and with its dark and light sides.

Technologies such as tablets, mobile phones and other wearable devices allow tracking and processing of data in combination with the ability to care for patients at the right time and place [3]. They adapt to the changing needs of the individual over time and are more like support provided by an effective health care provider, counsellor or coach. A type of support that can otherwise occur in meaningful face-to-face interactions. Behavioural design is relatively unused in healthcare, but it is high time to use it in this area [3].

This article will briefly look at the development of healthy adolescents and the problems that arise in the process of their growth. The impact and use of technology by adolescents and their importance for adolescents and people with chronic diseases. A study was made and presented on existing techniques, methods and models of behavioural design for the development of mobile applications.

2. THE PROCESS OF DEVELOPMENT OF ADOLESCENCE AND THE ACCOMPANYING PROBLEMS DURING THIS PERIOD

During adolescence, identity is built and plans for the future are drawn.

Teenage years are essential for cognitive control [12]. Because the prefrontal lobe is still poorly connected to other areas of the brain, adolescents find it more difficult to exercise cognitive control over situations [11]. Because of the stronger positive emotions, it is much more likely to take risky actions.

The focus requires an abstraction from emotional disorders and an emotional suppression scheme, which adolescents have not yet learned due to hormonal problems and the inability to still control their body. Under stress, the nervous system is flooded with the hormones cortisol and adrenaline, which leads to emotional exhaustion. High levels of cortisol lead to increased aggression and impulsivity. Then the focus is on worries, not work. [12] Full focus is not always available to teenagers due to hormonal imbalances [12].

"According to the WHO, 16% of children and adolescents between the ages of 10 and 19 in the world have mental disorders. Half of the mental illnesses occur around the age of 14, three quarters to the age of 25. Mental illness is the leading cause of disability in young people. Undiagnosed and untreated, mental illness has a serious impact on children's development, their educational achievements and their potential to live a full and productive life. " [10]. And according to [22] 50% of mental illnesses in adulthood begin before the age of 15 and 75% before the age of 18.

"Many children and adolescents with mental disorders face major challenges: stigma, isolation and discrimination, as well as lack of access to health services and educational institutions that violate fundamental human rights. Early recognition and proper management of the mental health of children and adolescents is needed to reach their full potential. " [10]

Without a pandemic, about 20% of adolescents experience various mental health problems [13], and the coronavirus pandemic (COVID-19) makes adolescence even more difficult [9].

In [13], an increase in consultation with clinical psychiatrists during and after online adolescent training was reported, and a recent study by UNICEF and the International Federation of Student Medical Associations (IFMSA) found that about 40% of teens experienced stress due to detachment from friends and the school environment, fear of illness and a future beyond their control.

The role of parents is crucial for the development of adolescents in any environment and setting. Regardless of whether they are emotionally mature [14] and their approach to upbringing, the development of the adolescent largely depends on them and their initiative.

Parents are responsible for setting rational time limits for the use of technology [2]. The use of technology is not a problem, but the way it is used. Awareness and balance in their use in children and adolescents is a difficult process, as the development of the brain and especially the prefrontal lobe continues until about 21-23 years of their development. And in a pandemic setting, the role of the parent is key in restricting their use.

But at the same time, if the child is not proactive and is combined with full control over him by parents or mentors, he will be deprived of the opportunity for orientation in life and imagination [6]. During this period, the more control, punishment, and judgment a parent encounters, the more likely they are to get stuck in the process of individualization.

A serious challenge to public health is the lifestyle of adolescents and students. They tend to eat unhealthy foods and have low physical activity, which leads to being overweight. Studies show that the level of physical activity of children and adolescents aged 9, 11, 12 and 15 decreases with the entry of children into adolescence [20].

As an alternative to gaining more independence, the ability to self-analyze one's mental and physiological states, and hence the acquisition of self-confidence, the use of mobile or web applications can be offered in order to support these skills.

3. PURPOSE OF TECHNOLOGY-BASED INTERVENTIONS AND THEIR USE BY ADOLESCENTS

Mobile healthcare is a new and rapidly evolving field. Mobile healthcare encompasses a variety of technological solutions that can offer heart rate, blood glucose, blood pressure, body temperature, and brain activity functionality. It can help provide high quality health care and allow for more accurate diagnosis and treatment. Mobile healthcare is not intended to replace healthcare professionals, but is seen more as a tool to support the management and delivery of healthcare [15]. Mobile healthcare can help avoid situations where patients refrain from seeking help because they worry about not feeling uncomfortable.

According to [16], there are 100,000 mobile applications for mobile health and chronic diseases, with the 20 most popular applications being for sports, fitness and health. Chronic diseases are considered diseases such as heart and vascular diseases, type 2 diabetes, obesity, inflammation of the joints, chronic respiratory diseases [18]. They are long-term diseases and for many reasons have no definitive cure. They require regular medical care [18]. To treat chronic diseases, there are five basic skills for personal management of chronic physical conditions: identifying problems, making decisions, using resources, forming a professional relationship between patient and doctor, and taking action [8].

Mobile applications can allow the treatment of chronically ill patients outside hospitals and reduce visits to the doctor, help solve the problem of shortage of health professionals, and provide almost constant support to users. Applications can be considered as facilities [8] to encourage healthy eating, physical activity and prevention of overweight and obesity [20]. Mobile interventions based on the principles of self-control can be effective in reducing depressive symptoms among adolescents with mental health problems [19].

The purpose of such applications is to monitor symptoms (frequency of daily blood sugar readings, etc.) and promotes self-care, support self-control, provide feedback through data entry.

Mobile applications provide an interactive, social and personalized platform that helps users change their own behavior with minimal professional contact [21].

The review and studies (not claiming to be sufficiently in-depth studies) show that there is a lack of research and an in-depth approach to the needs of adolescents in mental health applications [19] [20] and few studies have focused on the existing attitudes of teenagers towards health applications [21] [22], which may have different patterns of use of technology by adults. In [22], after an in-depth study, it was found that none of the tested applications developed for mental health were specifically designed for use by children and young people. Few studies have been published on efficacy in health promotion [20].

One of the few articles describing consumer research found that those diagnosed with chronic medical problems perceived health applications as indispensable tools to help them manage their conditions.

4. TECHNIQUES, TAXONOMIES AND THE APPLICATION OF BEHAVIORAL DESIGN AND BEHAVIORAL MODELS IN THE DEVELOPMENT OF DIGITAL APPLICATIONS

4.1 Existing techniques and approaches in developing mobile applications

The challenge is to develop effective innovative tools and interventions acceptable to adolescents through mobile technologies [19]. Mobile phones are a consumer product as opposed to a business product [8]. The development of a mobile application requires an understanding of

the needs of the end user, which is the first step in designing these types of technology-based interventions.

In [19] [21] an approach to conducting interviews is proposed as the data analysis is performed with the help of inductive thematic analysis. This is a flexible method of qualitative analysis that provides a richly detailed description of a set of data and gives an idea of the participants' views on a specific topic. The data can identify eight main themes: safety, engagement, functionality, social interaction, awareness promotion, accessibility, gender.

Several theories have been proposed in [20] that can predict and explain human behavior. This is the theory of planned behavior, which describes 3 factors: attitude, subjective norm and perceived behavioral control, which influence the intention of the individual to perform a behavior.

Another classical model is the transtheoretical model, which assesses an individual's willingness to adopt healthier behaviors and describes strategies or processes to guide the individual through the stages of change, from preconception to action and maintenance of action.

Behavior change techniques are based on 6 theories of behavior change: information-motivation-behavioral skills model, theory of reasoned action, theory of planned behavior, social cognitive theory, control theory, and operant conditioning. This taxonomy is useful when determining which of the techniques to apply in an application that is aimed at lifestyle change. Behavior change techniques trigger "rapid self-monitoring of behavior" when the application offers users to control their physical activity or daily intake [20].

The next technique is the theory of self-determination (SDT), combined with motivational interviewing. This SDT technique points to the importance of intrinsic motivation to change a person's behavior. Other techniques that can be used to create mobile applications for mobile health are the techniques of "rapid self-monitoring of behavior" and "providing feedback on effectiveness." The "specific goal setting" technique, in which they can provide conditional rewards [20].

Mental health applications, according to user tests, should be easy to use and engaging, with an attractive interface that uses color and graphics, and the ability to customize the interface, offer reminders, and be able to control how use the applications [19] [21].

Applications for healthy eating and physical activity are mainly promoted through self-assessment tools. By encouraging self-monitoring and providing feedback on performance, applications can raise awareness of food intake and physical activity levels of consumers [20].

"Gamification" or the integration of game elements is a strategy to counteract the negative perceptions around health applications. The integration of elements of the game, such as virtual badges, rankings, points and challenges, into health applications may arouse the interest of a wide audience of adolescents [21]. Gamification is a tool for positively influencing the use of systems to support change in health behavior [23]. It focuses on the person, not on the functions of the application. To master motivation and engagement, we learn mainly from games [26].

Consumer motivation can be maintained through rewards and opportunities for social comparison [20]. The inclusion of tangible rewards such as gift certificates, food baskets or exercise equipment is intended to externally motivate and engage users with lower motivation to complete targeted healthy behaviors. Other rewards may be in-store credit in the app store or virtual points that could lead to real, physical rewards to enhance the completion of positive health behaviors [21].

Having a "virtual trainer" can inspire healthier habits by providing individual exercises, diets and advice [21].

Sometimes the narrow focus on achieving a result can lead to a depressed state, so it is good to direct the user to behavior for a certain way of life [21].

The promotion of physical activity can be achieved by presenting information such as real-time biometric feedback, calorie expenditure, counting steps [21].

Consumer surveys have shown that it is important for users to personalize applications that offer goal setting, tracking of personal data and output of messages [21].

Applications are more effective when embedded in existing structures, such as healthcare and schools [20].

4.2 Accessibility and promotion through marketing

In order to motivate users to use a healthcare application, it is very important for them to see and hear that other persons also use a healthcare application [21]. Here an important role in the use and promotion of an application plays a well-known influencer, social networks. Lack of awareness is another important factor that hinders the use of health applications [21].

Because teens prefer visualization, music, comedy, and popular culture, health app marketing can use these tools to promote a health app.

Creating a mobile virtual community for overweight people can encourage support and seek advice to overcome ignorance to achieving the goal.

4.3 Behavioral models in behavioral design used to create applications

Whether science is called behavioral design, product psychology, or behavioral science, [5] it proposes to understand the oddities of the human mind and use that knowledge to change the way people live.

Behavioral design is a bridge between behavioral sciences and product design [1]. Behavioral design is a technology to help create the right environment for people to take action or make decisions to achieve specific goals [4]. It is used to change behavior, but does not force people to change [2]. The combination of the science of influence and design thinking is a method or framework for activating or changing people's behavior [4]. This is a technique used to create behavioral product design and is deeply rooted in psychology. Behavioral design provides a framework for addressing consumer needs, rediscovering behavioral changes, and can help people in two main cases in developing a digital design product [1]:

- **Product that needs to change behavior** - the user is directed to a product that helps him change his behavior at will. Here the product gives value to the consumer by offering, for example, learning a new language, controlling diabetes, organized time and task management, getting back in shape.
- **Product that requires a change in behavior** - the user changes his behavior within the product, trying to use available functionality such as document formatting, uploading photos or documents, organizing email contacts and more.

Human behavior is the most unpredictable obstacle in the online world. When a web product is developed in the right way, it has the power to encourage desired behavior and stop unwanted behavior in users [4]. As amazing as UX (user experience) and CX (customer experience) are, they can improve a website's performance, but it won't make users act the way you want them to.

People's decisions and behavior are deeply affected by the context. In digital products, the context represents the information architecture, navigation and UI of the application [2], and it influences the choice and behavior of the user. When developing a digital product, we must take into account the way people think and the way the mind works. Attention, memory and will are limited in humans, so the mind uses shortcuts, and applied in the wrong context can cause unintentional behavior and wrong decisions. The human mind is capable of handling several tasks at once and can memorize up to ten things at once.

Behavioral design is directly related to the system of habits and these behavioral patterns help designers to better design changes in people's behavior. When creating an application, it may turn out that it can become a habit by using it [6], and the success of an application depends on whether users have formed habits to use it. Habits are learned, and they can be acquired entirely from experience. When a person experiences a specific signal, he automatically executes an action.

How can an application program habits?

1 Model CAR (Cue-Action-Reward) [6] [2] is a framework that offers "flow" thinking in three steps:

Cues - Something that the user feels in their environment. There are three types of signs - internal, external and synthetic.

- **Internal signals:** hunger, boredom, thoughts about the taste of cinnamon, etc. They have the same power as external signals. A negative internal signal can cause outrage. These are addictive or pointless actions that can lead to toxic results for the product. It is recommended to avoid the application of negative internal signals.
- **External signals:** seeing on a television remote control, the sound of police sirens or the smell of freshly baked biscuits, cigarette smoke, etc.
- **Synthetic signals:** created intentionally by a behavioral designer to suggest a specific action. These are the specific brand color or letter (the letter "M" of McDonald's) for the purpose of recognizability, etc. The greatest strength of the synthetic signal is that it can be altered.

Action - a behavior that the user wants to perform. Actions must be quick, specific and well-described

Reward - is shown to the user as feedback that is unexpected and admirable. The award can be divided into three types:

- **Rewards of the self (desire for self-control and skills)** is related to intrinsic motivation and the desire to finish things. The desire to be better than yesterday.
- **Rewards of the Hunt (desire for conquer)** - depends on whether the application is competitive and more sought after, tracked, followed
- **Rewards of the Tribe (desire for belonging)** - mainly expressed in social networks with the reaction of users with emoticons (hearts and thumbs up), symbolizing affection

In addition to badges and points, reward can be any positive experience a user can experience - a funny GIF, some positive encouragement, a screen explosion of confetti, verbal praise, a delightful tone and vibration, or social praise from their peers. The reward is the immediate positive consequence of an action.

The brain builds habits only from positive consequences. The positive consequences must be unpredictable. People only become active when we experience positive effects. The unpredictability of positivity actually activates the mechanism for changing behavior.

The sign-action pair is the habit that the user must fulfill, and the feedback-reward is the thing with which the habit is learned through the application.

The CAR model can be applied if you need to increase user engagement.

2 According to the Fogg Behavior Model or MAT model [7] [4] [24], there are three main factors responsible for the movement of human behavior: motivation, ability, trigger. This model makes actions easier and the user more motivated.

Motivation - three different dimensions are used to provoke motivation in the user: pleasure / pain, hope / fear and acceptance / rejection.

Here are some design techniques to engage users:

- storytelling
- avoiding pain and seeking pleasure - "expected satisfaction from acquisition".

Ability - There are six main elements that can enhance users' abilities. These are time, physical effort, brain cycles, money, non-standard and social deviation.

Designers can increase the capabilities of users:

- By reducing the effort and time required to perform the behavior
- Reduce cognitive load - recognizes things instead of reminders
- Going through the experience or process

Trigger - can be a signal, a spark and a trigger.

A "Reminder" can be used here as a signal to quickly prompt users to start behaving.

All elements of the model are required for the user to perform a deliberate action. To perform a certain action, the user can be encouraged by increasing his motivation or ability to act. If the action is easy, then making it even easier will not change his behavior.

3 Hook Model-Framework for Behavior Change [25]

Created by psychology expert Nir Eyal to create user-engaging technology that creates habits such as a game, fitness app or online service.

This model consists of four critical phases:

Triggers - these are an internal signal - "the main reason for the formation of habits" and external signals (phone ringing), divided into four types:

- Paid - pay per click and partnership programs
- Earned: free, which keep the product in the spotlight (viral videos)
- Relationship: likes on social networks and word of mouth recommendations
- Owned: application icon, email newsletter or notification.

Action - the key behavior to be performed by a user. This can be a push notification, enter the daily calorie into your health and fitness app

Variable reward - the types of rewards are similar to the CAR model

The more satisfaction we get from performing an action, the more likely we are to repeat that activity.

Investment - crucial for building habits. The more time and effort the user invests in the product or service, the more it is valued. The investment is the time, effort and personal information that consumers contribute to the product to improve the overall experience.

When users go through the four phases of the Hook model, they will link the product or service as a source of relief.

Habit-building technologies are essential to increase people's engagement with your product or service. There are no sources in which all the behavioral models used to create a digital product are described and structured. The article does not claim to be exhaustive.

5. CONCLUSION

Mobile applications play an important role in adolescents' daily lives, and this implies their use in health promotion strategies [20].

Applications allow users to monitor themselves, set goals, provide personalized feedback, and increase their motivation. All of these tools can be part of a treatment program or to maintain educational methods, or function separately. The use of smartphone applications supports traditional approaches to health management, as they provide an interactive, social and personalized platform that helps users change their own behaviour with minimal professional contact [21].

There has been an explosion in mobile health applications in the last few years, but most applications are not of part of applications for the younger, technology-focused generation [21].

Adolescents are responsible for taking care of themselves, and health applications can enable them to put health into their own hands.

Over the next few years, rapid growth in behavioural design and guidance in the development of a code of ethics is expected to embrace the results and implications of the use of digital technologies and generate trust [3]. On the threshold of the fourth industrial revolution, there is a clear focus on creating a quality methodology through which to link ethical considerations with insufficiently established algorithms for artificial intelligence, racism in the provision of health care, policing. The next decade will provide an opportunity to create meaningful experiences connected in a global network and will support sole proprietors and small and medium-sized enterprises. In the future, behavioral science is expected to have an increasingly positive effect on people's lives.

The mission of behavioral design is to improve people's lives, contribute to collective results and maintain engagement, which should be the focus of all subdisciplines for behavioral design. The level of engagement and the factors contributing to this engagement of consumers are explored by the sciences of behavioral design and human-computer interaction. The results and situations in which each individual may find themselves are specific elements of research and design to create engaging and memorable experiences that offer a better understanding of the context of behavior, personal indicators of the individual. [3] New methods of consumer engagement can be presented through Gamification and digital technologies such as VR and AR. For technology to have a lasting positive impact on people's lives, there must be a desire to design behavioral solutions. The creation of a digital product is already looking for behavioral technology, not body technology [2]. Much work remains to be done in the future to unlock the full potential of behavioral design.

There is a clear need for applications to be created through close collaboration between scientific fields such as behavioral design, UX, product management and technology to provide value and benefit to consumers' daily lives. It is also clear that there is a lack and need for methodologically sound research to assess the safety, efficacy and effectiveness of health applications [22] for children and young people with mental health problems.

"What seems certain in general is that consumers have formed habits in which their mobile phones play an increasingly important role in their lives, whether for gaming, movie streaming or grocery shopping." [17]

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