The EMOINAD Guide construction proposal: An emotive interface design guide for attention deficit disorder in children

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Abstract. This article presents a proposal for construction of a guide which aims to contribute to the lack of guidelines for the design of therapeutic interfaces for attention deficit disorder in children, and describes the first version of the EMOINAD Guide (Emotive Interfaces for Attention Deficit) methodology. The EMOINAD Guide is composed of a set of design principles contributing to interfaces design for the treatment of children with this specific need. This paper examines the problematic situation, then, describes the state of art of attention deficit therapy applications and presents the developed methodology. A preliminary approximation of one of the design guidelines included in the Guide is also performed.

Keywords: Emotional Design; Interface design; Attention deficit; design principles.

1. Introduction

People experience stress and anxiety when the interface design is inadequate and when complex procedures occur (Shneiderman & Plaisant, 2003). In addition, when inconsistent sequences and actions are perceived without proper feedback it can trigger poor performance and occasional errors of the system, contributing to dissatisfaction and frustration of the user (Shneiderman & Plaisant, 2003). A good user interface design has an impact both on the ability of people to perform a task, and to the acceptance of the system, while a bad design can become frustrating and in a worst-case scenario it could cost lives. Plane crashes and nuclear disasters, for example, are only two cases that could happen due to poor interface design and/or software bugs, so many of the aforementioned problems could be easily avoided if it is taken into account the basic principles of design feedback (Klemmer, 2012).

The negative consequences of interacting with a poorly-designed interface are more significant for individuals suffering Deficit Disorder attention (ADD) than for others because these people, and especially children who suffer from this disorder, have difficulties staying focused and following the instructions that have been given to them (Salazar & Londoño, 2009). Faced with this problem, child psychiatrists resort to medication substances such as methylphenidate and atomoxetine, which in turn produce side effects such as blindness, eating disorders, depression, among others (Salazar & Londoño, 2009). Although this "solution" is effective in 70% of cases, it is not recommended in a long term because it could leave permanent sequelae (Salazar & Londoño, 2009).

To support medication, doctors have used certain types of software which have been adapted to the needs of people with ADD improving their working memory, planning and the inhibitory control (Raposo-Rivas & Salgado-Rodriguez, 2015). The success of these systems is related to motivation produced by a task, person or stimulus (Cadah, 2013). This is the reason why students with ADD get a better performance and learn best from those teachers who achieve empathy, provide support and incite them to work (Cadah, 2013).

At this point it is important to consider Neuroeducation as a discipline which establishes the principle that emotion and cognition go hand in hand and both interact to produce the subject's behavior (Cadah, 2013). This area suggests that attention is directed to what interests the individual and what provide a positive reward or avoid a negative reward; something that is not significant doesn't raise student's attention (Cadah, 2013). Dr. Francisco Mora, in his book "Neuroeducation: we learn what we love" also affirms this idea mentioning that attention refers to brain processes that respond to certain stimuli that are of interest to the individual (Mora, 2013). This fact, coupled with the need to build systems to support attention deficit therapies considering the emotions evoked by the child, makes it necessary to collect specific design principles for building interfaces that promote attention and in turn, promote evoking of positive emotions (Villareal Freire & Collazos Ordóñez, 2016).

In this article, the first version of the methodology to build an interface design guide is proposed to support developers in the task of building user friendly interfaces, specifically, for users with attention deficit disorder. This guide is called EMOINAD which stands for Emotive Interfaces for Attention Deficit.

With the development of this research we expect to contribute in three aspects: first, to provide principles to assist developers in the task of building user-friendly interfaces specifically for users with ADD; second, to expand the research related to therapeutic systems for attention deficit disorder in children and eventually extend the knowledge base on the subject of characterization of ADD in children. To do so, some studies that have considered this specific user profile have been taken as a start point and then, this research will be complemented with emotional design theories in order to develop interfaces proposals that evoke positive emotions in users. The ultimate goal is to collect a set of design principles so that any developer who wants to build therapeutic systems for attention deficit takes into account the particular needs of these users.

Before proposing the methodological process for the development of the EMOINAD guide, the problematic situation is described followed by the state of the art of the studies that have considered this particular user profile. Finally, the construction process, conclusions and future work are presented.

2. Justification

Attention deficit disorder (ADD) is one of the most known disorders of children and adolescents treated by psychiatrists nowadays (Cantwell, 1996; Munoz, Lopez, Lopez, & Lopez, 2015). The symptoms usually appear at an early age, usually before seven years old which may affect the learning process of the child and in the future it could seriously affect job performance and personal relationships (Brown, 2000; Salazar & Londoño, 2009).

In Colombia 1 out of 5 children is affected by this disorder (Munoz et al., 2015; Salazar & Londoño, 2009) and 70% of this population has repeated at least one scholar year. This has caused that most of the people who is affected by this disorder cannot easily carry out their studies and feel isolated from their peers (McKnight, 2010).

One of the most studied interventions for the treatment of ADD is the Behavioral Parental Training (BPT) in which the parents are linked in the process of intervention in order to support therapies outside the consulting

room; however, despite being a good strategy, optimal results are not obtained in the completion of tasks since many of them are not completed or are done with poor quality (Barkley, 2014). Several authors mentioned the need to improve these therapies through mobile health applications which help in the quantity and quality of tasks performed outside the consulting room. This fact opens the possibility to create new systems that meet the therapists' needs, but in practice developers do not have theories, principles or guidelines to establish a significant starting point that allows them to build new interfaces taking into account the particularities of the condition and needs of each health expert (Barkley, 2014).

In addition to the problem referred above, it should be considered Wheeler and Singh's studies which mention limitations of children with attention deficit disorder regarding to recognize the universal emotions of their peers, a fact that leads these children to build poor social relationships and to get away from the group (Singh et al., 1998; Wheeler Maedgen & Carlson, 2000); however, these studies didn't mention that children with ADD have limitations to express what they feel or to show sensitivity to an stimuli that intends to evoke an specific emotion. Taking this as a premise, it could be considered that the effect caused by an interface that tries to raise emotions in a child with attention deficit disorder is similar to the effect caused in any other child that doesn't have this disorder.

Other studies state that there is a direct relationship between something that evokes an emotion and something that attracts our attention, showing that emotions could guide our attention (Mora, 2013; Taylor & Fragopanagos, 2005). This fact demonstrates the importance of applying design guidelines that raise positive emotions in the interfaces in order to ensure that the child directs his/her attention to the material presented as therapy. There are authors like Dorian Peters who proposes principles that aim to encourage creativity, motivation and commitment of users establishing the idea that through these principles is possible to design interfaces that evoke positive emotions (Peters, 2014). Other authors such as Christopher Buttler and Oli Gardner only contribute in design guidelines to promote attention to the interfaces (Butler, 2010; Gardner, 2010). So, despite of the importance of raising positive emotions in the interfaces, it has not been taken into account all these aspects in ADD therapeutic systems.

According to these theories it is conceivable that by building interfaces that evoke the right emotions in children suffering from ADD, it could be

possible to obtain more attention from them and therefore a better reception. This particular principle converges to the emotional design idea that mentions the importance of emotions in humans to understand the world and how aesthetically appealing objects give users the idea of being more effective generating an emotional connection with them (Norman, 2011). Thus, it is expected that by applying principles of emotional design through interfaces for treating ADD is possible to induce positive emotions which facilitate cognitive processes and learning (Um, Plass, Hayward, & Homer, 2011).

This fact makes researchers consider the importance of establishing specific design principles for building software interfaces that promote attention and, in turn, allow a pleasant interaction.

3. Guidelines for Attention Deficit Disorder: A State of art

Currently there are numerous applications that try to contribute to the needs of people with ADD, most of them aiming to the development of games using virtual reality. Similarly, there have been studies that are intended as a guide for new developments; however, despite of being clear and easy to apply, they do not consider the emotional aspect of users and not enough validations are reported to test the applicability and results. Some of these researches are reported next:

- Vertegaal, R., Shell, JS., Chen, D., Mamuji, A.: A conceptualization of the importance of attention is developed mentioning that attention is a limited resource due to humans only pay attention to the message of one person at a time. Thus, the theory of eyecontact is introduced which establishes with 82% accuracy whether a person is being heard or not in a group of 4 people. In the studies also a framework for attentive user interfaces (AUI) is proposed. These specific interfaces optimize their communication with users and follow five key properties (Vertegaal, Shell, Chen, & Mamuji, 2006).

- Chia-Hsun Jackie Lee, Jon Wetzel, Ted Selker: In their research it is mentioned how to improve the interface design through an Attentive Interaction Design Toolkit called Attention Meter which

reads facial expressions, body motion and attentive activities. This tool records the attention score, the number of faces, the blink rate, among other relevant information (Lee et al., 2006).

- Spachos, D. et. al: In this research a mobile application called WHAAM is proposed, which provides teachers, parents and health experts a tool to monitor the behavior of the patient in an achievable, realistic and timely way (Spachos et al., 2014).

- T. S. Lee, C. G. Lim, D. Fung, and R: A study into the use of a brain-computer interface (BCI) in cognitive training is presented in order to quantify the level of attention of a user. Several clinical trials were conducted achieving significant improvements in both children and elderly people with Attention Deficit and Hiperactivity Disorder (ADHD) problems demonstrating the effectiveness of cognitive training (Guan, Lee, Lim, Fung, & Krishnan, 2015).

- O. Pykhtina, M. Balaam, G. Wood, S. Pattison, and P. Olivier: A prototype of an interactive board called "The Magic Land" is designed to support *play therapy* with children. A proposal of guidelines is also presented for designing systems that help to support problems in children with ADHD such as memory, concentration and attention due to the lack of exploratory studies in the use of technologies and the lack of interactive games in therapy for primary school children (Pykhtina, Balaam, Wood, Pattison, & Olivier, 2012).

- R. Anton, D. Opris, A. Dobrean, D. David, y A. Rizzo: The authors conducted an implementation of some psychotherapeutic principles involved in the therapy of patients with ADD in a virtual reality environment which can serve for three purposes: evaluation, training or treatment. This mechanism promises to improve control of the patients in a "real world" and be highly accurate as well as facilitate the work of the therapist (Anton, Opris, Dobrean, David, & Rizzo, 2009).

- Mcknight, L: In this study the researcher explores how software designers who are not familiar with users with attention deficits and hyperactivity, could use the concepts of usability to develop software to prevent the exclusion of these children. Thus a set of fifteen guidelines is described and should be implemented in any application to make it affordable to these users (Mcknight, 2011).

- L. Gomez y R. M. Carro: The study reports the base, development and testing in a real context of an application called AdapADHD which aims to support the training and assessment of children and adolescents with Attention Deficit Hyperactivity Disorder (ADHD). Through this application, patients are helped to improve the skills of concentration and control impulses taking into account their particular needs (Gomez & Carro, 2014).

- J. E. Munoz, D. S. Lopez, J. F. Lopez, and A. Lopez They present a proposal for the design and development of a video game using a brain computer interface (BCI) not only as an input device but also as a monitoring tool for neurophysiological signals (Munoz et al., 2015). This game is called "The Harvest Challenge" and reinforces four important aspects: ability to wait, ability to plan, ability to follow directions and ability to achieve goals.

- L. B. Oliveira, L. Ishitani, and A. M. Cardoso: In their research a systematic review of the literature is performed in order to identify the contributions and summarize the evidence for results with better quality and reliability. A game is also proposed which could be used in the middle of the academic activities helping patients to develop their cognitive ability taking into account usability issues (Oliveira, Ishitani, & Cardoso, 2013).

- P. J. M. Prins, S. Dovis, A. Ponsioen, E. ten Brink, and S. van der Oord: The authors suggest the benefits of adding gaming elements for treating people with ADHD and examines whether these elements could enhance their motivation and performance (Prins, Dovis, Ponsioen, ten Brink, & van der Oord, 2011). In their studies they showed that children who used a version of game training showed improved motivation, better working memory and better performance. These researches are the first to assess the importance of motivational factors through games and their relevance to the effectiveness of cognitive training.

- Meldah, A. Al-Suwaidan, y A. A. Al-Wabil, E. AlZahrani: The design of a multimedia educational game called "Memory Challenge" is described to support children with specific learning difficulties such as dyslexia and ADD. This game was designed for

both learning and entertainment and in their studies they compared the behavior of a child with ADD and a child without ADD to determine limiting factors to consider in the middle of the design. These results could be useful for further research (Al-Wabil, Meldah, Al-Suwaidan, & AlZahrani, 2010).

- M. Raposo-Rivas and A. B. Salgado-Rodriguez: In their studies it is determined whether the use of educational software can enhance working memory, planning, attention and inhibitory control in a specific case study. In particular, two types of educational software are analyzed as MeMotiva and LIM made specifically for the study and showed that these applications are potentiators instruments of working memory (Raposo-Rivas & Salgado-Rodriguez, 2015).

- S. Rodriguez Sarro Boarati: It is performed a full exploration in the area of human computer interaction (HCI), user profiles and attention deficit. He makes a proposal of ten big guidelines (Rodriguez Sarro Boarati, 2012). These recommendations could be applied in the construction of new interfaces adapted to different user profiles.

In most of the studies compiled, the description of different applications or systems that focus on monitoring, training or therapy for attention deficit can be observed, demonstrating the viability for building efficient applications that support the limitations of children with this specific disorder. However, only two studies are mentioned that aim to establish specific guidelines for the development of new interfaces (Mcknight, 2011; Rodriguez Sarro Boarati & Sosa Arias Peixoto, 2012). These studies will serve as a basis for the construction of the EMOINAD guide, which it is expected to help build interfaces that achieve greater fidelity of the children with the therapeutic systems.

4. Development of the EMOINAD Guide

After reviewing the state of the art, we proceeded to propose a set of procedures and activities which would allow the EMOINAD guide construction and would facilitate the establishment of guidelines for the design of interfaces for therapeutic to be used in the treatment of attention deficit in children considering the emotional perspective. These procedures have been adapted from the process of building the EMOEVA guide, which

provided guidelines for creating emotional interfaces for virtual learning environments (Villareal Freire, 2015). Each of the process steps are described in detail below.
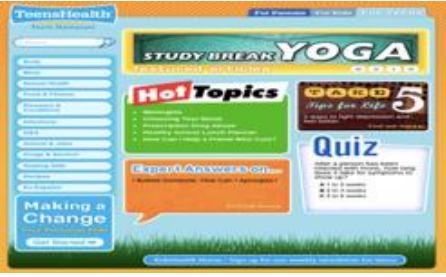
The first step is *to perform a process of analysis and classification of theories and principles related to the main areas of research*, which involves performing a process of detailed review of the literature in order to collect and analyze existing documentation regarding the three main areas such as design for emotion, design for ADD and child-centered design. Subsequently, information that can be used and/or adapted for the generation of guidelines for building emotional interfaces for children with attention deficit disorder is selected.

The second step, is to determine the characteristics of children with attention deficit amid interaction with therapeutic systems, which must be taken into account in interfaces development. This step involves three activities: first, to characterize the Attention Deficit Disorder in children, which will help to have a greater knowledge regarding this disorder. This activity will be done with experts advice on the subject of attention deficit, specifically under the direction of Dr. David Cubillos, Dr. Diana Lagos, and Dr. Carolina Cardenas. Second, to make a review of approaches existing for the treatment of children with attention deficit which will set the state of the art of interfaces developed so far for the treatment of ADD, and as a third activity is to set the components of attention deficit to be considered for the design of interfaces.

The third step is to propose a set of design principles tailored to the needs of children with attention deficit that enable the development of interfaces that evoke positive emotions, which involves proposing a set of principles of interface design that evoke positive emotions taking into account the needs of children with attention deficit and to develop an appropriate template to organize the information of each one of these principles. This template will be held in the format of the guidelines description of the World Wide Web Consortium (W3C) for being an international community that seeks the unification and development of web standards. In this template the intention and application of the principle will be described. It will also have a section of related resources where more detailed templates or documents will be annexed and finally the techniques that can be useful and the key terms to clarify any non-usual term used in the description will

be described. In Table 1 is displayed one of the preliminary design principles that is part of the EMOINAD guide in the W3C template.

Table 1. A design principle draft included in the EMOINAD Guide

Number and name	CM_1. Avoid the Primal Attention Grabbers
Intention	Some elements that attract the attention of people are human faces, food, sex, danger, noise and stories; attention grabbers are the elements that distract and do not support the task being performed. Avoiding attention grabbers is essential in the process of designing interfaces for children with attention deficit disorder and it should be ensured that the child pay attention only to the elements of their therapy (Peters, 2014). If the image included in the interface is intrinsically linked with the main objective, then these attention grabbers make sense otherwise probably only add unnecessary cognitive load and steal attention. In the case of children applications, in order to keep their attention the use of advertising banners should be avoided and opt for a colorful design, with little text and easy navigation (Nielsen, 2002).
Examples	The page of the Kidshealth organization (Figure 1) is an example of simplicity in which it can be perceived a clean and simple design (Nielsen, 2002). Also in the screenshot of the attention stroop game (Figure 2) is perceived an activity-oriented interface as most of the screen is covered by the activity and has only one panel on the left that shows the progress. Livemocha page (Figure 3) is another example of how to link images without distracting the person who is interacting. In this case, the figure of each letter is presented when is taught English vowels. Likewise, the simplicity of the interface is perceived by the focus on the lesson and removing attention grabbers. Figure 1. Kidshealth initial page

	Figure 2. Screenshot of Attention Stroop game Figure 3. Screenshot Livemocha online course
Related resources	Not related
Techniques	Technique of using graphics and multimedia Technique of color use Technique of using typography
Key terms	Not related

And the last step: *to perform an evaluation of the EMOINAD guide from four different perspectives*. The four perspectives mentioned are: the user perspective, the indirect-user perspective, the expert perspective and the author perspective. In the user perspective it is necessary to count with a group of developers who will put in practice the principles described in the EMOINAD guide and who will develop an interface proposal. This requires, as a first step, selecting users that will use the guide, to select the components to be developed and making the construction of the non-functional prototype. The non-direct user are the children who will use the interfaces developed according to the EMOINAD guide, in this case, children diagnosed with problems of attention deficit, so, the planning of the case study which includes managing the physical resources required for its implementation, will be done. For the third perspective, the EMOINAD Guide will be evaluated by a design expert who will give relevant comments, suggestions and feedback. Finally, from the author perspective is going to be evaluated each prototype to check if the design principles where put in practice correctly. With these evaluations it is going to be determined how easy to use the guide is, if this guide has been helpful for developers and the impact achieved through the developed prototypes.

With the process shown above is expected to have as result not only the

EMOINAD guide but relevant information regarding the interaction of children with ADD with interfaces and to confirm the hypothesis which states that, through this guide, developers will have a starting point to build interfaces that not only promote a positive user experience but also evoke positive emotions that help children with attention deficit disorder to raise their loyalty to the therapy system.

5. Conclusions and Future work

Until now it has been found some approximations of systems for the treatment of attention deficit, but there are no significant studies regarding the design guidelines for these types of environments (Villareal Freire & Collazos Ordóñez, 2016).

Treating attention deficit can be supplemented and supported by applications designed specifically for this purpose. Through the implementation of the guide is expected to facilitate the design of interfaces of these applications providing guidelines to promote attention and reduce the lack of motivation.

So far significant progress is not perceived in the area of principles of design of therapeutic interfaces in general, which represents a great challenge. At the same time, it makes the development of the guide be an innovative breakthrough in the design of therapeutic applications.

Considering the emotional aspect in the design principles, it is expected to increase acceptance of the user in the middle of the interaction with the interface developed following the recommendations proposed in the EMOINAD guide.

One of the limitations found is that the state of the art has been performed through a systemic review process, which has discarded other studies that are under review or that have not been listed in a search engine such as IEEE, Science direct, PubMed or Springer Link.

So far the first step of the process of building the guide is being finished which consists in the classification of theories found in the three main research areas: emotional design, design for ADD and child-centered design. The next step to follow corresponds to the implementation of each of the phases mentioned that constitute the development and validation of the EMOINAD guide.

References

Al-Wabil, A., Meldah, E., Al-Suwaidan, A., & AlZahrani, A. (2010). Designing Educational Games for Children with Specific Learning Difficulties: Insights from Involving Children and Practitioners. In *2010 Fifth International Multi-conference on Computing in the Global Information Technology* (pp. 195–198). IEEE.

Anton, R., Opris, D., Dobrean, A., David, D., & Rizzo, A. (2009). Virtual reality in rehabilitation of attention deficit / hyperactivity disorder The instrument construction principles. In *2009 Virtual Rehabilitation International Conference* (pp. 59–64). IEEE.

Barkley, R. (2014). Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment. Retrieved from
https://books.google.com/books?hl=es&lr=&id=0J0gBQAAQBAJ&oi=fnd&pg=PP1&dq=russell +barkley+attention&ots=FJ7hcOKR5F&sig=xBuEpCyq05Kpb7sMopI1uZTcpTw

Brown, T. E. (2000). *Attention-Deficit Disorders and Comorbidities in Children, Adolescents and Adults* (First). American Psychiatric Press. Retrieved from
http://www.drthomasebrown.com/pdfs/comChapter.pdf

Butler, C. (2010). Designing for User Attention. Retrieved from
https://www.newfangled.com/designing-for-attention/

Cadah, F. (2013). La importancia de las emociones en el aprendizaje y su relación con el TDAH. Retrieved December 10, 2015, from http://www.fundacioncadah.org/web/articulo/la-importancia-de-las-emociones-en-el-aprendizaje-y-su-relacion-con-el-tdah.html

Cantwell, D. P. (1996). Attention Deficit Disorder: A review of the past 10 years. *Child Adolescent Psychiatry*. Retrieved from http://www.sciencedirect.com.sci-hub.io/science/article/pii/S0890856709624916

Gardner, O. (2010). *Attention-Driven Design: 23 Visual Principles For Designing More Persuasive Landing Pages* (unbounce). Retrieved from http://get.unbounce.com/attention-driven-design/

Gomez, L., & Carro, R. M. (2014). Adaptive Training of Children with Attention Deficit Hyperactivity Disorder through Multi-touch Surfaces. In *2014 IEEE 14th International Conference on Advanced Learning Technologies* (pp. 561–563). IEEE.

Guan, C., Lee, T. S., Lim, C. G., Fung, D., & Krishnan, R. (2015). Brain-computer interface and its applications in cognitive training. In *The 3rd International Winter Conference on Brain-Computer Interface* (pp. 1–2). IEEE.

Hartmann, T., & Hallowell, E. M. (1997). *Attention Deficit Disorder : A Different Perception*. {Underwood Books}. Retrieved from
http://gen.lib.rus.ec/book/index.php?md5=75025c9f0fd5f91712440509d84e6160

Klemmer, S. (2012). Human Computer Interaction.

Lee, C.-H. J., Jang, C.-Y. I., Chen, T.-H. D., Wetzel, J., Shen, Y.-T. B., & Selker, T. (2006). Attention meter. In *CHI '06 extended abstracts on Human factors in computing systems - CHI EA '06* (p. 1007). New York, New York, USA: ACM Press.

Mcknight, L. (2011). Designing for ADHD: in search of guidelines. *Digital Technologies and Marginalized Youth*. Retrieved from http://uxpamagazine.org/designing_children_adhd/

McKnight, L. (2010). Designing for ADHD in search of guidelines. *IDC 2010 Digital Technologies and Marginalized Youth*. Retrieved from
http://www.academia.edu/download/30912875/mcknight.pdf

Mora, F. (2013). *NEUROEDUCACIÓN. Sólo se puede aprender aquello que se ama*. (ALIANZA EDITORIAL, Ed.). Retrieved from http://www.casadellibro.com/libro-neuroeducacion/9788420675336/2111775

Munoz, J. E., Lopez, D. S., Lopez, J. F., & Lopez, A. (2015). Design and creation of a BCI videogame to train sustained attention in children with ADHD. In *2015 10th Computing Colombian Conference (10CCC)* (pp. 194–199). IEEE.

Nielsen, J. (2002). Kids' corner: Website usability for children. *Jakob Nielsen's Alertbox*. Retrieved from https://scholar.google.com/scholar?hl=es&q=kids+corner&btnG=&lr=#0

Norman, D. (2011). El Diseño Emocional: Por qué nos gustan (o no) los objetos cotidianos.

Oliveira, L. B., Ishitani, L., & Cardoso, A. M. (2013). Jogos Computacionais e Transtorno de Déficit de Atenção e Hiperatividade: Revisão Sistemática de Literatura. *Nuevas Ideas En Informática Educativa TISE*, 223–230.

Peters, D. (2014). *Interface Design for Learning: Design strategies for the Learning Experience*. New Riders (Voices that Matter). Retrieved from http://ptgmedia.pearsoncmg.com/images/9780321903044/samplepages/0321903048.pdf

Prins, P. J. M., Dovis, S., Ponsioen, A., ten Brink, E., & van der Oord, S. (2011). Does computerized working memory training with game elements enhance motivation and training efficacy in children with ADHD? *Cyberpsychology, Behavior and Social Networking*, *14*(3), 115–22. http://doi.org/10.1089/cyber.2009.0206

Pykhtina, O., Balaam, M., Wood, G., Pattison, S., & Olivier, P. (2012). Designing for Attention Deficit Hyperactivity Disorder in Play Therapy: the case of Magic Land.

Raposo-Rivas, M., & Salgado-Rodriguez, A. B. (2015). Estudio sobre la intervención con Software educativo en un caso de TDAH. *Revista Nacional E Internacional de Educación Inclusiva*, *8*, 121–138.

Rodriguez Sarro Boarati, S. (2012). Identificação de guidelines para o projeto de interfaces no contexto de ECAs e TDA/H. Brasil. Retrieved from http://www.amazon.de/Identifica%25C3%25A7%25C3%25A3o-guidelines-para-interfaces-Hiperatividade/dp/3639833171

Rodriguez Sarro Boarati, S., & Sosa Arias Peixoto, C. (2012). Identification Guidelines for the Design of Interfaces in the Context of ECAs and ADHD (S). In *Twenty-Fourth International Conference on Software Engineering & Knowledge Engineering SEKE2012* (pp. 594–598). San Francisco, USA: Knowledge Systems Institute Graduate School.

Salazar, O. F., & Londoño, A. C. (2009). Trastorno por Déficit de Atención e Hiperactividad. *Carta de La Salud*, *161*. Retrieved from http://www.valledellili.org/media/pdf/carta-salud/CSOctubre_2009.pdf

Shneiderman, B., & Plaisant, C. (2003). Designing The User Interface: Strategies for Effective Human-Computer Interaction, 4/e (New Edition). Pearson Education India.

Singh, S. D., Ellis, C. R., Winton, A. S., Singh, N. N., Leung, J. P., & Oswald, D. P. (1998). Recognition of facial expressions of emotion by children with attention-deficit hyperactivity disorder. *Behavior Modification*, *22*(2), 128–42.

Spachos, D., Chifari, A., Chiazzese, G., Merlo, G., Doherty, G., & Bamidis, P. (2014). WHAAM: A mobile application for ubiquitous monitoring of ADHD behaviors. *2014 Intl Conference on Interactive Mobile Communication Technologies and Learning (IMCL2014)* (pp. 305–309). IEEE.

Taylor, J. G., & Fragopanagos, N. F. (2005). The interaction of attention and emotion. *Neural Networks*, *18*(4), 353–369.

Um, E., Plass, J. L., Hayward, E., & Homer, B. D. (2011). Emotional design in multimedia learning. *Journal of Educational Psychology*, 1–14. http://doi.org/10.1037/a0026609

Vertegaal, R., Shell, J., Chen, D., & Mamuji, A. (2006). Designing for augmented attention: Towards a framework for attentive user interfaces. *Computers in Human Behavior*. Retrieved from http://www.sciencedirect.com.sci-hub.io/science/article/pii/S0747563205001160

Villareal Freire, A. P. (2015). *Lineamientos soportados en el diseño emocional para el diseño de interfaces del módulo estudiante de un entorno virtual de aprendizaje*. Universidad del Cauca.

Villareal Freire, A. P., & Collazos Ordóñez, C. A. (2016). EMOINAD : Guia de Diseño de Interfaces

emotivas para el tratamiento de déficit de atención en niños. *11 Congreso Colombiano de computación*. Popayán.

Wheeler Maedgen, J., & Carlson, C. L. (2000). Social Functioning and Emotional Regulation in the Attention Deficit Hyperactivity Disorder Subtypes. *Journal of Clinical Child Psychology*, *29*(1), 30–42. http://doi.org/10.1207/S15374424jccp2901_4