

Proposed Methodological for Serious Games Design for Children with Cochlear Implant

Sandra P. Cano

Director: Dr. César Collazos,

Co-directora: Dra. Gloria Inés Álvarez

Adviser: Dr. William Rodríguez

University of the Cauca

September 26, 2016



ULL



UCLM

Outline

- 1 Background and Context
- 2 Description Problem
- 3 Objectives
- 4 Objective I: Cognitive and motor Characteristics
- 5 Objective II: Adapting a methodology for SG based in UCD
- 6 Objective III: Guidelines and Design Patterns that support in the Speech Therapy
- 7 Objective IV: Validating the Methodology
- 8 Research Register & Publications
- 9 Conclusions and Future Work

Outline

- 1 Background and Context
- 2 Description Problem
- 3 Objectives
- 4 Objective I: Cognitive and motor Characteristics
- 5 Objective II: Adapting a methodology for SG based in UCD
- 6 Objective III: Guidelines and Design Patterns that support in the Speech Therapy
- 7 Objective IV: Validating the Methodology
- 8 Research Register & Publications
- 9 Conclusions and Future Work

Hearing Impairment

Levels of Hearing Loss

Occurrence

Prelocutiva (born deaf)
Postlocutiva (acquired in the life)

Intensity

Mild (25 to 40dB loss)
Moderate (41 to 70 dB loss)
Severe (71 to 90 loss)
Profound (more than 90dB loss)



Communication

Sign Language
Reading-Lip
Cochlear Implant
auditory aids

Cognitive / Motors

Spatial Orientation, Memory, Attention Auditory, Perception, Executive Functions

Balance, Velocity of reaction, speed motions

Outline

- 1 Background and Context
- 2 Description Problem**
- 3 Objectives
- 4 Objective I: Cognitive and motor Characteristics
- 5 Objective II: Adapting a methodology for SG based in UCD
- 6 Objective III: Guidelines and Design Patterns that support in the Speech Therapy
- 7 Objective IV: Validating the Methodology
- 8 Research Register & Publications
- 9 Conclusions and Future Work

Problem

Serious Games

Methodologies

Auditory Impaired

User Profile

Context of Use

User Centered Design (ISO 9241:210)

students non-disabled

Methodologies

Characteristics /Methodologies	EMERGO	DOODLE	EDoS	MS	SF
Analysis UX		x			
Actors Communication	x	x	x	x	x
User Aspects		x			
Definition of Pedagogical Objectives	x	x	x	x	x
SG Aspects			x		x
Quantities Results					
Design Patterns for SG					x
Details Activities	x		x	x	
Efficiency	x	x	x	x	x
Documentation	x	x	x	x	
Objectives Validation	x			x	

Figura: Analysing Methodologies for Serious Games Design. MF: Marfisi-Schottman SF: Serious Facettes. MF[16, 2, 13, 18]

Outline

- 1 Background and Context
- 2 Description Problem
- 3 Objectives**
- 4 Objective I: Cognitive and motor Characteristics
- 5 Objective II: Adapting a methodology for SG based in UCD
- 6 Objective III: Guidelines and Design Patterns that support in the Speech Therapy
- 7 Objective IV: Validating the Methodology
- 8 Research Register & Publications
- 9 Conclusions and Future Work

Objectives

General

- To propose a methodology for serious games design for children with cochlear implant.

Specifics

- To select cognitive and motor characteristics that can influence in the interaction with serious game, following the discipline of adaptive learning.
- To define/adapt a specific software methodology for Serious Games for children with problems hearing, following the philosophy of User Centred Design (UCD).

Specifics

- Define a set of guidelines and design patterns for developing serious games that support in the speech therapy to the children, considering features of the voice.
- Validate the methodology through of the developing an experience applying serious games for children with cochlear implant in the region of the Valle.

Outline

- 1 Background and Context
- 2 Description Problem
- 3 Objectives
- 4 Objective I: Cognitive and motor Characteristics**
- 5 Objective II: Adapting a methodology for SG based in UCD
- 6 Objective III: Guidelines and Design Patterns that support in the Speech Therapy
- 7 Objective IV: Validating the Methodology
- 8 Research Register & Publications
- 9 Conclusions and Future Work

Empathy Study

Empathy has become a key concept in design theory. Previous Studies [23]

Empathy Map

What they Think and feel?

How is the user feeling about the experience?, what they motivate?
What matters to the user?
What occupies her thinking?
What worries and aspirations does she have?

What they listen?

What sounds, they listen?
what songs they love?
-Ambiental Sounds
Perception with more easily



What they see?

What things in her environment influence her?
What competitors is she seeing?
What is she seeing friends do?
What objects they see?
- What games they love?
-What storytelling they love?

What do they say or do?

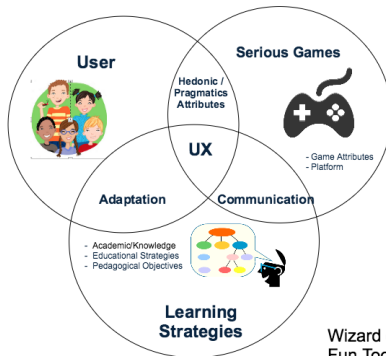
What are their activities?
What are they trying to achieve?
What is her attitude towards others?
What does she do in public?
How has her behaviour changed?

Analysis Model

Observational Studies
Literature Search
Interviews: Teachers,
Therapist, Psychologist

Requirements

Drawing Intervention
Direct Observation
Picture Card



Patterns Games
Communication visual
Characteristics of Interactive
Systems

Wizard of Oz
Fun Toolkit
Usability Tool

Figura: Analysis Model for Children with Auditory Impaired In [22]

Participants

- (7) Deaf children are ages ranged from 12 to 15 years. Mexico in the USAER school in Aguascalientes, a school that enables children with hearing impairment.
- (18) Children with Cochlear Implant ages ranged from 5 to 11 years. Institute for Blind and Deaf children of Valle del Cauca, Colombia.
- (8) Deaf Children Institute of Special Therapy Sens (ITES, Spanish), Club Leones of Valle del Cauca.
- (1) Girl with Reading Lip. Institute for Blind and Deaf children of Valle del Cauca, Colombia.

Ages Groups:

- Group 1: 2 children age 6 years
- Group 2: 5 children age 7 years
- Group 3: 7 children age 8 years
- Group 4: 2 children age 9 years
- Group 5: 2 children age 11 years
- Group 6: 1 children age 12 years
- Group 7: 4 children age 14 years

Analysis: Observational Studies

Cochlear Implant: Auditory-Verbal, Educational (Literacy), Cognitive.



Figura: Institute for Blind and Deaf children of Valle del Cauca, Colombia

Analysis: Wizard of Oz

Cochlear Implant: Auditory-Verbal. Analysing applications oriented to therapy, as:

- Speaking with TEO, speech therapy for children to learn verbal language. TEO is the character of game, and he speaks to the child as move along in their activities [9]
- Pre-lingua: is a tool to work of voice therapy. Working acoustic aspects as: intensity, duration, articulation of vowels in Spanish [20].
- Vocaliza: development games to support the phonological level[5]
- Vivoso: tool as support in acoustic aspects. [1]



Figura: Institute for Blind and Deaf children of Valle del Cauca, Colombia.

Analysis: Observational Studies

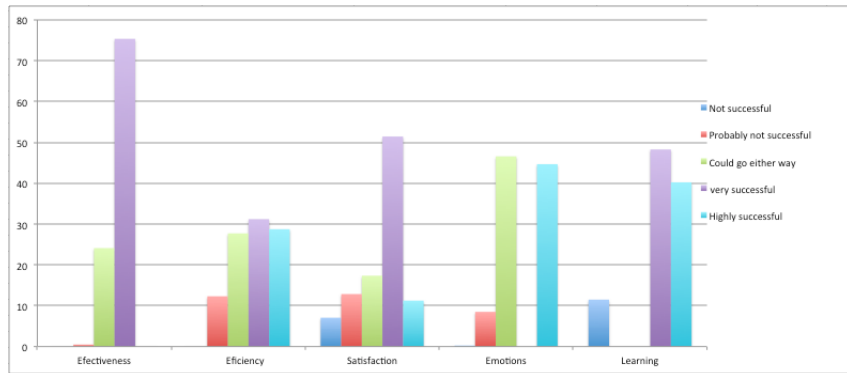


Figura: Evaluation with Pre-lingua

Analysis: Drawing and expressing

Drawing Intervention (Transition, Pre-Kinder and Kinder).



Figura: Institute for Blind and Deaf children of Valle del Cauca, Colombia

Analysis: Space

Drawing Intervention (Transition, Pre-Kinder and Kinder).



Analysis: Building

Drawing Intervention (Transition, Pre-Kinder and Kinder).

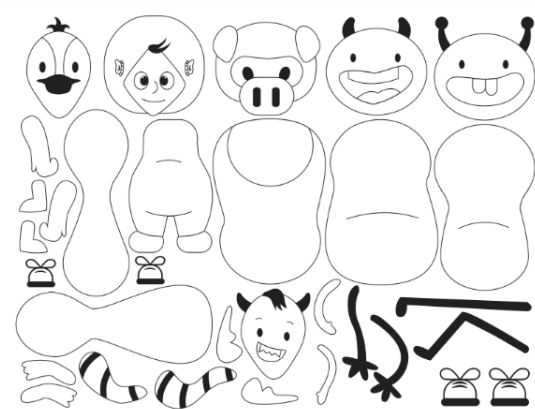


Figura: Institute for Blind and Deaf children of Valle del Cauca, Colombia

Analysis: Building

Drawing Intervention (Transition, Pre-Kinder and Kinder).



Figura: Institute for Blind and Deaf children of Valle del Cauca, Colombia

Analysis: Technology

Transition and Pre-Kinder.



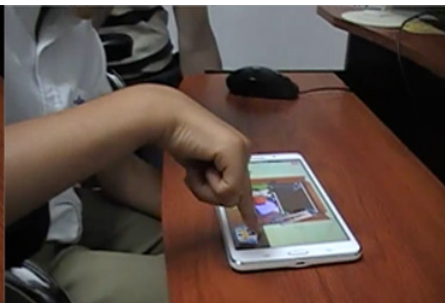
Figura: Institute for Blind and Deaf children of Valle del Cauca, Colombia

Analysis: Cognitive

Memory, Visual Attention



MEMORIA KIDS



GRUPOLANDIA

Figura: Institute for Blind and Deaf children of Valle del Cauca, Colombia

Analysis: Cognitive

Memory applied 8 children from transition.

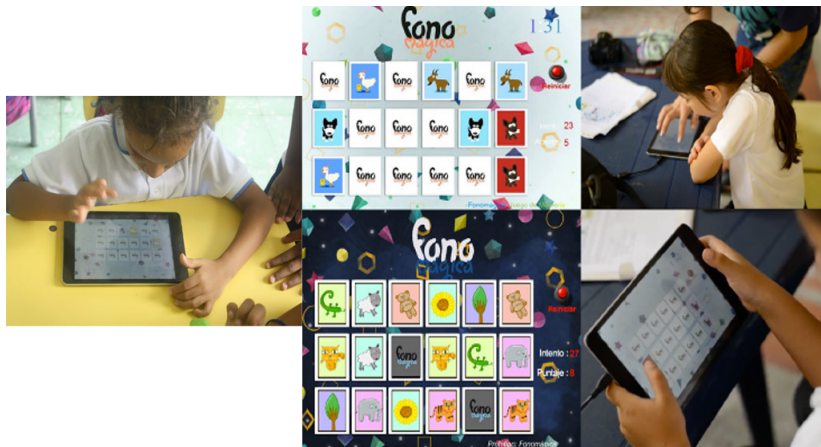


Figura: Institute for Blind and Deaf children of Valle del Cauca, Colombia

Results

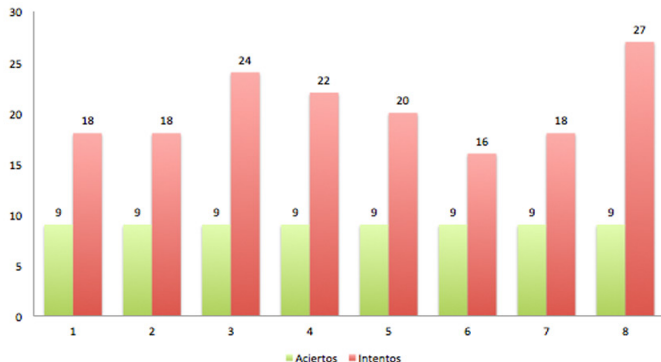


Figura: Institute for Blind and Deaf children of Valle del Cauca, Colombia

Analysis: Spatial Orientation



Figura: Institute for Blind and Deaf children of Valle del Cauca, Colombia

Analysis: Observational Studies

Deaf Children: Educational, Cognitive.



Figura: Deaf Children Institute of Special Therapy Sens (ITES, Spanish), Club Leones of Valle del Cauca

Analysis: Observational Studies

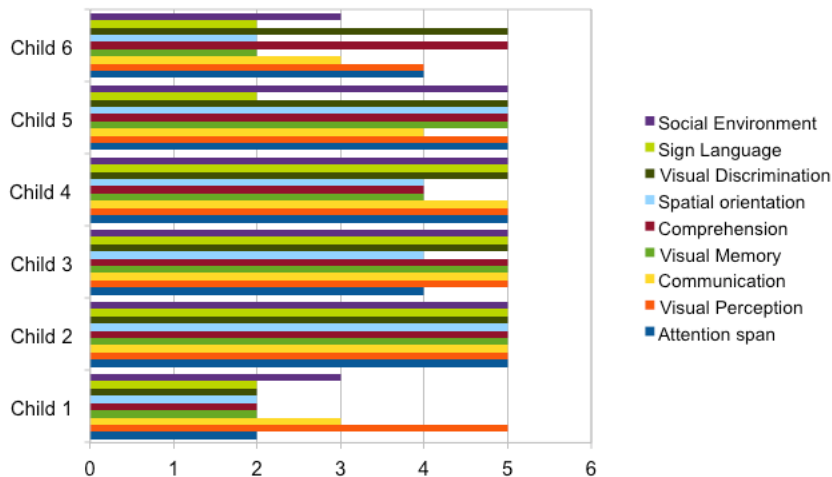
Deaf Children: Educational, Cognitive.



Figura: Mexico in the USAER school in Aguascalientes, a school enables with children with hearing impairment.

Analysis: Observational Studies

Deaf Children: Educational, Cognitive.



Analysis: Applications



USAER (9 APPS)



INSTITUTE BLIND AND
DEAF CHILDREN (7 APPS)



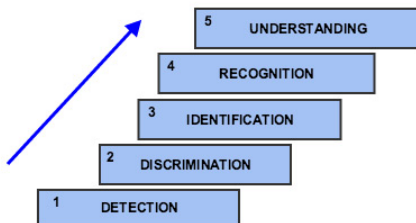
ITES - SCHOOL
LEONES CLUB (5 APPS)

Cognitive and Motors Characteristics

- The University San Buenaventura, Psychology working in Cognitive Processes with Deaf Children. SONAR created for children with limitations visuals and auditory.
- Previous studies have found differences in: perception [8], long-term memory [15] and visual memory [7]
- Spatial Orientation, memory (visual, auditory), Attention Auditory, Perception.
- Long-term memory have problems in conceptualizing and categorization. Temporary and linguistic codes are better for short term memory [cita]
- Evaluate the developement of Visual Perception is VMI and Frostig Test. Evaluated Areas: Visual perception, motor coordination, visual-motor integration.
- Psycometric test: Test Wechsler (USAER), ENI(in spanish, Evaluación Neuropsicología Infantil), Test Neuropsi.

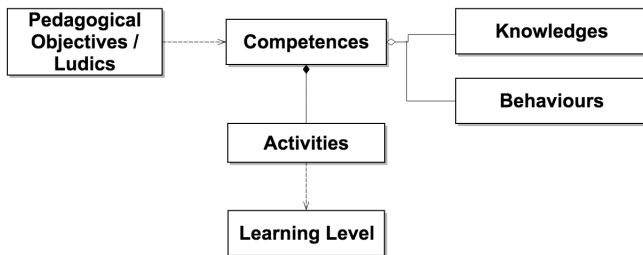
Speech Characteristics

- Speech rehabilitation. Auditory Verbal Therapy (AVT) set of steps as: sound detection, discrimination of phonemes, sound identification, recognition of sounds and understanding.



Pedagogical Objectives Model

Based in model proposed by Marfisi-Schottman [16]. Each Skill defined C_i is connected to set of Knowledges (K_n) and Behaviours (B_n), where $\sum_1^n K_n + \sum_1^n B_n$. Skills is composed of activities and each activity is related to learning level and average time making the activity.

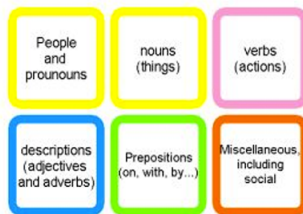


Analysing Teaching Methods and learning Styles

Color coding symbols by grammatical categories or parts of speech is a well-established practice called Fitzgerald Key, Gossens, Crain, Elder

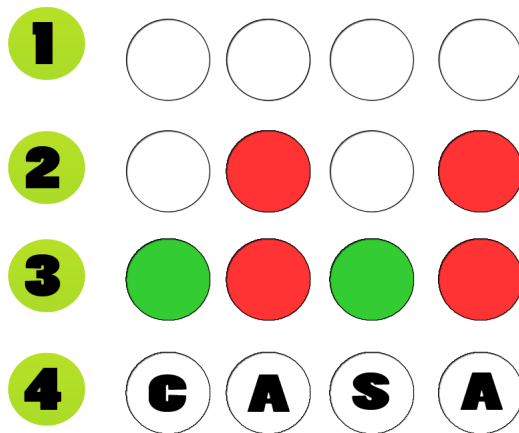


Goossens', Crain, Elder, 1992

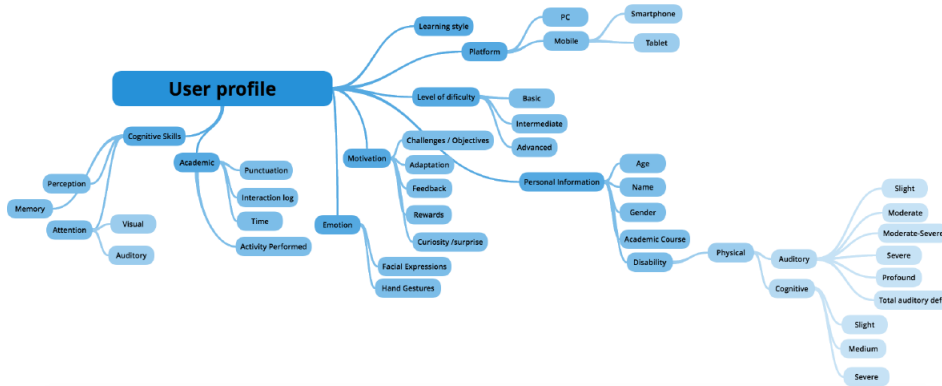


Analysing Teaching Methods and learning Styles

Invariant Method, proposed Russian language by Daniel Elkonin [11] and adapted to language spanish by Yulia Solovieva and Luis Quintanar [24]



Taxonomy of User Profile



Mini-Games as psychometric tool

Videogame interface to information capture about cognitive processes, as : memory, spatial orientation, selective attention, auditory perception, among others. Actually, We are capturing the information about cognitive processes by each child, where we take samples of 3 repetition by each child.

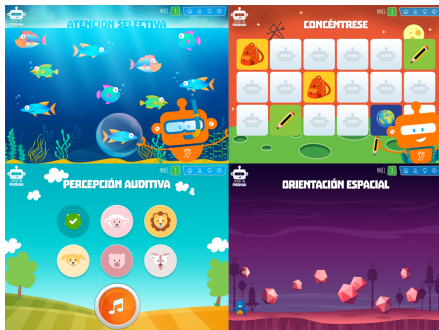
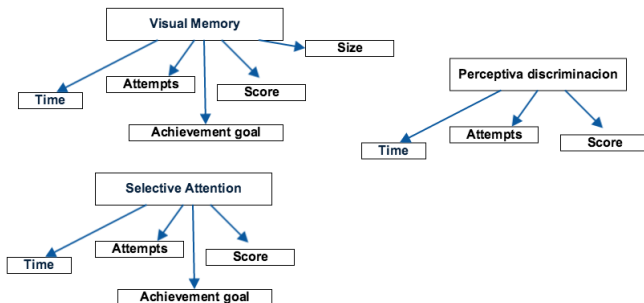


Figura: Mini-Games as tool Psychometric **Training with Phonak** in Android devices

Information Captured

- Information captured from the pre-test is vital for adjusting the level of difficulty of the activities
- Each of the skills (Cognitive Process) tested with the child is taken as a model classify into 3 classes: $C_i = low(L), medium(M), high(H)$
- Each data row corresponds to X^i to be used as training data and an $X_j^{(i)}$, which are a set of characteristics (j) corresponding to an observation of a child (i).

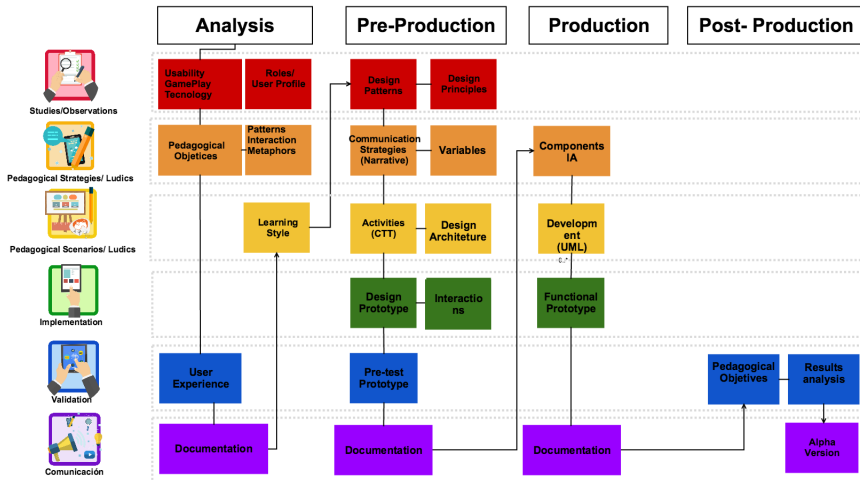


Outline

- 1 Background and Context
- 2 Description Problem
- 3 Objectives
- 4 Objective I: Cognitive and motor Characteristics
- 5 Objective II: Adapting a methodology for SG based in UCD**
- 6 Objective III: Guidelines and Design Patterns that support in the Speech Therapy
- 7 Objective IV: Validating the Methodology
- 8 Research Register & Publications
- 9 Conclusions and Future Work

Methodology: MECONESIS

Methodology based in Unified Software Development Process[19], which involves CTT notations, BPMN and UML.



MECONESIS (in spanish MEtodología para CONcepción de juEgos Serios para niños con discapacidad auditiva), is based in models:

- Analysis Model
- User Model
- Pedagogical Objectives Model
- Tasks Model
- Adaptation Model
- Scenarios Model
- Validation Model

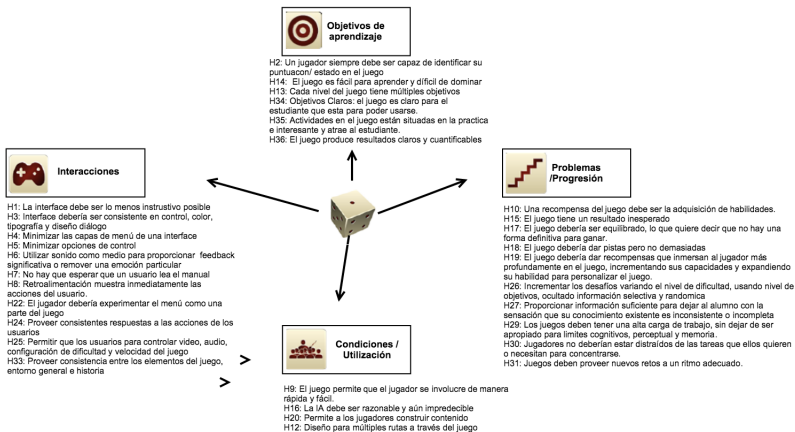
Tool in development : www.meconesis.com.

MECONESIS:Scenario Model



MECONESIS: Validation Model

Based in heuristics for serious game design in [? ?], selecting 34 heuristics.



MECONESIS:Tasks model



Tareas



T. Usuario



T. Docente



T. Sistema

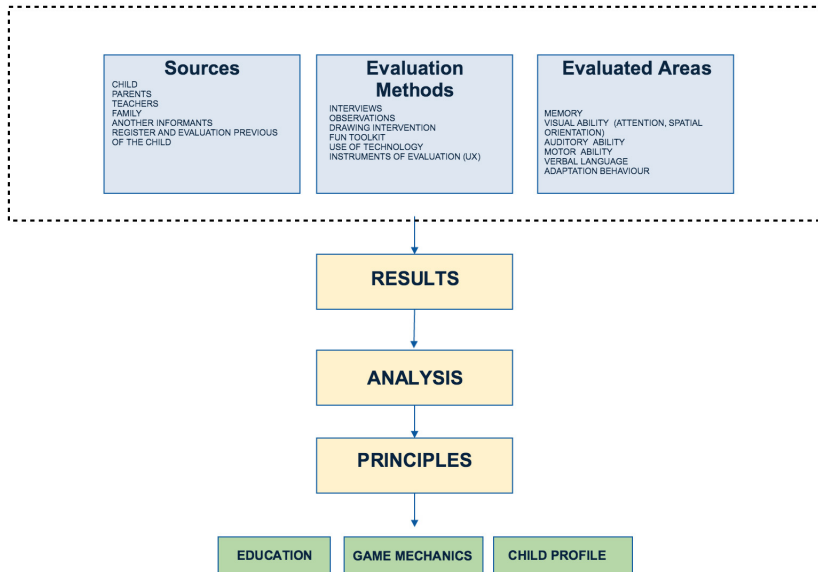


T. Interacción

Outline

- 1 Background and Context
- 2 Description Problem
- 3 Objectives
- 4 Objective I: Cognitive and motor Characteristics
- 5 Objective II: Adapting a methodology for SG based in UCD
- 6 Objective III: Guidelines and Design Patterns that support in the Speech Therapy**
- 7 Objective IV: Validating the Methodology
- 8 Research Register & Publications
- 9 Conclusions and Future Work

Principles



Principles: Pedagogical

Were defined 11 principles in education

- A1. Short Words are easy to learn, if the word is more long difficulting to memorize
- A2. Messages must be understandable, using images that can help to represent the message.
- A3. Short texts with pictograms
- A8. Identify levels of learning where that the tasks are related helping to acquire skills.
- A10. Present to the child a set of words with a specific long, and frequency determined.
- A11. Allow to manipulate or built one word through of one support image.

Principles: Game Mechanics

were defined 15 Principles in Game mechanics

- B1. Touch Screen is good interaction for child, who has difficulties using mouse [6]
- B2. The interface must provide feedback to the child on each action that he makes [17]
- B3. The game must have difficulty levels, because not all children have same learning
- B4. The game history and characters have influence in the age and genre of the child
- B9. The Game narrative must be associated with the learning content.
- B11. Allow to the game saves information on different actions that the child does.

Principles: User Profile

Were defined 9 principles in user profile.

- C1. Icons should have a meaning visual to the child. [17]
- C2. They need a feedback sensory about each one of their actions.
- C3. They are distracted easily, therefore they can have problems in focusing their attention.
- C4. Children prefer to interact with portable technologies, as Tablets and Smartphone.
- C5. Their cognitive processes basics, are: Attention, memory and language. Therefore, is important to define elements to capture their attention and combine visual strategies and gestural, for the child can have a better memory.
- C6. Reduce the number of tasks viso-spatial or quantity of information. [12]

Outline

- 1 Background and Context
- 2 Description Problem
- 3 Objectives
- 4 Objective I: Cognitive and motor Characteristics
- 5 Objective II: Adapting a methodology for SG based in UCD
- 6 Objective III: Guidelines and Design Patterns that support in the Speech Therapy
- 7 Objective IV: Validating the Methodology**
- 8 Research Register & Publications
- 9 Conclusions and Future Work

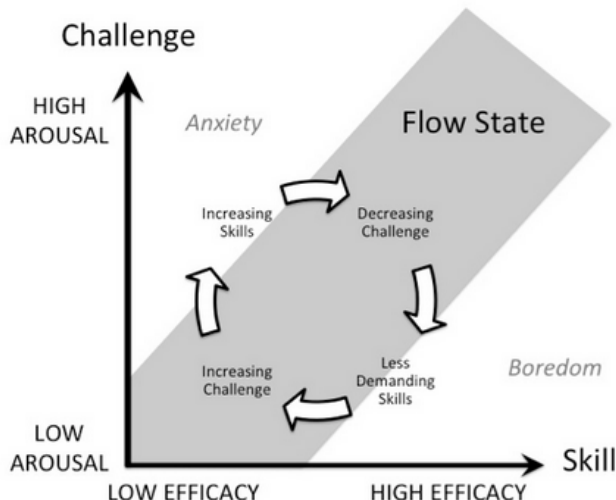
Case Studies

- Case 1: Teaching literacy based in Fitzgerald Key
- Case 2: Teaching literacy based in Invariant Method
- Case 3: AVT (Auditory Verbal Therapy)



Case 1

Study Case carried out with USAER and Institute for Blind and Deaf Children. Serious Games - Flow Csikszentmihalyi



Case 1: Objectives

Pedagogical Objectives

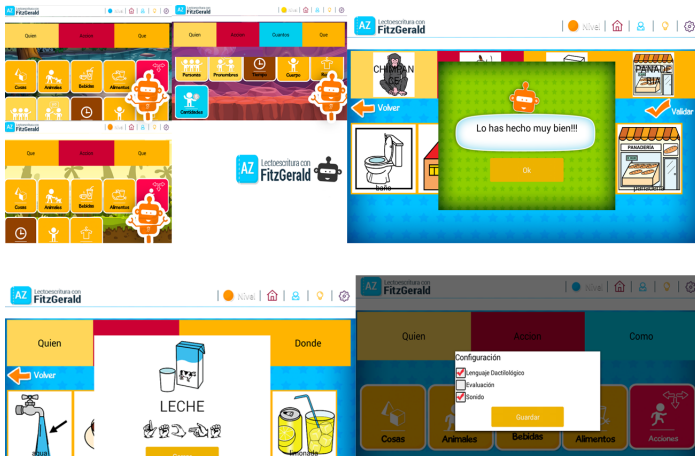
- Select the right words to structure a sentence
- Learning to use the Fitzgerald Key scheme through questions
- Identify the different schemes of a sentence, pronouns, nouns, verbs, adjectives and adverbs.
- Adapt difficulty levels learning levels related schemes of sentences.
- Score for each activity performed correctly
- Sort the user depending on the level of learning that is
- Accumulation score
- Keeping track player activity.

Case 1: Serious Games Aspects

- Challenges: Levels of difficulty in reaching targets.[21]
- Rules/goals: rules are the objectives of the game established in order to win, which is very important in the learning part.
- Feedback: Display each of the actions carried out. The indications can be visual, audible or tactile [21]
- Assessment: This measure compares the performance between players. [10]
- Surprise: Random elements within the game [10]
- Interaction: Adaptability and manipulation of the game where the game changes in response to player actions [14]
- Fantasy: The environment through which the game, setting and characters are developed, which involves the player. [21]

Case 1: Literacy with Fitzgerald

Application of a game to mobile devices as support in literacy learning, using the teaching method called key fitzgerald, which is used as colors code to structure a sentence. It's used in deaf children, whose channel communication is sign language.



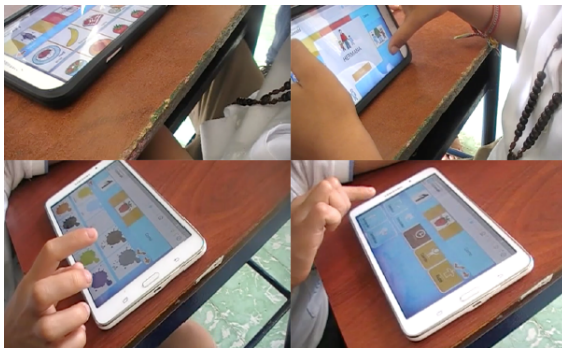
Case 1:Evaluating

Heuristic Evaluation taking the validation model proposed. was made with 5 experts in HCI. Were identified aspects to take on account in the game mechanics. The evaluation was composed of 34 heuristics grouped in 4 categories: learning objectives, interaction, problems/progress and conditions/use based in model proposed by [2]



Case 1:Evaluating

Children in the Institute (INCSVC)



Case 1:Evaluating

Children in the Institute (INCSVC)



Case 2: Phono-Magical

Built with studiants of Graphic Design at University of Cauca. Integrating real Objects



Case 2: Phono-Magical

Evaluating the Game Story and building the characters



Case 2: Phono-Magical

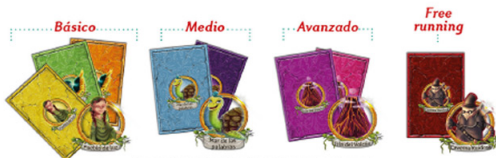


Figura 2.9: Tarjetas del prototipo del juego. Conocidas como Fonocards.



Gabriela/Gabriel



Mama Locua



Mutus



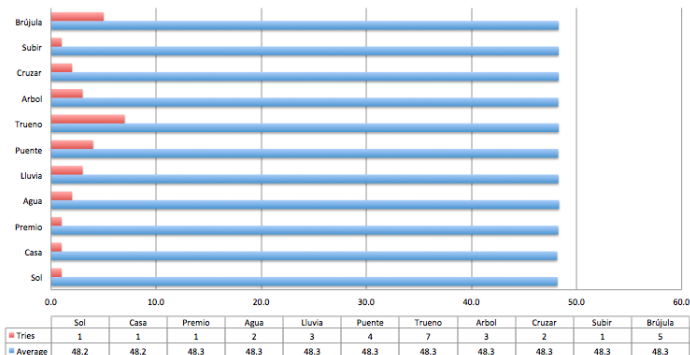
Case 2: Phono-Magical



Figura 19: Tarjetas del prototipo del juego. Conocidas como Fonecards



Case 2: Evaluation



Case 3: Training with Phonak



Case 3: Training with Phonak



Outline

- 1 Background and Context
- 2 Description Problem
- 3 Objectives
- 4 Objective I: Cognitive and motor Characteristics
- 5 Objective II: Adapting a methodology for SG based in UCD
- 6 Objective III: Guidelines and Design Patterns that support in the Speech Therapy
- 7 Objective IV: Validating the Methodology
- 8 Research Register & Publications**
- 9 Conclusions and Future Work

- Directed thesis 1 terminated (undergraduate), 2 development
- Articles (7): Springer, IEEE- Latinoamérica, International Journal of Information Technologies and Systems Approach, VAEP-RITA, IEEE Revista Iberoamericana de Tecnologías de Aprendizaje, Hombre - Máquina (UAO), Special issue of the UAIS Journal.
- Articles Conference Paper: (12)
- Chapter: 2 In review

<http://www.phonak.com.co/>



* S. Cano, E. Collares. *Interfaces de visualización para niños con necesidad educativa desde un enfoque multicultural*. VIII Congreso Colombiano de Computación, Armenia, Colombia.

- Trabajos de Grado

- Lower middle

Publications: 4

El concepto del escenario se basa en la construcción de un mundo imaginario, donde el protagonista principal llamado Phanuk, un niño que se siente diferente a los otros niños se ha perdido en un planeta llamado sondas, debe aprender a escuchar para encontrar a su familia. Al que para encontrarlos deberá adentrarse al poder del viento. Al que

Outline

- 1 Background and Context
- 2 Description Problem
- 3 Objectives
- 4 Objective I: Cognitive and motor Characteristics
- 5 Objective II: Adapting a methodology for SG based in UCD
- 6 Objective III: Guidelines and Design Patterns that support in the Speech Therapy
- 7 Objective IV: Validating the Methodology
- 8 Research Register & Publications
- 9 Conclusions and Future Work

Conclusions

- Models proposed help to achieve a multidisciplinary communication with all stakeholders.
- Methodology takes different contexts of use, where were applied cases study for children with different ways to communicate (sign language or verbal)
- User model proposed help to identify the aspects of child with auditory impaired using a set of evaluation methods.
- Evaluation methods that were applied with children were oriented in the user experience and usability. However, this methods aren't oriented to children with disability
- Cognitive processes very important in the design because they help to serious game design can adjust to needs of children
- Working with real objects can influence in the environment in which it operates the child. Take on account theories as Piaget and Vygotsky.
- Results obtained were positive, where were used different strategy types.
- The methodology provides principles to design serious games.

- Validate the third case
- integrate fonomagica in the course transition and primary to work with the teachers.
- Propose a methodology to evaluate in serious games oriented to children with special needs
- Identify collaboration patterns in the second case
- Involve evaluation methods that allow to obtain cognitive abilities in children.

- [1] Castillo A.D. Herramienta de software didáctica como soporte en la enseñanza del lenguaje oral para niños con deficiencia auditiva. *En primera ronda nacional de proyectos y realizaciones en tecnología biomédica. SENA Antioquia- Universidad de Antioquia - Univ Pontificia Bolivariana, Univ San Buenaventura Medellín- Escuela de ingeniería de Antioquia*, 2002.
- [2] Marne Bertrand, Huynh-Kim-Bang Benjamin, and Labat Jean-Marc. Articuler motivation et apprentissage grace aux facettes du jeu sérieux. *Actes de la Conférence EIAH*, pages 69–80, 2011.

- [3] Sandra Cano, César Collazos, Habib M. Fardoun, Daniyal M. Alghazzawi, and Abdullah Albarakati. Model based on learning needs of children with auditory impairment. *Springer International Publishing. Social Computing and Social Media: 8th International Conference, SCSM 2016, Held as Part of HCI International 2016, Toronto, ON, Canada, July 17–22, 2016. Proceedings*, pages 324–334, 2016.
- [4] Sandra Cano and César Collazos Carina S. Gonzalez Sergio Zapata Collazos, Jaime A. Muñoz. Hacia una metodología para la concepción de juegos serios para niños con discapacidad auditiva. *Revista IEEE América Latina*, 14(5):2511–2521, 2016.
- [5] Vaquero Carlos, Saz Oscar, Lleida Eduardo, and Rodriguez William R. E-inclusion technologies for the speech handicapped. *Acoustics, Speech and Signal Processing International Conference on*, pages 4509–4512, 2008.

- [6] Chiara Eva Catalo, Angelo Marco Luccini, and Michela Mortara. Best practices for an effective design and evaluation of serious games. (1-13), 2014.
- [7] Bavelier D., Dye M., and Hauser P. Do deaf individuals see better? *Trends in Cognitive Sciences*, 10:512–518, 2006.
- [8] Bosworth D. and Dobkins K. Left-hemisphere dominance for motion processing in deaf signers. *Psychological Science*, 10(3):256–262, 1999.
- [9] Loaiza D, Oviedo C, Castillo A, Portilla A., Alvarez G, Linares D., and Navarro A. A video game prototype for speech rehabilitation. *Games and Virtual Worlds for Serious Applications 5th International Conference*, pages 1–4, 2013.
- [10] Michael D and Chen S. *Serious Games: Games That Educate, Train, and Inform (1er ed)*. Course Technology PTR, 2005.

- [11] Elkonin D.D. *El desarrollo psicológico en las edades infantiles*. Academia de Ciencias Pedagógicas y Sociales, 1995.
- [12] Damien Djaouti. *Serious Game Design, Considérations théoriques et techniques sur la création de jeux vidéo à vocation utilitaire*. PhD thesis, Université de toulouse.
- [13] Nadolski Rob J, Hummel Hans G K, Van Den Brink Henk J, Hoefakker Ruud E, Sloomatker Aad, Kurvers Hub J, and Storm Jeroen. Emergo: A methodology and toolkit for developing serious games in higher education. *Journal Simul. Gaming*, pages 338–352, 2008.
- [14] Owen M. *An anatomy of games: A discussion paper*. Futurelab, 2004.
- [15] Rudner M., Andin J., and Ronnberg J. Working memory, deafness and sign language. *Scandinavian Journal of Psychology*, 50(5):495–505, 2009.

- [16] Iza Marfisi-Schottman. *Méthodologie, modèles et outils pour la conception de Learning Games*. Thèse doctorat informatique et mathématiques, L'Institut national des sciences appliquées de Lyon, 2012.
- [17] Iza Marfisi-Schottman. *Méthodologie, modèles et outils pour la conception de Learning Games*. Thèse doctorat informatique et mathématiques, L'Institut national des sciences appliquées de Lyon, 2012.
- [18] McMahon Mark. The doddle model: A flexible document - oriented model for the design of serious games. *Games-Based Learning Advancements for Multi-Sensory Human Computer Interfaces: Techniques and Effective Practices*. IGI Global, pages 98–118, 2009.
- [19] Kroll Per and Kruchten Philoppe. The rational unified process made easy. *A Practitioner's Guide to the RUP*, pages 69–80, 2003.

- [20] Rodriguez William R, Saz Oscar, and Lleida Eduardo. A prelingual tool for the education of altered voices. *Speech Communication*, pages 584–600, 2012.
- [21] Garris Rosemary, Ahlers Robert, and Driskell James E. Games, motivation and learning: A research and practice model. *Simulation & Gaming*, 14(5):441–467, 2002.
- [22] Cano Sandra, Arteaga Jaime Mu noz, Collazos César A., and Amador Viviana Bustos. Model for analysis of serious games for literacty in children from an user experience approach. *Proceedings of the XVI International Conference on Human Computer Interaction*, pages 18:1–18:9, 2015.

- [23] Karin Slegers, Pieter Duysburgh, and An Jacobs. Research methods for involving hearing impaired children in it innovation. In *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries*, NordiCHI '10, pages 781–784, New York, NY, USA, 2010. ACM.
- [24] Solovieva Y and Quintanar L. *Método de formación de lectura para la corrección de dificultades en el desarrollo*. Tesis de maestría en diagnóstico y rehabilitación neuropsicológica,, Universidad Autónoma de Puebla, México., 2012.