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App for measuring early childhood development: a case study

App para la medición del desarrollo temprano infantil: estudio de caso

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ABSTRACT

Introduction. Integrating smartphone use into an emerging early childhood education curriculum can offer several significant benefits.
Methodology. We apply mixed methods (evidence-based practices, action research, formative evaluation, and integration of technological devices).
Results. A manual has been created that summarizes early intervention practices that improve child development outcomes. An Open Educational Resource (OER) has incorporated child development assessment tools and intervention exercises for children. An app has facilitated access to OER. Finally, the app's perceptions used by families and practitioners (professionals) aged 0-5 years have been measured through the User Experience Questionnaire (CEU).
Discussion. The evaluative findings indicated that the age of family members and practitioners made a powerful difference in the educational app's attractiveness, efficiency, and stimulation. In contrast, academic qualification only affected controllability.

RESUMEN

Introducción. La integración del uso de teléfonos inteligentes en un currículo emergente de educación infantil puede ofrecer una serie de beneficios significativos.
Metodología. Se han aplicado métodos mixtos (prácticas basadas en la evidencia, investigación-acción, evaluación formativa e integración de dispositivos tecnológicos).
Resultados. Se ha creado un manual que resume prácticas de intervención temprana que mejoran los resultados del desarrollo infantil. Se han incorporado instrumentos de evaluación del desarrollo infantil y ejercicios de intervención para niños en un *Recurso Educativo Abierto* (REA). Se ha implantado una app educativa para facilitar el acceso a REA. Finalmente, se han medido las percepciones de familiares y practicadores profesionales sobre(profesionales) de la app educativa usada para el desarrollo infantil entre 0 y 5 años a través del *Cuestionario Experiencia de Uso (CEU)*.
Discusión. Los hallazgos evaluativos indicaron que la edad de los miembros de las familias y los profesionales familiares y practicadores (profesionales) marcaba una diferencia potente en la atracción, eficiencia y estimulación de la app educativa, mientras que la titulación académica solo lo hacía en la dimensión controlabilidad.

KEYWORDS – PALABRAS CLAVE

Early childhood development, smartphone, educational applications, technology platforms, web design.
Desarrollo temprano infantil, teléfono inteligente, aplicaciones educativas, plataformas tecnológicas, diseño web.

1. Introduction

Smartphones have benefits in an emerging early childhood education curriculum because they allow access to educational content to develop reading, writing, numeracy and problem solving. The applications included in smartphones adjust the difficulties of educational tasks according to children's progress. Simultaneously, they foster parents' digital literacy by enabling active and participatory learning, while giving immediate feedback to children and parents on children's mistakes.

1.1. Key factors and applications related to the use of technology in childhood

The factors that influence the use of digital technology can be of different nature: individual (such as age, cognitive development or personal interests), family (and in this case we find parental beliefs, homework supervision or the rules established at home), educational (and thus we find the availability of resources, school policies or teacher training). Finally, socioeconomic factors (including access to devices and level of internet connectivity) (Blackwell et al., 2014; Collier-Meeket al., 2020).

The abundance of studies around associations between screen time, emotional development, social skills, and sleep quality has prompted a meta-analysis of the efficiency of technologies related to psychosocial factors in child development (Mallawaarachchi et al., 2022). Following the analyses, the authors discussed that “increased early childhood smartphone and tablet use was correlated, albeit weakly, with poorer overall child-specific developmental factors (i.e., aggregate of psychosocial, cognitive and sleep domains” (p. 27).

Technological platforms are used in early childhood education to improve children's language, social and motor skills, to document the activities they perform and to adapt the curriculum to their present needs (Parnell & Bartlett, 2012). Ultimately, the use of technologies understood as narrative games or problem-solving platforms for school content serves to teach social-emotional skills, fundamentally for those children who lack adequate social-emotional learning (Nikolopoulou & Gialamas, 2015; McClelland et al., 2017). Consequently, it seems recurrent to imbue beliefs in faculty to design learning experiences based on digital games (Odom & Wolery, 2003).

Some authors perceive games as motivational and educational tools; others doubt their pedagogical effectiveness (McClelland, Tominey, Schmitt, & Duncan, 2017). The use of technologies such as narrative games or problem-solving platforms for school content serves to teach social-emotional skills, primarily for those children who lack social-emotional learning, because qualitative studies have indicated that technology had a positive effect on engagement, social interactions, and mathematical skills (Zomer & Kay, 2016). Simultaneously, increased communication between parents and educators through interactive platforms is considered transcendental.

In this sense, programs aimed at children with special needs (e.g., augmentative communication) have been implemented and are summarized in the monographic issue of the *International Journal of Special Education, 34*(1), 2019. Likewise, interventions with technologies to teach older children have been evaluated with programs such as augmented reality or gamification that have shown positive results in motivation and learning, and self-assessment has been promoted in older children through the use of digital tools (Hudson,

2019). Likewise, the need to measure the long-term effects for the generalization of knowledge in an emerging curriculum has been noticed (Lim, 2017).

A correlation has been found between parents' educational self-efficacy and enhanced use of technologies at home (Hadlingtonet al., 2019; Fidan & Olur, 2023). Moreover, in 2023, Fidan and Olur discussed “studies especially on the effects and roles of digital parenting” (p. 15192), which use technologies to teach parenting skills for effective parenting, e.g., video tutorials or apps that provide feedback on parenting strategies. Convincingly, joint use of devices between parents and children fosters emotional connection and enhances children's learning.

However, excessive use of technological devices is related to aggressive moods, impulsivity and lower self-regulation of users. Therefore, interventions based on media education can reduce disruptive behaviors. An appropriate use of technologies by children has the benefit of promoting interactive learning and the development of digital skills. On the contrary, the psychological risks of misuse of technologies refer to attention problems, social isolation and technological dependence. However, technological applications contribute to the sensory and motor development of children with disabilities (Pila et al., 2021).

Haptic technologies that allow users to interact with the environment by tactile means have social uses in socio-educational simulations and research and in physical therapies. In this regard, technological tools such as digital questionnaires have been developed to assess the cognitive, motor, social, and emotional development of young children and monitor their developmental milestones (Louisiana Department of Education, 2023). Among the data collected by the questionnaires are academic progress and social skills to customize interventions based on the findings, always taking care of the ethical principles of confidentiality in handling sensitive data within educational settings (Lohmann et al., 2024). Documentation of learning with digital tools is unquestionable to record children's progress in real time (e.g., digital portfolios) (Mertala, 2019).

With this in mind, smartphones have become an administrative and documentary tool (Goh et al., 2015). The use of these devices in schools allows tracking children's learning progress, communicating with parents and recording daily academic activities (Sørenssen & Bergschöld, 2021). Consequently, digital tools connect families to intervention resources (Dunst et al., 2019; Dunst et al., 2020). Indeed, some purpose-designed mobile apps can detect early signs of developmental delays in children (Wallace, 2018).

The opinions of teachers and developers of smart technologies used by children are complementary. Precisely, teachers reason that technologies are additional to children's development, stressing the importance of adequate supervision (Vidal-Hall et al., 2020), while developers seek a balance between entertainment and an education in application design (Kucirkova & Flewitt, 2020; Kucirkova et al., 2021). In both cases, the need to empirically validate new tools before their widespread implementation seems evident.

To this end, it is pertinent to integrate learning theories (constructivism, sociocultural) in the design and evaluation of educational technologies. Likewise, the establishment of clear parental rules and regulations on children's time in front of a screen, type of content and schedules of use of technologies, which should be flexible and adapted to the individual needs of each child, is also timely (Merdin & Şahinb, 2023; Griffith et al., 2024). The research by Bonilla and Aguaded (2018) manifested the interest shown by families to the proposal of receiving training in information and communication technology at school, i.e., parents demand participation in training activities to improve their digital and media skills.

Consequently, parents' education should run parallel to children's education (Snodgrass et al., 2017). Consistent with the weaknesses found in previous work, this study posed the following research questions:

1. What are the early intervention practices that improve child development outcomes, summarized in an early childhood developmental assessment manual (birth to age five)?

2. Can a website be designed with developmental assessment tools and intervention exercises for children?

3. Can a mobile application (educational app) be drafted to facilitate access to a website with illustrations of milestones of children's progress between 0 and 5 years of age, and their follow-up?

4. Can an educational app focused on families and professionals of children 0-5 years old be evaluated and its effects measured?

2. Methodology

We used a mixed-methods approach (evidence-based practice, action research, formative evaluation and technology integration).

2.1. Participants

Non-probability sampling was employed in which families and professionals were chosen by utility, as in the study by Subiñas et al. (2022) which has served as an example approach. The formative evaluation of the educational App was developed in La Laguna (Tenerife). After ethical approval by the University, detailed information was given orally and by telephone to families and professionals. The sample consisted of 51 cases of children and 62 families and professionals who authorized the experiment. The total number of participating infants were as follows: 30 boys and 21 girls. The children were 1 year old (14 cases), 2 years old (24), 3 years old (6), 4 years old (5), 5 years old (2) and 8 years old (1).

The gender of family members and professionals was predominantly female (82.3%, N=51) versus male (17.7%, N=11). The predominant age of family members and professionals was 18-29 years (58.1%, N=36), 30-39 years (17.7%, N=11), 40-49 years (16.1%, N=10) and over 50 years (8.1%, N=50). The size of members using the educational App was 47. Of these, professionals used the educational app (61.7%), followed by family members (36.2%). Of the 61 responses received, the highest academic degree received was bachelor's (50%, N=31), doctorate (24.2%, N=15), bachelor's (17.7%, N=11) or master's (8.1%, N=5).

2.2. Instruments

First, the UPDating University Curricula on Early Intervention (UPDEIT) team developed an Early Care Manual[1]. From 0 to 5 years following the evidence-based practice method. It included text and illustrations for the early detection of visual and hearing problems and the assessment of motor development. It was translated into the four languages (English, Greek, Macedonian and Spanish) of the countries participating in the UPDEIT project. It was a teaching resource aimed at educators and students in teacher training programs such as the Early Childhood Developmental Screenings Guidebook (Louisiana Department of Education, 2023).

Second, it established an open source Internet Open Educational Resource (OER), following an action research method and webinars[2] with members of the UPDEIT team. It was dedicated to child development covering screening tools, intervention exercises and strategies adapted to developmental delays in perception, gross motor, fine motor, personal-social development, communication, play and social development in four languages (English, Greek, Macedonian and Spanish) (Table 1).

Table 1

Open Educational Resource (OER)

GUESS WHICH HAND IT IS IN (PERCEPTION AREA) Take a small toy and hide it in one of your palms. The first time, let the child see which palm you will hide the toy in. Then ask him which hand the toy is in and let him guess. The next time, don't show him which hand he is putting the toy in and ask him again where it is and let him guess. The activity is suitable to stimulate the child's curiosity in searching for objects.
OPEN - CLOSE (MOTOR SKILLS, PERCEPTION, INDEPENDENCE) Opening and closing are very interesting activities for children, whether it is a door, a window or a drawer. They like to open them and see what is inside. Teach the child to open and close different types of doors: sliding, regular.... Pay attention to the child's hands and feet while doing the activity.
PUTTING OBJECTS IN AND TAKING OBJECTS OUT (MOTOR SKILLS, PERCEPTION, INDEPENDENCE) Prepare a transparent box or jar with a wide opening through which the child can reach a small ball. Show the child how to put the ball in the jar and then take it out. Assist them in their attempts.
PLAYING WITH PAPER (PERCEPTION, FINE MOTOR) Use different types of paper and show the child how it can be crumpled, twisted, pulled and used to make origami. This activity stimulates the child's imagination and creativity.
PILED CUPS Take several plastic cups and show the child how to stack the cups inside each other, then help the child stack them independently.
BLOCK TOWER Start with three blocks, showing the child how to build a block tower. Help as needed. At this age, it may take some time for the child to master the skill. Allow the child to knock over the tower if he/she wants to.
MOVING LARGE OBJECTS

[1] UPDating University Curricula on Early Intervention (UPDEIT). European Union project Erasmus+), competitive no. 2021-1-MK01-KA220-HED-000022981 2022-2024, in which the following universities participated: Cyril Methodius University and Uchilnica Daskalovski (Macedonia), Frederick University (Cyprus) and University of La Laguna (Spain).

[2] Webinars were organized using the ZOOM platform.

Give the child a large, soft pillow or toy and allow him/her to move with it. This is important for maintaining balance and control when walking with reduced visibility of the floor, encouraging spatial assessment.

GETTING TO KNOW FAMILY MEMBERS

Take a photo album or pictures from your phone and introduce each family member by name and the child's relationship to them. Repeat and encourage the child to say his or her name when you show him or her a picture of a specific person. If you do this often, it will be easier for the child to recognize and then name the faces he or she sees in the pictures.

TICKLE TIME

Sit with the child in front of a mirror. Tickle the child's feet and the child will see in the mirror where you are tickling them. Tickle other parts of his body as well, naming the part that is tickling him at that moment. This is a fun way for the child to learn body parts and, at the same time, develop self-awareness.

FUN WITH GRAVITY

Take a rubber ball and drop it. When it bounces on the ground, catch it again. Drop the ball from different heights and show the child what happens. Also, show him that the ball is simply falling and he is not throwing it. You can also drop other objects from your hand so the child can see that they do not bounce like the ball.

DANCE (MOTOR AREA - BALANCE AND RHYTHM)

Once the child begins to balance, show him that music is fun and that we can move our bodies to the beat. This activity introduces the child to dance. Watching you, the child will begin to move his arms and body during the songs. You can also sing the songs and move your body along with the child.

IMPORTANT CONVERSATION (SPEECH AND COMMUNICATION AREA)

When the child is in a good mood and comes to you after finishing a game, start a conversation by asking brief questions. Consider every sound uttered as a response. Initiate frequent conversations on different topics: what was the game like, what were you doing when the child arrived, what is daddy doing, what will he do next, etc. Be enthusiastic in asking questions, even when the child cannot yet answer. Instead of the child, you can always give the answer, introducing the child to interaction and learning from a model. Even when the child attempts to vocalize, accept it as an answer and confirm the attempt by giving the full answer on his or her behalf.

GETTING OUT OF BED (MOTOR AREA)

Place the child on a soft surface such as a bed that is no higher than the child's neck. Next, lay the child on his side on the edge of the bed, help him grasp the surface with his hands, and then move him so that his legs dangle down. Holding his hands, let the body move slowly downward. When he stands on the floor, praise him enthusiastically for his effort. Repeat the same thing several times throughout the day, holding his hand, until he is confident to lie down on his own.

HIDE AND SEEK (PERCEPTUAL, PLAY, SOCIAL DEVELOPMENT)

Play hide-and-seek by hiding in easy places and calling out to the child. When they are close to your hiding place, come out and yell “Boo!”, but be careful not to startle the child. Repeat the game from time to time. After a few times, the child will understand the concept and will be able to change their hiding place.

MAINTAIN FOCUS (AREA OF PERCEPTION, LOGIC, AND REASONING).

While the child is interested in playing with a favorite toy, take it, wrap it in several pieces of paper, and put it in a laundry basket while you watch. Then ask him where the toy is. You will have to help him find it at first, but eventually, he will begin to find it on his own. This helps develop focus and persistence.

GESTURE COMMUNICATION

Communication is incomplete without hand and body gestures. Tell stories or anecdotes with full hand and body movements so that the child learns to express himself through gestures and facial expressions, not just words. For example, when you are excited and yell “Yay!”, hold up your hands.

LEARNING ABOUT ANIMALS

Show the child different animals on your phone or cards (lion, monkey, horse, etc.) that are difficult to see in everyday life. Start with the ones he/she already knows. Introduce the sound and movement each animal makes.

Third, we outlined an educational app as an accessible and convenient way to monitor children's growth and development contained in the OER that was used by family members and parents, and that could be extended to caregivers and health professionals to identify possible developmental delays and provide early interventions. This had highlighted prominent mobile apps (CDC's Milestone Tracker (https://www.cdc.gov/ncbddd/actearly/milestones-app.html), BabySparks (https://babysparks.com/es/), Kinedu (https://app-es.kinedu.com) or Grow by WebMD (https://www.webmd.com/baby/default.htm). These apps include lists of developmental milestones by age, offer personalized activities to support children's cognitive, motor, social and emotional development, progress tracking, health and nutrition advice, language development assessments for use by family members and parents.

The UPDEIT educational app used the term “haptics” associated with touch (Pila et al., 2021), and was available on iOS and Android platforms that ensured security, usability, versatility, and data protection for users.

Finally, the Questionnaire Experience of Use (CEU) was a subjective test aimed at describing, classifying or rating the satisfaction of parents and family members with the educational app. The questionnaire had the format of a semantic differential of Osgood (1964). It was composed of six dimensions (attractiveness, transparency, efficiency, controllability, stimulation and novelty) and 26 pairs of antonymous adjectives on a seven-point scale. It operated on paper and Google, like other questionnaires (Lohmann et al., 2024).

To the knowledge of binary adjectives that were at the extremes of agreement (+), i.e., 5, 6, and 7, and disagreement (-), i.e., 1, 2, and 3 of a word, a value of 4 representing partial knowledge of the evaluative item or item was added. These values of the CEU scale were represented as shown in Table 2. In this way, greater evaluative sensitivity was gained.

Adjetives								Adjetives
	—	—	—	—	—	—	—	
Unpleasant	-3	-2	-1	0	+1	+2	+3	Pleasant

Each meaning is reflected in the following table (Table 2)

Table 2

Meaning of the numeric system to interpret the scale

Numerical system	Meaning
+3	Very pleasant
+2	Quite pleasant
+1	Somewhat pleasant
0	Neither pleasant nor unpleasant
-1	Somewhat unpleasant
-2	Quite unpleasant
-3	Very unpleasant

2.3. Procedure

The effectiveness indicators were determined by the successive revisions of the Early Intervention Manual. From 0 to 5 years through webinars.

Then, members of the Macedonian (Saints Cyril and Methodius University of Skopje, and Училница Даскаловски/ Ucilnica Daskalovski) and Cypriot (Frederick University) teams of the UPDEIT project designed a website (https://mdl.frederick.ac.cy/UPDEITPlatform/Dashboard) that included interactive and multimedia elements with other structural ones. The validation of the website occurred after successive webinars with all the international members of the project.

Subsequently, researchers from the Cypriot team at Frederick University made the digital transformation by designing an educational app for smartphones that allowed the management of the developmental milestones of children from 0 to 5 years of age of the OER. The validation of the design of the educational app was carried out by applying a checklist that was completed in an international face-to-face meeting of the UPDEIT team held at the University of La Laguna in 2023 (See https://updeit.eu//Main/News).

Finally, seven researchers from the UPDEIT team from La Laguna, specializing in inclusive education applied the educational app with 51 children and 62 adults (51 professionals and 11 families -parent-) to understand the feasibility of its use. They evaluated the treatment fidelity of the educational app, conceptualized as adherence, as suggested by Collier-Meek et al. (2020: 335-336). The formative evaluation took place between February and March 2023. Each researcher had one or more professionals and family members with their children. Each educational app evaluation session lasted approximately 15-25 minutes.

2.4. Data analysis

The evaluative analysis of the educational app had not been guided by any previous research hypothesis or theory, as had occurred in a study among educators and designers of this style of technology (Kucirkova & Flewitt, 2020). As we indicated, each professional and family member's response to the CEU was scored on a seven-point graduated ruler or Likert-type scale, with 1 and 7 being the extreme values for bipolar adjectives, following Osgood's (1964) semantic differential technique.

The antonymic or binary adjectives measured gradients in the six CEU dimensions: attractiveness (unpleasant-unpleasant; bad-good; repellent-attractive, awkward-comfortable, ugly-suggestive, unpleasant-sympathetic), transparency (incomprehensible-comprehensible; intricate-simple; complicated-easy, confusing-clear), efficiency (slow-fast, inefficient-efficient, theoretical-pragmatic, anarchic-orderly), controllability (unpredictable-predictable, obstructive-expeditious, insecure-unsure; unconcerned-expectant), stimulation (insignificant-valuable, boring-exciting, dull-interesting), and novelty (chimerical-creative, conventional-original, familiar-novel, routine-innovative).

3. Results

The study employed a combination of statistical tests to analyze data and understand the relationship between variables, as well as to determine the reliability of the results. The Fisher-Snedecor F-test was used to compare the variance of more than two sets of data and to determine if there was a significant difference between the means of the populations from which the samples were drawn. The chi-square coefficient (χ^2) was used to determine whether there was a significant relationship between two or more categorical variables, and a reliability analysis was used to assess the consistency and stability of a measure in different situations, as other researchers had proceeded in their work (Posokhova et al., 2016).

In the present study, two CEU reliability coefficients were applied: the Cronbach's Alpha coefficient for six dimensions and N= 62 with a value of .943 and the Guttman discrimination coefficient in the dimensions: attraction (.786), transparency (.948), efficiency (.943), controllability (.913), stimulation (.921) and novelty (.946). In both cases, the semantic differential had internal consistency reliability and the ability to discriminate between people with high and low scores on each dimension. Table 3 shows the means, standard deviations, variance and mode of the dimensions.

Table 3

Means and standard deviations of the dimensions

Dimensions	Means	Standard deviations	Skewness	Kurtosis
Attraction	4.35	1.784	-.649.	-1.113
Transparency	5.40	1.336	-.744	-.021
Efficiency	5.47	1.082	.006	-1.261
Controllability	5.79	1.103	-.475	-.791
Stimulation	5.95	1.220	-.856	-.316
Novelty	5.50	1.211	-.372	-.558

The greatest dispersion around the mean explained by the variance was in the attraction dimension, which was also observed in the spread of the data around the mean value

(standard deviation). The mode indicated that 6 (quite pleasant) and 7 (very pleasant) were the predominant or most representative values of the six dimensions.

Table 4 shows the chi-square statistics for the dimensions and the p-value associated with each dimension. Since the p-value was less than the α (.05) level of significance in four dimensions: attractiveness, controllability, stimulation, and novelty, the null hypothesis was rejected, concluding that there was a significant relationship between these dimensions.

Table 4

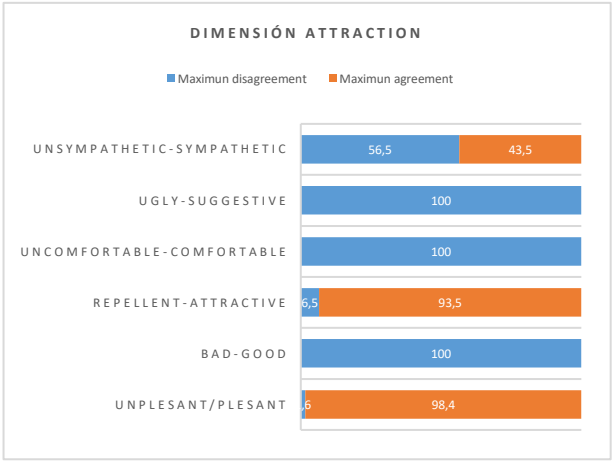
Contingency table of chi-square test of the dimensions

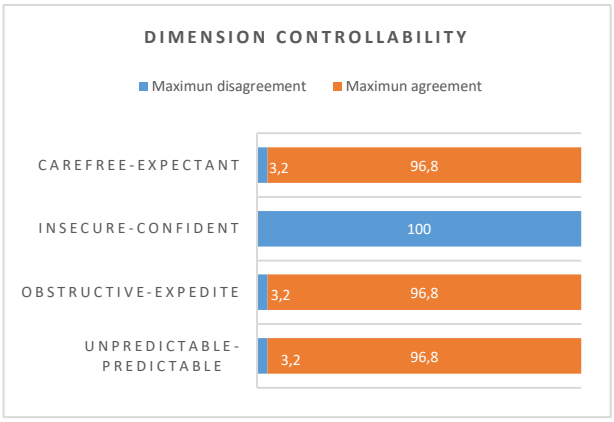
	Attraction	Transparency	Efficiency	Controllability	Stimulation	Novelty
Chi-Squared	36.226	29.613	21.548	37.613	97.032	29.355
Sig.	p<.001	p<.057	p<.063	p<.001	p<.001	p<.001

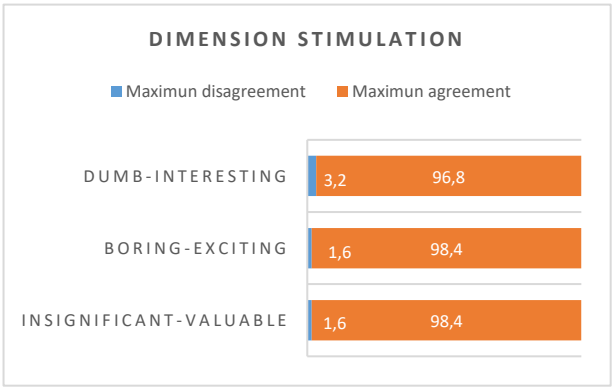
Figure 1 shows the graphical representation of the values obtained for the dimensions that were found to be significant.

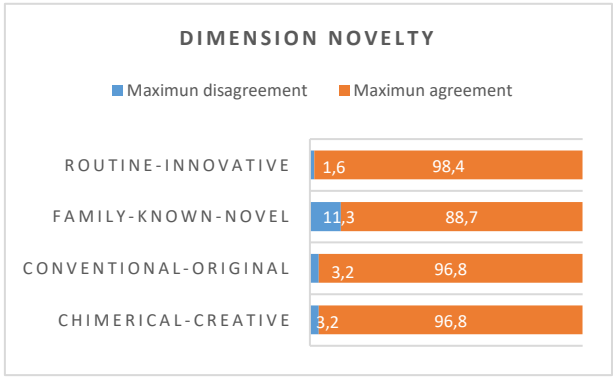
Figure 1

Representation of the values of the elements in the dimensions attraction, controllability, stimulation and novelty of the semantic differential









Of the six attractiveness items, three attitudes had a rating of “maximum disagreement” (ugly, uncomfortable and bad), indicating that the educational app was presented as suggestive, comfortable and good. The unsympathetic-sympathetic pair, however, shows a mean rating between unsympathetic and sympathetic.

In addition, subjects had a totally positive perception (interesting, exciting and valuable) on three elements of stimulation and on four elements of novelty (innovative, novel, original and creative). Likewise, three items (expectancy, expediency and predictability) were totally positive and one totally negative in controllability, which represented the perception of “maximum disagreement” and, therefore, there was no insecurity in the educational app.

Strengths indicated that users found the educational app engaging and motivating (stimulation). Also, that it offered something different and fresh compared to other options on the market (novelty), and they knew what to expect from the educational app, that it

worked efficiently, safely, and that it was easy to understand and use. The educational app is rated in the attractiveness dimension as suggestive, comfortable, appealing, good and pleasant.

As a somewhat weaker point, it seems that the educational app is rated somewhere between nice/unfriendly and a small percentage (11.3%) find it not very novel.

There were no significant differences between families and professionals, according to gender and academic qualifications of the users.

However, there were significant differences in terms of subjects' age in three dimensions: attraction (F=5.126, 3gl, p<.003) with the following values: 18-29 ($\bar{x}$=5.63, σ=.499), 30-39 ($\bar{x}$=4.88, σ=.817), 40-49 ($\bar{x}$=5.22, σ=.676) and highlighting the significant difference between the 18-29 and 30-39 group (F=4.84, 45gl, p<.001) with higher mean in the case of 18-29.

In the efficiency dimension (F=2.966, 3gl, p<.039), the following values are presented by age: 18-29 ($\bar{x}$=5.61, σ=1.004), 30-39 ($\bar{x}$=4.66, σ=861), 40-49 ($\bar{x}$=5.60, σ=1.113), and >50 ($\bar{x}$=5.00, σ=968). Furthermore, it stands out that the 18-29 age group ($\bar{x}$=5.61, σ=1.004) manifests a significant difference with the 30-39 group ($\bar{x}$=4.66, σ=861) (F=.434, 45gl, p<.007).

In the stimulation dimension (F=4.836, 3gl, p<.005) significant differences were obtained by age: 18-29 ($\bar{x}$=6.24, σ=.950), 30-39 ($\bar{x}$=4.84, σ=1.393), 40-49 ($\bar{x}$=5.38, σ=1.506), and >50 ($\bar{x}$=5.90, σ=1.069). The largest significant difference was between age group 18-29 ($\bar{x}$=6.24, σ=.950) and 30-39 ($\bar{x}$=4.84, σ=1.393), (F=2.086, 45gl, p<.001).

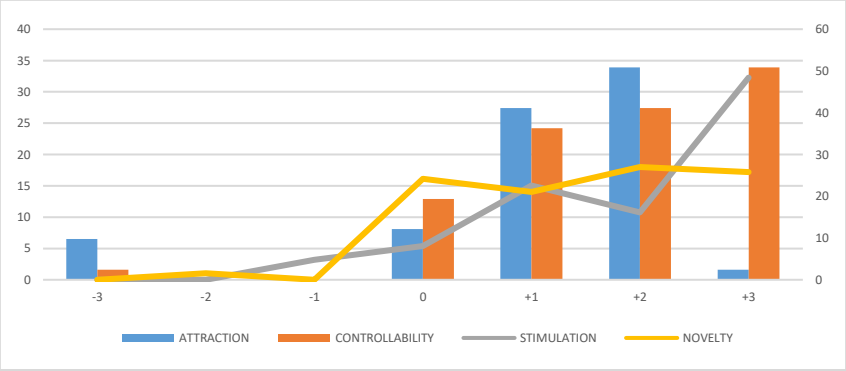
Likewise, significant differences were found concerning the academic degree of the sample in the controllability dimension (F=3.950, gl3, p<.012): Master's degree ($\bar{x}$=4.40, σ=1.506), PhD ($\bar{x}$=5.85, σ=.944), Bachelor's degree ($\bar{x}$=6.00, σ=.944) and Bachelor's degree ($\bar{x}$=5.43, σ=1.090). The largest significant difference was between those with Bachelor's education ($\bar{x}$=6.00, σ=.944) and Bachelor's ($\bar{x}$=5.43, σ=1.090) with a significant difference (F=12.298, 3gl, p<.012).

Figure 2 shows graphically that the maximum pole (+3 “very pleasant”) in the pleasant consideration of the app is the stimulation dimension followed by controllability and novelty. It is followed by the consideration of “quite pleasant” (+2) where attraction occupies a relevant role followed equally by controllability and novelty. “Somewhat pleasant” (+1) is rated by those who emphasize attraction in the app, then controllability, followed by stimulation and finally novelty.

Note that average scores somewhat outstanding can only be mentioned novelty and the values of the negative poles in the proposed adjectives is very minority..

Figure 2

Gradation in the evaluation of the adjectives (-3 to +3) organized in the four dimensions that obtained significant values



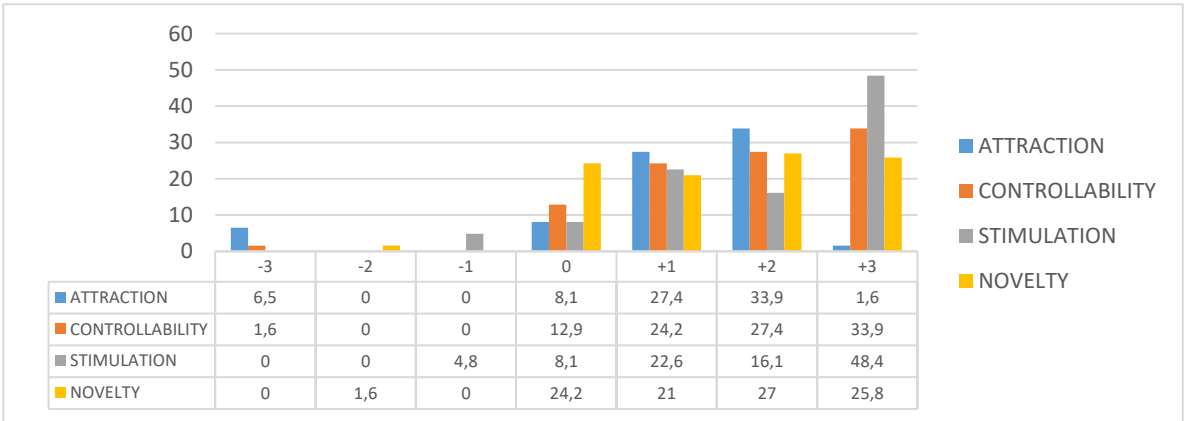
However, there were significant differences about the age of the subjects in three dimensions: attraction (F=5.126, 3gl, p<.003), efficiency (F=2.966, 3gl, p<.039) and stimulation (F=4.836, 3gl, p<.005). Likewise, significant differences were found to the academic degree of the sample in the controllability dimension (F=3.950, gl3, p<.012).

Figure 3 shows graphically that the stimulation, controllability and novelty dimensions are located at the maximum pole (+3 “very pleasant”) of the educational app. It is followed by the gradient “quite pleasant” (+2) where attraction occupies a relevant role followed equally by the controllability and novelty dimensions. Subjects rated “somewhat pleasant” (+1) the educational app dimensions attraction, followed by controllability, stimulation and novelty.

Note that the novelty dimension obtains the mean scores somewhat prominent in the pleasantness scalar gradients, while the adjectives located in the unpleasantness scalar values are very little perceptible.

Figure 3

Gradation in the evaluation of the adjectives (-3 to +3) organized in the four dimensions that obtain significant values



	-3	-2	-1	0	+1	+2	+3
ATTRACTION	6,5	0	0	8,1	27,4	33,9	1,6
CONTROLLABILITY	1,6	0	0	12,9	24,2	27,4	33,9
STIMULATION	0	0	4,8	8,1	22,6	16,1	48,4
NOVELTY	0	1,6	0	24,2	21	27	25,8

4. Discussion

The evaluative objective of the educational app was to ascertain the perceptions of family members and professionals targeting children ages 0-5 years focused on six dimensions (attractiveness, transparency, efficiency, etc.) measured through CEU.

The findings of this research problem indicated that the age of family members and professionals made a powerful difference in the attractiveness, efficiency and stimulation dimensions of CEU, while academic degree only did so in the controllability dimension.

Attraction was not a unidimensional concept, because it described the intensity of a sensory reaction, alluded to the moral and ethical evaluation of something, focused on the physical and emotional sensation experienced by the subjects, on the aesthetic perception of the educational app and on the possibility of connecting with someone through it. In this dimension, there was a significant difference between the 18-29 and 30-39 groups, with a higher mean in the case of the 18-29 group, reflecting the fact that the younger the age, the more attractive the educational app was considered to be.

Efficiency was the ability to achieve a given objective with the minimum possible resources and time. It also indicated a balance between theory and practice, and was related to the organization and structure of a process. In the efficiency dimension, the 18-29 age group shows a significant difference with the 30-39 group. The younger group emphasizes the efficiency of the educational app.

Stimulation, caused by relevance, intensity and motivation, was the ability of an incitement (in this case the educational app) to capture attention, arouse interest and generate a response in a sample subject. In this dimension, significant differences were obtained by age, with the greatest significant difference being with the 18-29 age group. Again, the younger group found the educational app stimulating.

There were significant differences between subjects with different academic degrees in the controllability dimension. Thus, graduates perceived greater controllability in the educational app than subjects with a bachelor's degree.

The educational app offered something different and fresh with an efficient, safe and easy to understand and use operation. The attraction dimension showed that it was suggestive, comfortable, appealing, good and pleasant. On the other hand, it was rated somewhere between nice/antipathetic and a small percentage of subjects found it not very novel.

The evaluation of the educational app provides contributions regarding the educational technology contained in the OER manual and, specifically, the future design of digital personalization of smartphones for use by parents, caregivers, educators, and health professionals. First, it focuses on convergences of the educational app. What views were shared by family members and professionals? Considering the sample by gender, they responded with the same perceptions in all dimensions. Classified by academic level, their perceptions were the same in all dimensions, except controllability, and ordered by age, they had analogous perceptions in transparency, controllability and novelty.

The main difference between subjects occurred for reasons of age and academic level. Understanding these convergences and divergences between family members and professionals, as Kucirkova & Flewitt (2020, p. 146) did, is crucial for the development of successful strategies for the implementation of the educational app in initial teacher training and in early childhood education teacher development. This had been suggested by researchers in other contexts (Dunst, 2019), and so could be implemented in cultural and educational contexts analogous to Tenerife.

4.1. Limitations and implications

The results should be interpreted with some caution for several reasons. First, family members and professionals evaluated an educational app with a semantic differential that they were unfamiliar with and may have been reluctant because it was the first time they met with a researcher, as Goh et al. (2015, p. 794) mentioned in their study; second, the dimensions of the semantic differential included elements that should have been rationally and empirically justified; third, the educational app was a technological tool based on OER evidence that encompassed areas of child development, (communication, motor, social-emotional development, etc.); however, the semantic differential did not identify possible delays in child development in key areas that would allow for early and effective intervention, as was the case with the ASQ (Ages & Stages Questionnaires, third edition) by Squires & Bricker (2009). And third, the accessibility of the app for parents and trainers was not ideal, because telepractice involves the use of technologies such as video calls, interactive platforms or applications to provide educational, therapeutic or training services at a distance.

Technological implications applied to early childhood care: Design and usability. The educational app needs an urgent renovation in its visual design and usability. Priority should be given to the creation of an attractive, intuitive and user-friendly interface. Emotional connection. An emotional connection must be created with the users. This can be achieved through a friendly language, an attractive interface and a focus on users' needs and preferences. Security. Addressing the perception of insecurity is critical. Robust security measures should be implemented and clearly communicate to users how their data is protected. Leverage strengths. Capitalize on the positive perception of stimulation and novelty. You can continue to innovate and offer interesting and valuable content to keep users motivated and engaged.

5. Conclusions

The results obtained have led to the following conclusions linked to the initial questions:

First, creation of the REA manual that summarizes early intervention practices that improve child development outcomes.

Second, OER has incorporated child development assessment tools and intervention exercises for children.

Third, an educational app has facilitated access to OER.

Finally, family and professional perceptions of the educational app on child development between 0 and 5 years of age have been tested.

Author contributions
Conceptualisation, V.A.-L.M.; Data curation, V.A.-L.M., A.R.-O.M.; Formal analysis, V.A.-L.M., A.R.-O.M.; Investigation, V.A.-L.M., A.R.-O.M.; Methodology, A.R.-O.M.; Project administration, A.R.-O.M.; Supervision, V.A.-L.M., A.R.-O.M.; Validation, V.A.-L.M., A.R.-O.M.; Writing—original draft, V.A.-L.M., A.R.-O.M.; Writing—review and editing, V.A.-L.M., A.R.-O.M.

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Data Availability Statement
The data set used in this study is available at reasonable request to the corresponding author

Ethics approval
Not aplicable

Consent for publication
The author has consented to the publication of the results obtained by means of the corresponding consent forms.

Conflicts of interest
The author declares that they have no conflict of interest

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