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# Safe and inclusive educational apps: Digital protection from an ethical and critical perspective

## Aplicaciones educativas seguras e inclusivas: La protección digital desde una perspectiva ética y crítica

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## ABSTRACT

The mediated use of technology fosters learning from early childhood and is a potential resource for inclusive education. Nevertheless, the huge range of options and exposure to interactive digital content, which is often online, also implies a series of risks. The definition of protection underlying the current strategies to protect children is inadequate as it only extends to reducing children's exposure to harmful content. This study proposes the expansion of this definition. Through systematic observation of 200 apps within the Catalan sphere for children under 8 years of age and principal component analysis, the results support a multidimensional conceptualisation of protection which, instead of being restricted to the potential risks, also considers aspects related to the educational and inclusive potential of digital resources. Five factors are suggested in order to select these resources and contribute to the digital competence of teachers and students. The first factor concerns the use of protection mechanisms and the existence of external interference, the second factor indicates the presence of adaptation tools; the exposure to stereotypes corresponds to the third factor and the last two consider the previous knowledge required and the verbal component of the apps. Finally, the scope of the suggested definition and its limitations as a guide for future analysis will be discussed.

## RESUMEN

El uso mediado de la tecnología fomenta el aprendizaje desde la infancia y representa un potencial recurso para la educación inclusiva. Al mismo tiempo, la creciente exposición a contenidos digitales interactivos, a menudo conectados a la red, conlleva una serie de riesgos para los niños. A las estrategias actualmente empleadas para protegerlos, que se limitan a reducir su exposición a contenidos perjudiciales, parece subyacer una definición de protección inadecuada. Esta investigación propone que se amplíe esta definición. A través de una observación sistemática de 200 apps para menores de ocho años en el ámbito catalán y un análisis de componentes principales, se propone una definición multidimensional de protección que no se limita a detallar los riesgos potenciales, sino que también considera aspectos relacionados con el potencial educativo e inclusivo de los recursos digitales. Se sugieren cinco factores a considerar para seleccionar estos recursos y contribuir a la competencia digital de docentes y alumnos. El primer factor concierne al uso de mecanismos de protección y la existencia de interferencias externas; el segundo factor indica la presencia de herramientas de adaptación; la exposición a estereotipos corresponde al tercer factor y los últimos dos consideran los conocimientos previos requeridos y el componente verbal de las apps. Finalmente se discute el alcance de la definición propuesta y sus limitaciones para guiar análisis futuros.

## KEYWORDS | PALABRAS CLAVE

Children, educational technology, apps, safety, inclusive education, content analysis, protection of minors, cybersafety, digital competence.

Niños, tecnología educativa, apps, seguridad, educación inclusiva, análisis de contenido, protección de menores, ciberseguridad, competencia digital.

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## 1. Introduction

Data from the report "EU Kids online" (Livingstone, 2014) and Nielsen Group (2012) relating to the adoption of technologies by children and young people in Europe shows they connect to the internet on a daily basis, using various devices (mobile phones in particular), and at an increasingly young age. This trend has continued to date.

According to the OFCom report (2017), 65% of children aged between 3 and 4 and 75% of those aged between 5 and 7 years old use tablets on a daily basis in the UK, and 23% in the age range 3 to 4 and 47% of those aged 5 to 7 use smartphones. The Common Sense Census corroborates these data (Rideout, 2017). At the same time, the number of apps for pre-school age children has increased considerably (the Apple Store alone has over 80,000 apps for children, in line with the growing demand for digital tools from educators and families that can help children to learn, play and entertain themselves (Troseth, Russo, & Strouse, 2016). The contextual framework for this research focuses on the Catalan sphere, which has registered exponential growth in its digital games industry since 2012, as noted in the report "Llibre blanc de la indústria catalana del videojoc" (Desarrollo Español de Videojuegos, 2016).

The possible benefits for learning processes that may derive from digital games in general, and for children in particular, is one of the most extensively debated issues in the literature. In fact, the learning potential offered by interactive digital resources is widely supported (Herodotou, 2017; Flewitt, Messer, & Kucirkova, 2015; Kirkorian & Pempek, 2013), although children's exposure to potentially harmful online content generates controversy. In this regard, the European Commission (2006) identifies three macro-categories of risks for underage users: risks related to getting in touch with strangers (cyber-bullying, grooming and sexting), rather than exposure and access to different kinds of inappropriate and harmful content (for instance pornography or violence), or privacy risks (for example, services that use geo-localization).

Lievens (2015) also notes the existence of three types of online risks for children: those related to content, in which the child is a recipient; risks relating to contact, in which they are proactive participants; and behavioural risks, in which the child is an actor who breaches certain behavioural rules (e.g. making purchases or downloading illegal content). This type of classification makes clear the complexity of the phenomenon as well as the different types of threat children face online and offline, implying that new measures for prevention and protection need to be found.

With this objective in mind, the European Union report establishing a "European framework for the digital competence of educators" (Redecker, 2017) stresses that safety measures cannot be limited to setting up external barriers (preventing access to potentially harmful content, for instance). Instead, the priority should be to empower learners to identify and manage risks autonomously. Following the conclusions of Livingstone, Mascheroni and Staksrud (2015), an educator's role as a mediator is a key factor in limiting the potential risks associated with the use of technologies in online settings. However, the ability to select the most suitable devices and content "should not be taken for granted" (Felini, 2015: 114).

Scholars generally agree that the gatekeepers of children's technology use need support (in terms of information or training) to perform this selection and to understand the risks associated with the use of mobile devices (European Commission, 2015; De Haan, Van-der-Hof, Bekkers, & Pijpers, 2013). At the same time, however, they stress the need for a structural change that could redefine educators' skills within the framework of a more general process of pedagogical innovation (Howard, Yang, Ma, Maton, & Rennie, 2018; Redecker, 2017; Suárez-Guerrero, Lloret-Catalá, & Mengual-Andrés, 2016).

On the other hand, initiatives such as the International Age Rating Coalition (IARC) have attempted to enable parents and educators to select digital resources by classifying digital content for suitable age groups. IARC is used worldwide and is currently the system adopted to classify all apps in the Windows Store for PCs, tablets and smartphones. It has the added value of allowing the target age to be identified using an ad hoc classification for each country, such as the Pan European Game Information (PEGI) system in Europe, which was formerly used to classify audiovisual and console video games by age. PEGI classifies content according to five age groups: 3, 7, 12, 16 and 18. To determine the classifications it uses a residual definition, meaning the product is considered suitable for all ages (PEGI 3) or for children aged 7 or above (PEGI 7) if it does not include the following disturbing elements: violence, bad language, horror,

or anything that may be frightening, explicit references to drugs and/or sex, discrimination, gambling or betting, or online gaming with other people. Indeed, developers of games targeting children under 8 years old do not tend to include explicit scenes of violence or the other elements mentioned, but it does not necessarily follow that all video games devoid of this type of content will have been developed with children in mind.

The limited classification criteria may explain why, according to the PEGI report (2013), 58% of the total 25,387 content items classified using the PEGI system between 2003 and 2015 were deemed to be PEGI 3 or PEGI 7; in other words, suitable for children. Similarly, the "Anuario de la industria del videojuego" (AEVI, 2013) highlights the fact that over half the 20 best-selling videogames are classified as suitable for PEGI 3 (for all audiences) or PEGI 7. These data underscore the limited ability of the current definition of protection to engender the reality of the risks children face, for instance, the risk of exclusion or exposure to more normalised but no less harmful content (such as stereotypes related to ethnicity or gender).

The limitations that affect the current attempts at regulation derive from a definition of "protection" which falls short for two reasons, the first being that the definition is merely residual (i.e. the absence of certain threats deems the content to be appropriate), whilst the second is that it does not take into account the suitability of the apps' characteristics for the target audience, infringing children's right to participation in and access to Information and Communication Technologies (ICT) as laid down by the United Nations under the Convention on the Rights of the Child (Assembly of the United Nations, 1989) and the Convention on the Rights of Persons with Disabilities (Assembly of the United Nations, 2006). For instance, it has been proven that digital games can increase social skills (e.g. self-concept, self-efficacy, awareness of emotions, etc.) and communicative skills in children with autistic spectrum disorder (ASD) (Hourcade & al., 2013; Gay & Leijdekkers, 2014) and with Down's syndrome (Porter, 2018; Yussof & al., 2016). However, to fully take advantage of these possible benefits, teachers need to know which digital resources are most suited to students and how to guarantee the safe use of technology during the learning process (Soler, López-Sánchez, & Lacave, 2018).

The current definition of protection circumscribes the task of prevention to reducing the potential risks and children's exposure to harmful content, thus situating the child-player as a mere object of protection.

The first step is to agree on a definition, which will depend on the role attributed to child players. In the author's view, the current definition of protection circumscribes the task of prevention to reducing the potential risks and children's exposure to harmful content, thus situating the child-player as a mere object of protection. In contrast, initiatives such as the Better Internet for Kids campaign by the European Commission (2012) place particular emphasis on the need to promote activities to empower children from an early age in order to foster their engagement in the digital world. And teachers play a key role in this regard.

Taking into account these limitations, this research defends a broader conceptualisation of child protection in line with that established by BinDhim and Trevena (2015), encompassing both the absence of threats and accessibility. From this perspective, the research is grounded on the paradigm of Universal Design for ICT, envisaging accessible design that can adapt to all boys and girls, both with normal development and special educational needs (Holt, Moore, & Beckett, 2014; Sobel, O'Leary, & Kientz, 2015; Odom, & Diamond, 1998). The research aims to offer a new and more critical and ethical perspective on the concept of protection related to underage users. To explore the theoretical-empirical consistency of this definition, and to establish which aspects teachers should take into account when selecting educational digital tools, we conducted a content analysis and principal component analysis, that are explained below.

## 2. Instruments and method

### 2.1. Sample and features of the selected apps

The sample was limited to apps targeting children under 8 years old (apps classified as PEGI 3 and PEGI 7 and/or 4+ in the Apple Store), due to the scarcity of studies focusing on early childhood and the need to consider the specific features of child development during the first few years of life.

Apps were selected using a search engine (Google Search) and two databases (Apple Store and Google Play Store) and based upon two inclusion criteria: 1) the app should be aimed at children from 0 to 7 years old following the explicit statement of the developer or, if this information was not available, by the distributors; 2) the app developer should be based in Catalonia and/or at least one version of the app should be in Catalan (see Acknowledgments).

To ensure a heterogeneous sample, simple random sampling was used to exclude apps by the same developers with the same programming and visual engine but different content (for example: colouring in princesses, colouring in cars, colouring in animals). Using these criteria, the final sample included 200 apps in Catalan or developed in Catalonia aimed at children under 8 years old.

The apps analysed were created by 87 different developers and were all launched between 2011 and 2017. Due to the geographic focus of the research, 80% of the apps in the sample were developed in Spain (149 in Catalonia and 11 outside this region). 47% of the sample works on more than one operating system and 34.5% (n=69) are completely free. Of the paid-for apps, 36 cost less than €3, 15 between €3 and €10 and 3 between €10 and €30.

### 2.2. Analytical approach

The methodology used in the research was content analysis through structured observation, which is usually used in the study of digital and interactive applications for children (Amy, Alisa, & Andrea, 2002; Bruckman & Bandlow, 2002). The methodological framework of the project is the post-positivist research paradigm (Creswell, 2008). The observation sheet used to perform the content analysis was composed of a total of twenty variables, of which six were descriptive and dichotomous and aimed at identifying some basic features of the apps, such as: a) whether the app is aimed at a group with special educational needs; b) whether the responses adapt to the user; c) whether it includes the option to select different levels of difficulty; d) whether it can be used offline; e) whether it can be used by multiple players; and finally, f) whether it uses geolocation systems.

Table 1 shows the other variables —also dichotomous (presence=1 / absence=0) used for the operationalization of the "child protection" construct, considering the safe use of digital content and its accessibility.

**Table 1. Dichotomous variables observed and their average value in the sample (n=200)**

| Variables | Mean |
|---|---|
| Absence of information for parents and/or educators | 0.64 |
| Absence of barriers to block external links or purchases | 0.47 |
| Invasive content (does not interrupt interaction, can be removed) | 0.21 |
| Invasive content (does not interrupt interaction, cannot be removed) | 0.13 |
| Non-invasive content (does not appear during the game) | 0.29 |
| Gender stereotypes | 0.20 |
| Ethnic stereotypes | 0.06 |
| Absence of visual adaptation tools | 0.94 |
| Absence of auditory adaptation tools | 0.91 |
| Absence of reduced mobility adaptation tools | 0.86 |
| On-screen verbal feedback | 0.26 |
| Verbal messages required to play | 0.20 |
| Scenario and elements can be recognised from 12 years old | 0.05 |
| Text is required to play | 0.50 |

The conceptualization of the variables in the previous table is generally self-explanatory (presence or absence of certain technical features or design characteristics). Ethnic stereotypes, however, were defined as the set of qualities or behaviours that are attributed in a generalized way to a culture, or to a person, according to their origin.

As defined by Cusack (2013: 17), "'gender stereotyping' is the practice of ascribing to an individual man or woman specific attributes, characteristics or roles by reason only of her or his membership in the social group of men or women".

As regards the procedure, a researcher carried out observation of the 200 apps in the sample in the last quarter of 2017 using an iPad and a Samsung Galaxy tablet. The observation protocol of each app involved an initial 10-minute interaction with the game, after which the researcher started coding the information using an Excel sheet. During the coding process the researcher was free to return to the app as necessary and with no time restrictions until the analysis form was complete.

Nine experts, six women and three men, validated the observation sheet (content validity by expert judgments): five professors (three from the area of education technology and two from special and inclusive education); a full professor in education and mother of two children under eight, one of them with Down's syndrome; a children's app developer; a communication professional and father of three children under the age of 8; and a nursery school teacher with vast experience in educational inclusion and pre-schoolers with functional diversity. Two researchers conducted a pilot test, independently observing the same three apps, which were not included in the final sample.

Table 2 shows the results of the inter-rater reliability measure for the three apps, which show a very good level of agreement (Landis & Koch, 1977).

**Table 2. Inter-rater reliability measure calculated using Cohen's Kappa coefficient**

| Symmetric Measures | | | | |
|---|---|---|---|---|
| **Measure of agreement** | **Value** | **Asymp Standard error** | **Approx. T** | **Approx. Sig** |
| Kappa (app1) | .857 | .027 | 18.647 | .000 |
| Kappa (app2) | .778 | .033 | 16.876 | .000 |
| Kappa (app3) | .759 | .034 | 16.618 | .000 |

An analysis of the observed frequencies and contingency tables was chosen to describe the characteristics of the apps analysed. Following this, principal component analysis was conducted (hereinafter referred to as PCA) to observe the eigenvalues of each component. PCA was performed using the Varimax orthogonal rotation method. Descriptive and inferential statistical analysis was performed using statistics software IBM SPSS Statistics.

## 3. Results

### 3.1. Description of the sample of 200 apps

In terms of the target age group, it is notable that in 126 cases the developer does not state the group the app is designed for, and in 9 the app is stated as suitable for all ages. In other words, 67.5% of the apps do not include any precise instructions from the developers with regard to the target age group. 163 of the apps can be used offline (81.5%), 27 can be used offline without access to all content (13.5%) and 10 cannot be used offline (5%). When it comes to privacy, the presence and use of geolocation systems was considered, but was only recorded in 2 apps.

To stimulate collaborative and inclusive peer-to-peer play, apps need to allow games to be played by more than one user. However, 177 apps (88.5%) are designed for a single player. Only 13 apps are explicitly aimed at a particular group (children with ASD, Down's syndrome, attention deficit disorder, attention deficit hyperactivity disorder or other learning disorders). In 9 cases (3 in apps for children with ASD) the apps are adaptive (4.5%) —in other words, the user's response determines the difficulty of the game— whereas 73 apps include the option to choose different levels of difficulty (36.5%).

### 3.2. Adequacy with the protection and safety assumptions for children under eight years' old

A descriptive analysis was carried out of the characteristics of the apps according to the definition of child protection used in this research, encompassing both the idea of safety in the strict sense and elements related to access in the design and content of apps for children. 35% of the sample provides information for parents and/or educators in the application itself, and 1.5% provides a link via an external website. In other words, only 36.5% contain information for parents and educators.

Barriers to block children from accessing external links or purchases during the game are incorporated in 57 apps (28.5%). Considering they are not necessary in another 49 cases (24.5%), 47% of the sample does not comply with the requirement to prevent access (involuntary or conscious) to external links or purchases by children. Likewise, only 40.5% of the apps analysed are free from external interference, with most exhibiting at least one of the following features:

- Invasive advertisements or messages that interrupt the interaction (n=7; 3.5% of the sample).
- Invasive advertisements or messages that, despite not interrupting the interaction, cannot be removed (n=25; 12.5%);
- Invasive advertisements or messages that do not interrupt the interaction but can be removed, for example by clicking on the "x" symbol to close the window (n=41; 20.5%);
- Non-invasive advertisements or messages that do not appear during the game (n=58; 29%).

As expected, none of the content covered by PEGI was found, although gender stereotypes were found in 39 cases (19.5%), and ethnic stereotypes in 11 cases (5.5%). In terms of aspects related to accessibility, three different dimensions were considered: the range of strategies or mechanisms for visual, auditory and motor adaptation. Visual adaptation tools were only found in 13 apps (6.5%). From these, only 3 apps allow identification, inversion or adaptation of colours, 7 allow text size to be changed, 6 the screen or element size to be changed and 2 have a voice-over. Similar data was recorded with the visual adaptation tools (only 13 apps analysed included these) and auditory adaptation tools (19 apps).

Finally, tools to adapt to reduced physical and motor skills were found in 28 cases (14%). The sample therefore has serious shortcomings in terms of accessibility, especially if we consider that none of the apps analysed allow the keyboard to be adapted or the use of external devices for reduced mobility. Only two apps recognise drawing on the screen and two allow the use of alternative gestures as a different mode of interacting with the screen and achieving the goal of the game (i.e. tap instead of drag).

Approximately half the sample (109 apps, 54.5%) does not include verbal messages. In 40 apps (20%) verbal messages are essential to play, which presents both cognitive and communicative adaptation problems for some groups with special educational needs. Conversely, feedback on the game screen is verbal in 25.5% of the cases analysed. In relation to the adequacy for the target, text was identified as necessary to play in 99 apps (49.5%).

Exclusively taking into account the 70 apps explicitly aimed at children aged 6 or under (at pre-school age reading and writing skills are not usually developed), text is necessary to be able to play in over half (n=37; 53%). Bearing in mind that the study focuses on children aged between 0 and 8 years old, this could be interpreted as an indicator of the game developers' poor understanding of the target group. Scenarios and elements that could only be recognised by children over 12 years old were also observed (10.5%).

### 3.3. Reduction of dimensions

The PCA included variables associated with the idea of protection (Table 3), with the exception of one variable present in very few cases ("Invasive advertisements or message that interrupt the interaction", n=7). The descriptive variables were not considered, because in themselves they do not constitute a problem of accessibility or safety for underage users. As already mentioned, the variables used in the PCA are dichotomous, their presence (1) or absence (0) being recorded during observation. The PCA allowed us to extract five components with values over the Kaiser criterion of 1. The five components together explained 60.4% of the variance. The Kaiser-Meyer-Olkin measure for sampling adequacy is 0.663, above the commonly recommended value of 0.6 (Kaiser & Rice, 1974), and Bartlett's sphericity test is significant, $x2\ (91)=488.758$, $p<.001$, which indicates that the correlations between the variables are high enough to justify the PCA.

| Table 3. Rotated component matrix | | | | | |
|---|---|---|---|---|---|
| | C1 | C2 | C3 | C4 | C5 |
| Absence of barriers to block external links or purchases | .781 | .074 | .047 | .137 | -.057 |
| Invasive content (does not interrupt interaction, can be removed) | .755 | .056 | .165 | -.108 | .045 |
| Non-invasive content (does not appear during the game) | .665 | .093 | .085 | .102 | .333 |
| Invasive content (does not interrupt interaction, cannot be removed) | .656 | .069 | .034 | .008 | -.057 |
| Absence of information for parents and/or educators | .592 | .081 | -.155 | -.150 | -.276 |
| Absence of auditory adaptation tools | .137 | .807 | .054 | -.083 | -.129 |
| Absence of visual adaptation tools | .025 | .776 | .084 | .239 | .077 |
| Absence of reduced mobility adaptation tools | .108 | .758 | -.006 | -.166 | -.071 |
| Ethnic stereotypes | .067 | -.002 | .847 | .053 | -.092 |
| Gender stereotypes | .075 | .108 | .818 | -.039 | .055 |
| Scenario and elements can be recognised from 12 years old | .122 | -.074 | -.053 | .802 | -.093 |
| Text is required to play | -.072 | .027 | .051 | .647 | .061 |
| On-screen verbal feedback | .081 | .042 | -.038 | -.172 | .812 |
| Verbal messages required to play | -.181 | -.291 | -.023 | .235 | .556 |
| Total of the explained variance | 20.8% | 12.3% | 10.2% | 8.9% | 8.2% |
| Composite Reliability (CR) | 0.82 | 0.82 | 0.82 | 0.69 | 0.64 |
| Average Variance Extracted (AVE) | 0.48 | 0.61 | 0.69 | 0.53 | 0.48 |

The reliability of the constructs was measured with the composite reliability index (CR) (Bagozzi & Yi, 1988) and the average variance extracted (AVE) (Fornell & Larcker, 1981). The values for each of the components extracted are summarised in the last two rows of Table 3. Both indices are above or approaching their respective cut-off values (CR>.60 and AVE>.50) for all five components. A cut-off value of $\lambda$=0.5 was established in order to make a decision about the number of variables to retain for each component. All the variables contained in the five components showed positive factorial loadings (in other words, the variables showed positive correlation with the respective latent component).

The first component, the "Security dimension", accounts for 20.8% of the total variance and brings together items associated with insufficient prevision of protection mechanisms on one hand, and the existence of external interference, on the other. The absence of barriers to block external links or purchases is the aspect that contributes most to the first component in terms of factorial load ($\lambda$=0.781), followed by the presence of invasive advertisements or messages that, although they do not interrupt the action, may represent a negative interference, especially considering the age of the users. These invasive advertisements and/or messages have different characteristics, as they may sometimes be removed by the user ($\lambda$=0.755), whilst others do not appear during the game ($\lambda$=0.665) or simply cannot be removed ($\lambda$=0.656). Lastly, this component encompasses an aspect related to the absence of information for parents/educators ($\lambda$=0.592).

The second component accounts for 12.3% of the total variance. It was labelled "Adaptation tools" and identifies variables associated with the presence (or in this case lack of) strategies and mechanisms that favour inclusive use of the app. Specifically, the second component establishes a connection between three aspects: the absence of auditory adaptation tools ($\lambda$=0.807), visual adaptation tools ($\lambda$=0.776), and reduced physical and motor skills adaptation tools ($\lambda$=0.758). The third component ("Exposure to stereotypes") accounts for 10.2% of the total variance. In this case, reference is made to ethnic stereotypes ($\lambda$=0.847) or gender stereotypes ($\lambda$=0.818).

The fourth and fifth components account for 8.9% and 8.2% of the total variance and are "Prior knowledge" and "Verbal component", respectively. Both identify issues with adequacy. The first makes special reference to textual barriers –text is required to play ($\lambda$=0.647)– associated with the user's ability to recognise the scenario and elements from 12 years old onwards ($\lambda$=0.802). Verbal barriers themselves are identified in component five: either the feedback is verbal on the game screen ($\lambda$=0.812) or verbal messages are necessary to play ($\lambda$=0.556).

In sum, the outputs derived from the PCA suggest that in the case under analysis focusing on apps in the Catalan language or developed in Catalonia, the traditional definition of protection (identified by the first component) contributes to 34.4% of the total variance explained (20.8/60.4*100). On the other hand, roughly two thirds of the variance explained (the remaining 65.6%) is accountable to an idea of

child protection encompassing aspects related to accessibility (adaptation tools, users' prior knowledge and auditory skills) and inclusiveness (absence of stereotypes).

## 4. Discussion and conclusions

The spread of digital technologies, the growing use of mobile devices in childhood and their progressive introduction into the classroom, implies a challenge for teachers, new knowledge and digital skills. Child protection in the digital environment is a complex issue that should be approached in a more comprehensive way than it is at present. In this sense, children's right to participation and accessibility from early childhood justifies our proposal for a more critical and ethical definition of protection; one that is not limited to preventing threats but that takes into account other aspects such as universal design and the accessibility of apps for young children.

The results suggest an invitation to teachers and educators in general to consider at least 5 aspects related to the design and development of educational digital tools (in this case, apps) that contribute to this updated definition of protection:

1) App mechanisms and strategies that could help to increase "safety" in its most traditional conceptualization and that include:

- Barriers to connecting to the internet and the absence of external interference accountable for the risks associated with being online (contact with strangers and the violation of privacy, and the use of geolocation).
- Information provided by the app (or not provided in 63.5% of the sample analysed) and aimed at parents and educators should ideally inform them of the game's educational and recreational potential and warn of any potential risks. This information would empower educators as well as increasing their feelings of safety thanks to their perception of being able to control the risk factors.

2) Exposure and access to unsuitable or harmful content within the app itself has an undesirable effect in the mid and long term. None of the content "screened" by current age classification systems used for apps for children was observed during the analysis (explicit scenes involving sex, drugs, violence, etc). This notwithstanding, rather than stressing the ability of the PEGI system to classify apps for underage users, these results reveal its limitations in detecting other risks users may be exposed to (discrimination, exclusion, etc.), such as "exposure to stereotypes" (Component 3) relating to both gender and ethnicity;

3) Integration of visual, auditory and reduced physical or motor skills "adaptation tools" (Component 2) which protect the right to accessibility and participation for all children, within the framework of universal design and inclusive education;

4) Adaptation of the interactive content and design for the target group, considering children's "prior knowledge" (Component 4). Despite the fact that the suitable age is often specified (as is the case with board games), the industry tendency to treat child users as a single undifferentiated target group is criticised. Reading and writing skills being essential to be able to play the game, an element found in the vast majority of the sample, is considered an accessibility issue (especially bearing in mind the audiovisual potential of interactive games);

5) Finally, the verbal component of the app should be considered (Component 5). This aspect ends up being a hindrance for children with normal development (who are learning to speak and/or are not familiar with the language), or those with special educational needs (deafness or hypoacusia, auditory memory and processing disabilities, ADHD and other learning difficulties), as in many apps it is the only way to access information.

Our proposal aims to contribute to the debate on the digital skills of teachers, but without suggesting that the set of characteristics observed is exhaustive. In addition, there were some limitations that affected the research; in terms of the instrument, it was not possible to measure its external validity as it was created specifically for the study. Additionally, from a methodology perspective, the single context and limited size of the sample prevent us from generalizing the results across the thousands of apps on the market for children under 8 years old. These limitations open up possibilities for future research to test this proposal in other contexts, with the objective of establishing guidelines to critically select resources that can guarantee

children's safety and ensure their right to participation.

Introducing digital competences into pedagogical practices in the classroom is not only up to teachers, but implies a structural change within educational institutions (Suárez-Guerrero, Lloret-Catalá & Mengual-Andrés, 2016; Howard, Yang, Ma, Maton, & Rennie, 2018). However, empowering teachers would at least produce a set of spill-over effects on students and the educational community at large. Becoming familiar with the different stages of designing, planning and implementing the use of digital technology is one of the priorities addressed by the "European framework for the digital competence of educators" (Redecker, 2017), with particular emphasis on an educational context in which, in the near future, teachers would not just select but would actually develop digital tools. To sum up, protecting children from an ethical and inclusive perspective means providing them with critical knowledge from pre-school onwards, to help them become fully integrated in the digital world.

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The research focuses on the specific case of the Catalan audiovisual market in compliance with the funding specification of the "Catalan Audiovisual Council", which supports studies on safety measures for underage users.

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