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Article

Quality model of recommender systems of applications for children and teenagers

Modelo de calidad de las plataformas de recomendación de aplicaciones infantiles y juveniles

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Abstract

Digital content for children and teenagers grows continuously, so recognizing the good quality ones is a complex task, since apps stores do not always provide complete information. In this context apps reviews arise, web sites dedicated to select, evaluate and review these products day by day. Not all of them offer the same quality information: this is why it is necessary to study and compare them. Based on these considerations, 25 recommenders are evaluated according to 27 different criteria, like the structure of the site, the information they provide and their visibility on social media. The evaluation shows which are the best recommenders according to the criteria established in the article.

Resumen

Los contenidos digitales para niños y jóvenes son un sector que crece de manera continua, por lo que reconocer la calidad de los mismos es una tarea compleja, ya que las tiendas de aplicaciones no siempre proporcionan información clara y completa. En este contexto nacen las plataformas de recomendación de aplicaciones, sitios web dedicados a seleccionar, evaluar y reseñar los productos que día a día aparecen. Como no todos ofrecen información de la misma calidad resulta necesario estudiarlos y compararlos. Partiendo de estas consideraciones en el trabajo se evalúan veinticinco recomendadores, en base a veintisiete indicadores agrupados según se refieran a la estructura del sitio web, la información que aportan sobre el contenido y la visibilidad que consiguen en las redes sociales. La evaluación realizada muestra cuáles son los mejores recomendadores según los indicadores establecidos en el artículo.

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Introduction

The development of mobile applications is making available certain unprecedented resources in the sphere of publications for children and teenagers; such resources were unprecedented in printed books and in the first e-books, and their presence is leading to transformations in the way we tell stories created to be read on a screen (Ruiz-Domínguez, 2014).

Applications or apps are specific software designed for mobile devices, smartphones and tablets. By using them, we can perform very different tasks related to various spheres -professional, recreational, educational, access to services, etc.-, facilitating tasks or activities that must be performed (Santiago, Trabaldo, Kamijo & Fernández, 2015), being reading one of them.

2018 marked the 10th anniversary of the app environment. Online stores opened to the public in 2008 offering contents for the most widely used operating systems, App Store for iOs and Google Play for Android (Shankland, 2008). Since then, the market has experienced an astounding growth: Google Play included about 2,567,752 applications in January 2019, whereas Appstore included almost 2 million applications in the third quarter of 2018, according to data offered by the Statista web portal (Statista, 2019).

Screens are a privileged medium to consume cultural, recreational and educational contents, and they also open a new market for contents for children and teenagers where valuable, useful contents for their development and growth can be found, as well as other contents of dubious quality.

Insofar as this industry is growing, it is essential to identify the most suitable materials for each target group, as well as to determine the nature and quality thereof. For this reason, providing impartial information, reliable recommendations and innovative tools for all the mediators involved in the world of children and young people should be one of the main objectives of those people who work with digital contents, helping the latter to leverage the potential that digital contents and technology can bring to the lives of children and teenagers; therefore, both parents and educators must provide children with applications that are suitable for the development of children (Grané-Oró & Crescenzi-Lanna, 2016).

Parents, teachers and librarians must be constantly updated in a rapidly changing digital world. They now need more than ever reliable guides that help them to explore a world where change is the only constant, as well as assistance in decision-making processes regarding the media, the types of works that make up the offer, the contents, values and innovating elements (Cencerrado-Malmierca, Pelosi, & Yuste-Tuero, 2018).

In order to meet this need, several search engines and recommender and guidance systems were created to make the app offer known and provide some guidance in selecting contents for families, schools and libraries.

These spaces are presented as an essential support at the service of all the stakeholders involved in the design, development, distribution and promotion of digital reading and emerge as valuable resources that allow mediators to stay abreast of the latest developments, facilitating their work. Most works selected are discovered in the social media, blogs, applications or online communities (Riaza, 2016).

A series of questions regarding such tools arise inevitably: what are the content selection criteria? What information is offered to mediators? Why are the criteria of application stores not enough to know those products that being purchased? What use of the media do these tools make?

Objectives and methodology

In order to answer all these questions, the objective of this article is to offer an overview of the recommender systems used to select applications for children and teenagers, to characterise them, analyse them and to propose a series of useful parameters for their evaluation, by studying their suitability and making a proposal of essential indicators that should be taken into account for any recommender system to be regarded as a high-quality system.

According to the objectives stated, a methodology that contains several individual stages was designed.

In first place, a bibliographic review in several databases (Dialnet, LISA, LISTA, ERIC, SCOPUS) was performed and Google Scholar, as well as in websites of authors, research groups and institutions, by retrieving the following terms: ‹‹applications››, ‹‹children››, ‹‹recommender systems›› y ‹‹recommenders››. The results of the bibliographic review allowed to realise that most studies fall into two categories: those that analyse the impact of these resources from a medical and psychological point of view and those that deal with apps as educational tools.

Nevertheless, there is a third minority group that proposes evaluation criteria for the applications, analysing the dynamics of these products within the framework of digital stores and analysing their potential in the context of digital reading. The studies that have been particularly relevant for this article belong to this third category. In first place, the work by García-Rodríguez & Gómez-Díaz (2016), which includes a section including app recommenders and Children's and Youth Literature blogs (LIJ, as per its Spanish acronym) in digital environments, an essential key to compile bibliography and select the first systems; in second place, the study conducted by Chen, Xu, Zhou & Zhu (2013), which analyses the criteria used by Google Play and App Store to evaluate the contents for children on sale, the study of Miller (2016), which includes specific directions to select applications aimed at teachers and librarians; in last place, the study conducted by Gómez-Díaz & García-Rodríguez (2018) on the selection of app books.

With regard to the websites used, the most relevant ones were the blog of Gemma Lluch (http://www.gemmalluch.com/esp/blog/), the website of the *GRETEL* research group (http://www.gretel.cat/es/), the reading promotion and digital literacy project *LiteracyApps* (http://www.readingrockets.org/literacyapps), promoted by the *National Literacy Trust,* the website of the *Common Sense Media* (2015) and *Fundamentally Children* organisation (https://www.fundamentallychildren.com), an organisation that provides advice of independent experts on games, toys, applications, technology, electronic security, child development, etc...

Those websites that were likely to be assessed were selected subsequently. In order for the evaluation results to be as representative as possible, several criteria were taken into account and included in the list, such as nationality, selecting recommenders from different countries and in different languages; dependency and funding modality (blogs, online stores, non-profit organisations, consulting services, etc.); variety of reviews and ratings, and vision of the administrator or target public. Finally, twenty-five of them were selected (table 1).

In order to define the variables or analysis, we took the following works as a starting point: Codina (2008), Ayuso-García & Martínez-Navarro (2006), Galina-Russell (2016), who evaluate the websites that allowed to define certain indicators such as authority, content updates, ergonomics and relevance for the target public; Ayuso-García & Martínez-Navarro (2006), García-Romero & Faba-Pérez (2015), who evaluate digital libraries; and Lluch's work (2018) on the characteristics of publishers' websites.

Table 1.
Recommender systems selected for evaluation

AppEnfant	ApplicaKids	AppTK
Appy Autism	Best Apps for Kids	Boolino
CommonSenseMedia	ContempoPlay	Déclic Kids- Digital Media for Kids
Digital Storytime	Frikids	Fundamentally Children
Generación APPS	Id Boox	KinderTown
La Souris Grise	Le Petite Bibliothèque Ronde- BibApps	Literacy Apps
Mamamo	Peque Tablet	Smart apps for kids
Super Julie- Le top de applis pour enfants	The App Date	Top Best Apps For Kids
Moms with apps		

Source: Prepared by the authors.

On the other hand, scholarly works that focus on the evaluation of applications, such as that conducted by Grané-Oró & Crescenzi-Lanna (2016) or García-Rodríguez & Gómez-Díaz (2015) were used, supplemented by observation and analysis of the information included in de various recommenders, totalling twenty-eight indicators divided into three large groups (figure 1).

The parameters and indicators selected are described below.

Authority

1: Author. Responsibility and identification of the website managers. It must be part of the compulsory evaluation requirements.

2: Objectives Information that allows to identify the website's mission, vision and objectives.

3: Communication. It is possible to contact the website managers. It must be part of the minimum evaluation requirements.

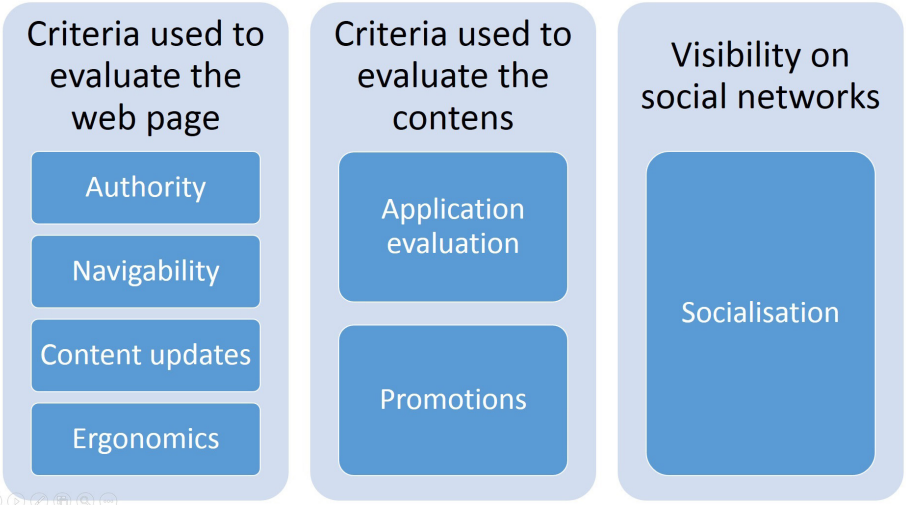

Figure 1. Parameters and criteria used to evaluate the recommenders.
Source: prepared by the authors.

4: Reputation. Prices, mentions and recognition received. This indicator enhances the reliability and validity given by the users, creating a network of relationships between recommenders, industry experts, institutions, etc.

Navigability

5: Navigation map. Graphic representation or description of the website's structure and its content. Important requirement, especially for websites with a large amount of contents.

6: Simple search system. Free or simple search tool without specifying the field searched. Essential requirement to make navigation easier.

7: Advanced search system. This tool offers options and limiters for a more accurate and refined search.

8: Search filters. This tool allows to filter and customise the search to get finer results of a search previously performed. This indicator is directly linked to information on the applications. They are analysed as subindicators: age, category, price, awards, operating system, subject and overall rating.

Content updates

9: Update. Periodical incorporation of new contents, modification and update thereof.

Suitability and quality of the contents

10: Target public. Identification of the category of users the website contents are aimed at. The "Adaptation and Appeal" indicator relies on this indicator.

11: Adaptation. The contents are appropriate for the target public in terms of complexity, interests, etc. The level of complexity, the existence of technical terms, the contents and the approach of the ratings are analysed in order to determine if they are appropriate for potential users.

12: Quality of texts. Orthographic correctness, vocabulary clarity and form friendliness. It is important to review five ratings at least in order to determine if the resources available match the indicator's definition.

13: Attraction. The contents must arouse the users' interest, offer useful information and allow them to determine if the applications suit their needs. It is important to perform an overall review of five ratings at least.

Ergonomics

14: Ease of navigation. Order and structure of the contents within the website for a fluid navigation. The layout and order of the contents are two factors that have an impact on the choices made by mediators. Clear, well-organised websites allow to focus on the contents to a greater extent.

15: User-friendliness. Set of aspects through which users can consult the contents in an easy, accessible and friendly way.

16: Icon identification The icons match the contents and suit the pictures used.

17: Clarity and contrast. Balance between text and background, pictures and text, pictures and background. This indicator is linked to the "Legibility" parameter.

18: Legibility. The typographic typefaces used must make reading easier with a suitable size and colour, indentations, etc.

Application evaluation

19: Description. Elements that are determined and basically make up the ratings. It is advisable to perform a review of five ratings at least in order to determine the elements that remain constant.

Subindicators: Title/App name, icon, developer, recommended age, link to store(s), language, operating system(s), image gallery, apptrailer, category, thematic tags.

20: Competences and skills. Ratings can include a section specifying the competences required to make a smart use of the application and the skills it enhances.

Subindicators: Competences required; Skills to develop.

21: Quality criteria. Valuation under the form of a text or rating that enables the reader to evaluate the quality of a specific app. It is necessary to perform a review of five ratings at least.
Subindicators: Overall rating/ Score, Rating (text).

Promotions

22: Product information. Additional information on facilities and offers to get applications.

Socialisation

23: Audiovisual platforms. Audiovisual platforms such as YouTube or Vimeo are used to disseminate the contents.

24: Image platforms. Image platforms such as Pinterest or Instagram are used to disseminate the contents.

25: Own social spaces. The website has its own social spaces.

26: Social media. The recommender interacts with users through "friendship" social media, such as Facebook or Google+.

27: Microblogging. The website interacts with users through microblogging platforms, such as Twitter.

28: Sharing. Spaces are available, where users can rate and share their opinions, and there are also buttons to share the contents directly through different social media.

The last step was information gathering, carried out between February 1st and 11th, using a Word template from which data were imported to an Excel sheet in order to create tables and graphs. Compliance with each indicator was checked during this process, without any weighing level.

Result analysis and discussion

Once the criteria were defined, they were applied to the systems selected. The results are outlined below.

Authority

This section explains that most recommenders have a section clarifying who is behind the contents, objectives and contact modality, but less than 50% include some kind of recognition or collaboration with experts or institutions (figure 2).

The data show that it is important to know the vision and the mission of the website when evaluating and selecting the applications, and that the potential users should be are aware of the evaluation objectives and criteria used directly.

As far as reputation is concerned, it would seem that this industry has not received specific recognition; nevertheless, there are some noteworthy cases, such as the Digital Storytime blog, which has created a network of websites devoted to app ratings and technology.

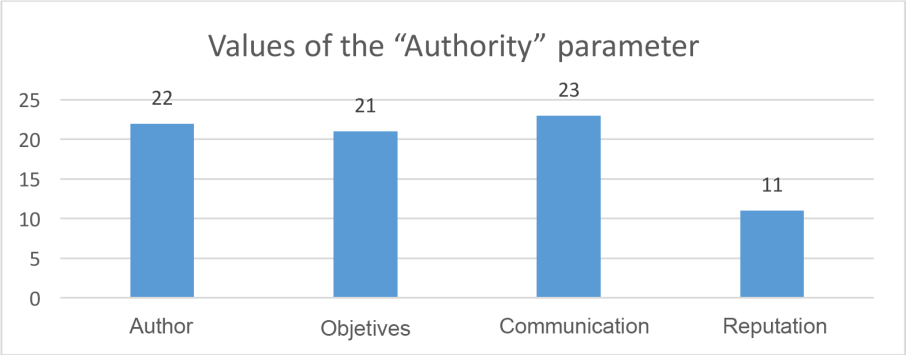

Figure 2. Values of the "Authority" parameter.

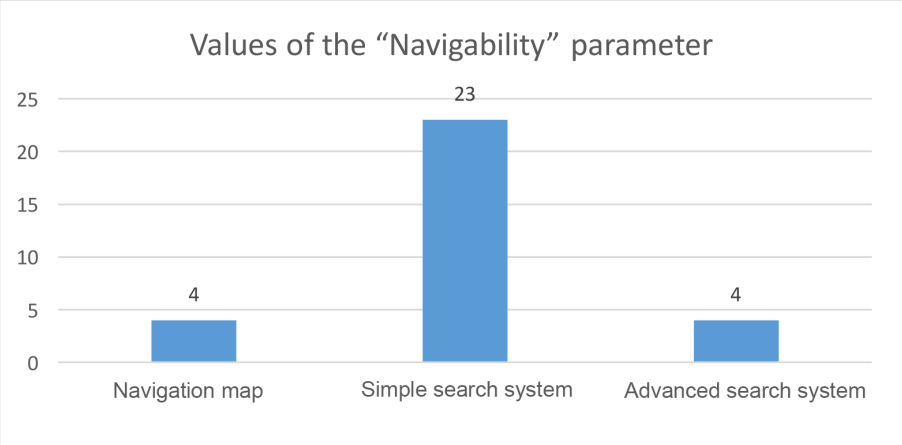

Figure 3. Values of the "Navigability" parameter.

Navigability

This parameter plays an important role in evaluation given the browser's function as an instrument that allows to find and select the most suitable applications to the users' interests (figure 3).

As far as the navigation map is concerned, only four webs include this feature. Although it may be striking *a priori*, it should be noted that its absence cannot be seen as a negative aspect as long as the contents are displayed in a simple, accessible way, and a large majority of the websites analysed are complying with this.

It is obvious that simple search prevails among search systems, while this tool is available in 25% of the advanced search systems, maybe due to the large number of titles included in their catalogue.

As far as search filters are concerned, age is the most widely used, which is logical if we take into account that most systems are aimed at adults who normally use this criterion when they make their purchases.

Subject and category are filters that are present in most websites: these search options

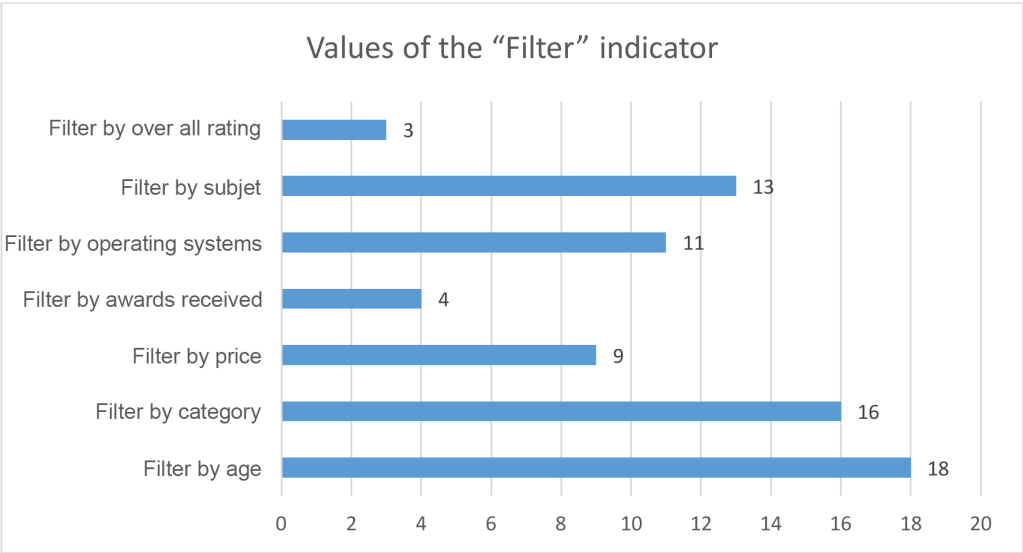

Figure 4. Values of the "Filter" indicator.

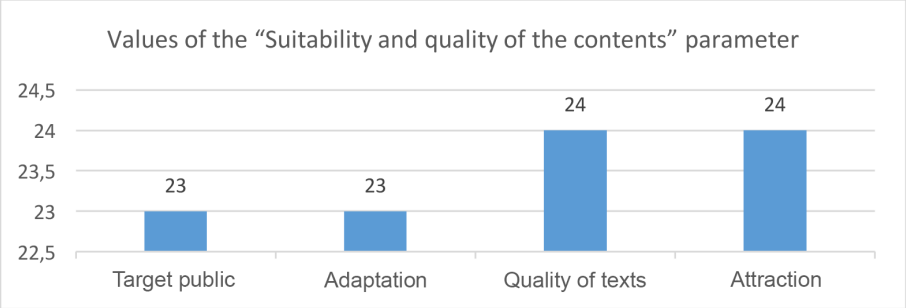

Figure 5. Values of the "Suitability and quality of the content" parameter.

should always be available, maybe together with the browsing of specific subjects, as the tags application and subject allocation make search and discovery of new products easier.

Less than 50% of recommenders can filter by operating systems. This absence when refining search is partially offset by the fact that most ratings include a section to that end. A further aspect that must be addressed is the fact that most recommenders perform ratings for one only operating system, in which case it would not be important (figure 4).

As far as the update of the contents is concerned, anybody involved in children's and teenagers' education needs reference points to deal with such changes and access the most recent information, and almost all the websites analysed herein have this feature (22/25), although it is not possible to establish a specific periodicity (figure 5).

The contents offered by the recommender must be suitable to the ratings' target public.

A specific target public can be identified in the case of almost all the indicators. Similarly, the quality of texts and their adaptation to the target public are aspects that are carefully dealt with in almost all the cases.

The main recipients are parents and teachers, as reflected in the most common filters analysed above -age and subject- and in the ratings structure. One observes the scant presence of recommendations aimed at librarians, an aspect that should be worked on, as those apps related to reading can become an instrument to promote digital reading in libraries, notably in children's libraries (García-Rodríguez & Gómez-Díaz, 2015).

Several indicators specialised in people suffering from autism and in professionals of the publishing world are included in the "Sundry" section. Therefore, it can be stated that the resources analysed are aimed at a varied target public, mainly adults, and just a few of such resources take final users into account.

As far as ergonomics is concerned, the websites analysed have a certain degree of ease of navigation. All of them meet the "Clarity and contrast" and "Legibility" indicators; therefore, it can be stated that the design elements of these websites are carefully laid out, that text and background, pictures and text, pictures and background are well balanced and that typography is clear and neat.

There is a significant difference in terms of ergonomics between institutional and personal websites, most probably due to the fact that the former have more resources available to hire the services of professionals who are knowledgeable on the subject and the latter use free software and perform maintenance tasks personally.

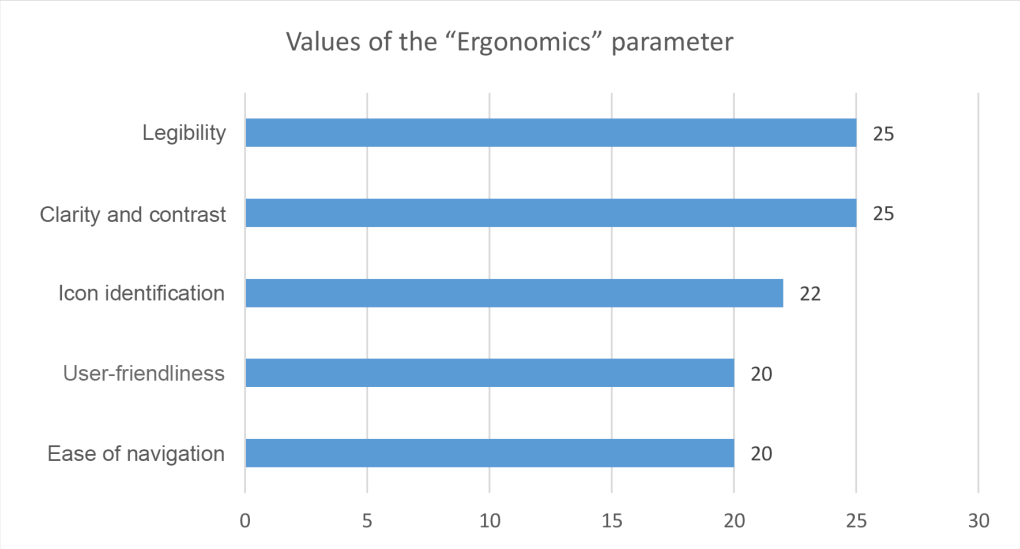

Figure 6. Values of the "Ergonomics" parameter.

Beyond the different types of rating, they all pay attention to the quality of texts, they are clear, concise and close to the recipients in terms of writing, by avoiding using too many technical terms and offering the information required to know and determine whether a product is valid or not (figure 6).

Application evaluation

Ratings are the core of this type of resources. Three different sections can be identified among those selected indicators: one has a more descriptive nature, where the app's features can be found; another one focuses on the competences required to use the product and the skills that shall be developed and one final section is devoted to the experts' assessments under the form of scores or ratings (Figure 7).

All systems use the same name for the rating title and the app name, which is essential to search for the product more easily in different stores, and have a section that includes a general description of the contents that is different to the rating, where the author evaluates and comments on specific aspects.

Given the fact that longer ratings result in lower possibilities of reading, ideal ratings should be short and concise and avoid using too many technical terms.

In most websites selected, ratings include the app icon, a key element if one takes into account that "The icon of an application is like the cover of a book, it is a calling card and a way to differentiate it from many other similar products" (García-Rodríguez & Gómez-Díaz, 2015, p. 4).

The "Recommended age" indicator is included in most recommenders, a criterion widely used by adults when it comes to decide whether they are buying the product or no. Language is an important aspect in less than 50% of recommenders; websites in English normally pay more attention to this aspect.

The number of systems offering apptrailers is low; nevertheless, it cannot be seen as a negative aspect in all cases as it does not depend on them but on the fact that developers themselves are in charge of creating them.

Less than 50% of recommenders rate applications using stars or other symbols, which is very helpful for children given its visual appear-

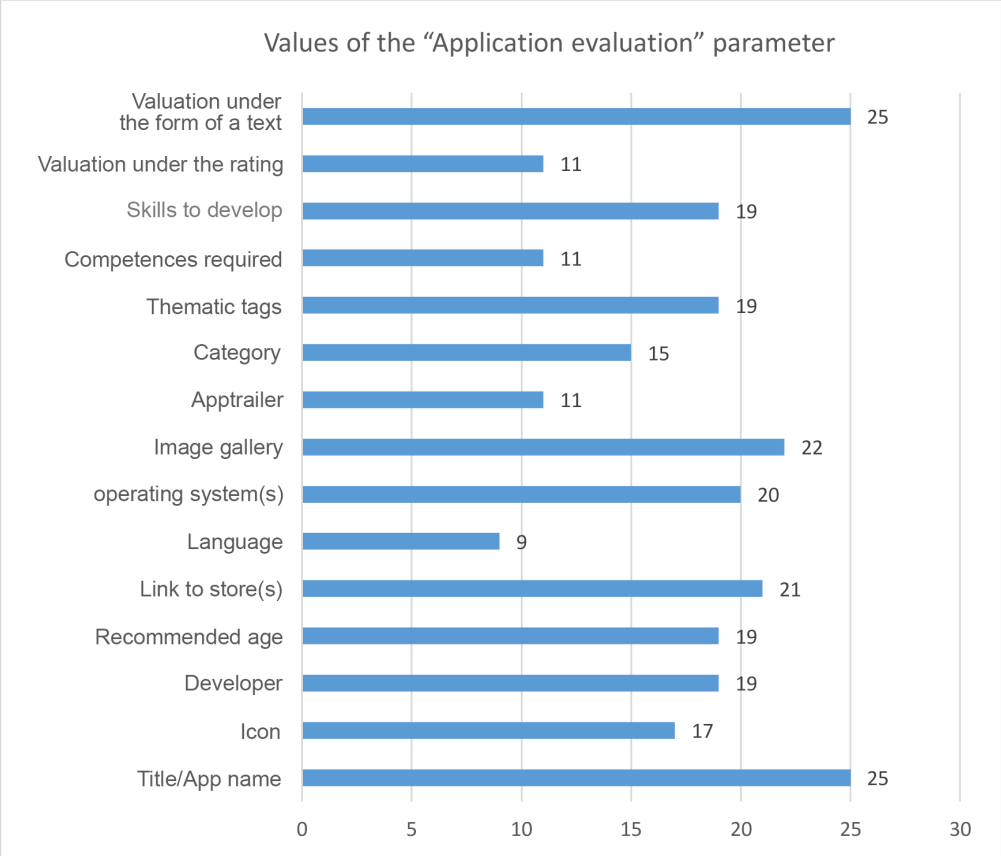

Figure 7. Values of the "Application evaluation" parameter.

ance, while ratings are more important for adult users, the main target public of these websites.

Promotions

As far as information on discounts, offers, etc. is concerned, only seven websites include this section, confirming that just a few of them collect such information as a result of their relationships with stores or developers. It should be noted that this aspect does not only depend on the website but on the promotions offered by developers.

Socialisation

This section allows to evaluate the adaptation of recommenders to Web 2.0 environments in terms of communication and interaction with users. As can be seen in figure 7, most recommenders use one or more social channels to disseminate their contents more easily.

User recommendations are essential to disseminate contents; for this reason, it is important that these systems have a space to comment on each rating and to share them through different social media. Generic social media, such as Facebook, or microblogging social media, such as Twitter, are the most widely used.

Nevertheless, it is noteworthy that recommenders do not make the most of audiovisual platforms, such as Vimeo or YouTube, to disseminate their contents or apptrailers, although they are very frequently used from mobile devices (*We Are Social*, 2017).

As far as image platforms are concerned, Pinterest is the most widely used. On the other

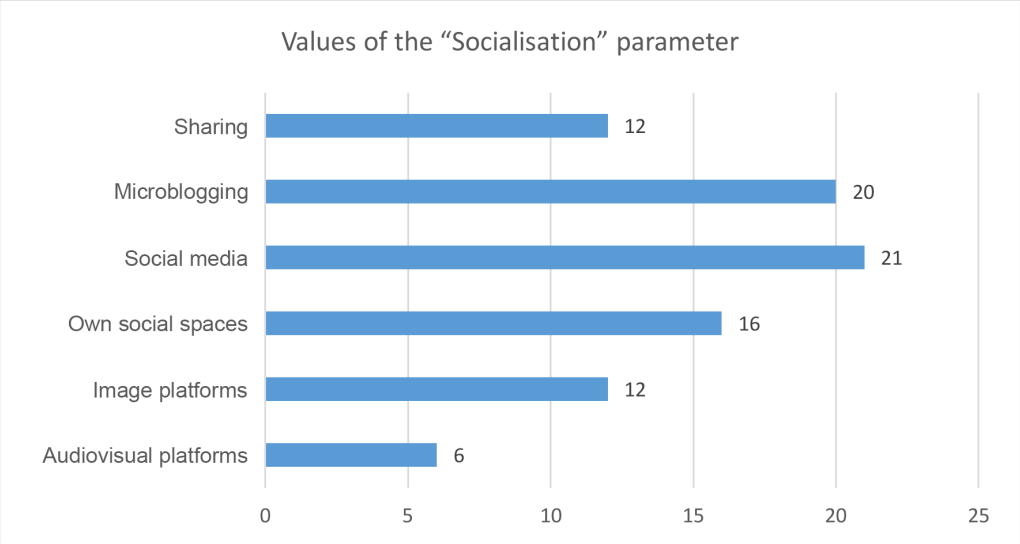

Figure 8. Values of the "Socialisation" parameter.

hand, Instagram is not a prefered information channel, although it is one of the most widely used social media among children and teenagers (Common Sense Media, 2015). The explanation for this is straightforward: these systems are aimed at adult users and therefore they use the most popular social media among this target public. If children and teenagers were considered to a greater extent as a target public, Instagram would rank differently for sure.

By applying the indicators to the various systems, we obtain the information contained in table 2.

Conclusions and future lines of research

The evaluation of digital contents for children and teenagers is special and requires multiple approaches in order to make the most of its potentials due to their particular features. For this reason, it is very important to study how those contents aimed at them are evaluated, who the people responsible behind these rankings are and what aspects of each product are highlighted.

A recommender's evaluation process must take three aspects into account. On one hand, the issues related to the "traditional" websites are evaluated; on the other, the criteria used to evaluate the applications; and, in last place, "socialisation", i.e., the use of their own spaces and of external ones, a very interesting analysis as the social media are currently a conversation and reading space where, using appropriate dynamics, reading comprehension can be worked on from very different perspectives (Rovira-Collado, 2015).

In general terms, the recommender analysis has provided us with very interesting results, although the features of some of them do not fully match the essential criteria set.

In percentage terms, it can be stated that most systems analysed meet more that 50% of the indicators set. In general terms, those systems administered by people who do not belong to the world of Children's and Youth Literature, such as parents, have deficiencies and constraints, as well as those recommenders of generic contents. It can thus be inferred that those recommenders that belong to institutions or consolidated

Table 2.
Indicators per recommender (%)

Recommender	Indicators used (%)	Recommender	Indicators used (%)
Fundamentally Children	85%	Generación APPS	67%
AppEnfant	83%	KinderTown	67%
La Souris Grise	80%	Super Julie	67%
AppTK	76 %	Déclic Kids	65%
Mamamò	76%	Best Apps for Kids	63%
Common Sense Media	74%	TOP BEST APPS FOR KIDS	63%
Digital Storytime	74%	Id Boox	61%
BibApps	74%	Smart apps for kids	61%
Literacy Apps	74%	ContempoPlay	54%
Boolino	72%	Moms with apps	54%
Appyautism	72%	ApplicaKids	48%
Frikids	67%	Peque Tablet	48%
		The App Date	41%

research groups presumably have better conditions in terms of website's structure, the study of applications and its dissemination in the social media.

Most resources analysed have websites in good conditions (15 out of the 25 websites analysed have more than 17 out of the 28 indicators available), without any significant differences between them. Regarding the information on the contents offered, 13 recommenders met more than 75% of the indicators set. Additionally, the results obtained in the "Socialisation" section confirm what has been previously stated about the importance of social media, as 24 out of the 25 recommenders are active in one social platform at least.

In particular, *Children*, *AppEnfant* and *La Souris Grise* can be seen as a paradigm of good practices, while *ApplicaKids* , *Peque Tablet* and *The App Date* have the worst results (as they hardly meet 48 and 41% of the criteria set, respectively).

To sum up, in 2018 the major app stores are still like the *Wild West* (Guernsey, 2012), where control on the contents offered remains low. The information presented through app descriptions is very partial and does not always help to determine whether the product being purchased is appropriate or not. For this reason, parents, educators, librarians and other mediators can find totally different applications depending on the way they search for them. These aspects highlight the need to perform some extra work in order for these stakeholders to be able to identify top quality apps with specific contents that develop the skills sought for specific ages.

Research on these websites can be an important step forward to understand how they work and the interests behind them: many recommenders offer pay ratings and/or have undisclosed links with developers that can result in biases (Jussel, 2015).

The amount of work to be done regarding digital contents is huge. It is essential that stake-

holders from different study spheres collaborate with each other in order to offer the most multidisciplinary approach that ispossible. Developers will only develop and market useful products of quality for children and teenagers by setting clear and precise criteria, clear policies and regulations.

From this point of view, this article offers a series of evaluation criteria with two functions: identifying the main features of recommenders and offering an overview of the status of these tools based on such criteria, which can be used to create good practice guides for both schools and libraries.

Once data have been analysed, new trends have been identified, which shall in turn be studied in greater depth. On one hand, it would be interesting to extend evaluations to websites that also take care of other digital contents in order to identify those aspects taken into account during evaluation; on the other hand, it would also be advisable to process the knowledge gained on the world of applications for childrenand teenagers to offer tools conceived so that mediators can facilitate the integration of such contents in homes, schools and libraries.

It would also be advisable to take advantage of the data acquired about app evaluation and compare them to the features of those products marketed on app stores.

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