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How does Information Pollution Challenge Children's Right to Information Access?

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Abstract

Informed by existing literature, in addition to lessons learned from ongoing research work pertaining to online information seeking, in this contribution, we discuss our view of how information pollution affects a critical yet understudied user group: children. We first highlight the need to take into account the unique characteristics of children's search context, which can be defined in terms of various factors, from children's age, abilities, skills, and cognitive development to the fuzzy line separating learning and fun. We then describe the importance of good design in assisting children in the different roles they play as searchers so that they can recognize and distinguish harmful and helpful content. Lastly, we discuss guidelines for effectively engaging teachers, parents, and children in the design, introduction, and use of search tools to support young users not only in accessing the information available online but also taking advantage of and learning safely from it. The focus on children not only helps us move forward to help a target group but, more importantly, it is a great starting point for further investigating a broad range of information pollution issues.

Keywords

Children, Web search, Information Pollution, Information Retrieval

1. Introduction

The internet has become an essential part of modern life, providing users of all ages with various digital resources [1]. Let's focus for instance on young users. A study by Danovitch [2] illustrates how 4-year-olds turn to their tablets for a YouTube video, while 6-year-olds use voice-controlled digital assistants to ask questions about nature. Indeed, children¹ can access a sometimes overwhelming amount of resources via search engines, apps, and other platforms accessed via internet-based devices. Resources children are exposed to can potentially influence

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¹We adopt UNICEF's broad definition of children, encompassing individuals up to 18 years old.

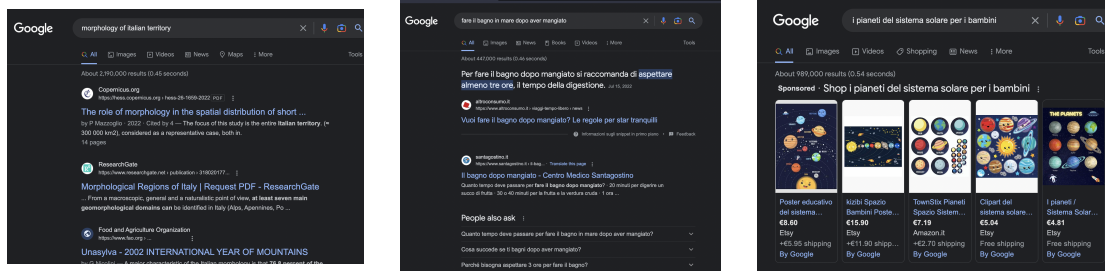
their development [2]. This is why it is not possible to overlook that not all resources children come across are linked to genuine content, which could have detrimental effects [3].

In this article, we spotlight a latent issue: *children's right to information access* [4, 5]. Specifically, we reflect upon information—or lack thereof—children interact with when they use general *search engines*, like Google, to conduct inquiry tasks. While seeking information online, children may encounter irrelevant resources that do not match their needs or interests leading to frustration and confusion [6, 7]. In addition to resources unsuitable to the context of the inquiry (e.g., for leisure vs. learning), children may, perhaps inadvertently, find misleading resources. As illustrated in Figure 1, in practice, children can be exposed to harmful products or ideas, as well as resources that might be to be a distraction. They could also be presented with resources that do not match children's age or development, including violent, sexual, or otherwise inappropriate content [8]. Many search engines have filters and controls in place to try and prevent these types of resources from appearing in Search Engine Result Pages (SERPs). However, they are not always efficient: children continue to be exposed to harmful resources they might not know how to cope with, along with resources they might not be able to comprehend; they can also encounter failed searches due to over-filtering [9, 8]. In the end, it is evident the urgent need to consider the presence or introduction into the web search ecosystem content with harmful or poisonous effects—the dictionary definition of pollution—that can prevent children from accessing *genuine information* online.

Although the research community has shown increasing interest in misinformation and disinformation² [11, 12, 13, 14], which can harm information access in web search and social media platforms, the impact on children remains relatively unexplored. Misinformation and disinformation fall under the definition of *information pollution* by Meel and Vishwakarma [15]: “how the contents on the web are being contaminated intentionally or sometimes unintentionally”. Specifically, the authors stress that false information negatively affects society at large, and may take the form of fake reviews, fake news, satire, or hoaxes [15]. In our work, we argue that there are other factors that can negatively affect children [16] and therefore can and should actively be regarded as pollution [17], such as resources that are not easy to comprehend [8], those evoking hate or violence, as well as those being a conduit for cyberbullying [18]. To this end, and to best tune the definition of information pollution to children attempting to access online information, we refer to guidance stated by pre-service teachers in [19] and extend Meel and Vishwakarma's definition [15] to go beyond misinformation and disinformation, and also consider the “presence of unnecessary, incorrect, out-of-date, unreliable, inconsistent, commercial information, which was not published by experts on the Internet in a disordered manner” [20].

There is no denying that the use of search engines can be a valuable aid for children [21]. It is fundamental, however, for children to become self-sufficient to independently tackle information pollution in its many forms. For this, they need to have adequate guidance to allow them to explore resources retrieved by the search engines they favour [22], rather than dedicated apps or specialised sites. Teachers and caregivers should be made aware of the potential perils of resources readily accessible via search engines and how to support children in reaching readable

²As defined in [10], misinformation encompasses false or misleading information with no adverse intention, whereas disinformation is “false information, spread deliberately” with the intention to mislead and/or deceive.



- (a) Children searching for the morphology of a country (Italy) are faced with misleading outcomes among the top-2 SERP results. They are both not useful, the first because it misses the original intent of the query and it is hard to read; the second is directed to researchers or expert readers.
- (b) Children curious about how long to wait before they can go to the sea after a meal first see imprecise information, in a bigger, i.e., more eye-catching, font than the rest of SERP results. Among the remaining results, they find a broad range of responses as digestion depends on many variables (e.g., the quantity of food ingested, the temperature of the water), which children might not take into account.
- (c) Children seeking information about the solar system encounter ads as their top result. In this case, rather than images about the topic of their search, children are inadvertently steered towards advertisements.

Figure 1: Search Engine Results Pages generated using Google for sample queries on March 2023. Each illustrates different elements contributing to information pollution.

and useful answers when they search within the universe of digital content [23]. In other words, the adults in their lives have to help children develop the competences they need to “actively learn and participate in the digitally rich society” [24].

Informed by Information Retrieval, Information Systems, and Human-Computer Interaction literature, as well as lessons learned emerging from our ongoing research work on children’s information access, in the rest of this article we examine information pollution and its impact on children’s web search from multiple perspectives. We acknowledge that as children develop, they might be affected by and respond to different perspectives of information pollution in a variety of manners. Consequently, we share the underpinnings of information pollution and its connection to children regularly using search engines, and leave an in-depth discussion centred on children at specific stages of development for future work.

In the end, ensuring a safe and positive online experience for children needs expert guidance. It is crucial for researchers and industry practitioners in the realm of information retrieval systems and other systems and platforms children use, like Instagram, YouTube, and TikTok, to consider the potential harms information pollution can inflict on children and take steps to protect them when developing and deploying these systems. By considering the well-being of children we can help ensure that the internet is a positive and enriching resource for all [25].

2. The importance of considering the context of a child

Children become part of the digital environment from an early age [26, 2]. Modelling the adults they live and interact with, toddlers start using their parents' devices to go online using a broad range of apps. At the same time, the risks associated with the online world have always been a concern. This is especially worrisome when it comes to search engines, which children are known to prefer as their first stop for information discovery [2, 6]. As a result, the concept of information pollution must be defined and dynamically adjusted in light of the goal of their search activities and the environment in which they take place. Many elements must be considered [27, 28], including motivation and intent of the search, as well as whether the inquiry task is assigned by teachers, is a component of a school assignment, is prompted by a personal interest falling under the leisure dimension, or is a combination of all of the above. Family background, age, personality, expectations, skills, and other elements affect children's ability to critically examine retrieved material in relation to the task at hand. All play a role in establishing what constitutes information pollution and how information pollution affects children searching online.

The findings from [29] reveal how children deem the protection of their privacy as an important feature when designing a search companion, someone to keep them safe when searching and protecting them from harmful material. Safety online seems to be a choice shared by children and adults and should therefore be accounted for when devising interventions to support children in their online search experience [23, 30]. Searching as learning and learning to search are essential digital competencies children need to acquire in order to fully develop into active citizens and members of society in the future. Naturally, adults and society at large tend to assume a protective behaviour, aiming at preserving children from being exposed to different forms of harmful information pollution. This is an understandable reaction, yet it could result in children growing into young adults who are completely unprepared to face the complexities and dangers caused by information pollution. A much more effective strategy would be to introduce children to the reality of searching online and showing them how to recognise helpful reputable sources as opposed to harmful or useless ones. Training children by offering them the right support at the right time when they explore retrieved information is something the authors of [31, 32] advocate as well.

3. The importance of a good design

We turn to the Child Computer Interaction (CCI) community and their effort towards designing for user experience with and for children. In line with the "child as protagonist" principle [33], we find a growing literature reporting the active roles children can play in the different stages of collaborative design from informant to evaluator as well as an active member of inter-generational research teams [34].

We see emerging from literature in this area [35, 36, 37] that the core idea is that children are the experts when describing how and why their peers search for education and leisure and as such should be listened to and acknowledged in their contribution to the design effort. Good design is grounded on deep usage research to provide a deep understanding of users'

needs, habits, and expectations, in addition to enabling designers to extract user requirements to guide them all the way toward prototyping and evaluation. Children can greatly contribute by sharing their perceptions of how existing search technology works and so enabling researchers to make sense of their mental models in terms of expectations, barriers, and misconceptions to be dealt with by the new tools to be. The adults in the loop, including caregivers, teachers, and researchers, play a vital role in ensuring healthy and active children's participation. Not only they will act as facilitators and motivators in keeping children engaged with the collaborative design activities they have devised, but with their guidance and example, they provide natural scaffolding to enable children to safely explore the search space and avoid pollution while learning how to do so in the future independently.

4. The importance of re-thinking relevance

When discussing information pollution in the context of web search we need to be precise about some concepts: relevant/irrelevant resources and genuine/polluted information. Traditionally, search systems tend to optimise retrieval and ranking strategies in terms of relevance, leaving it up to the adults seeking information to check the reliability of the retrieved resources, regardless of their position in the SERPs. Children, on the other hand, are known to trust (search) technology and are already challenged in discerning relevant vs. irrelevant resources [38, 39, 31]. This makes it even more difficult for them to recognise that they might encounter intended or unintended harmful information in the SERPs they browse, more so given their lack of experience in judging and consulting online material.

The guidance and support of the "more knowledgeable other" [40], whether that be a caregiver or a peer more well-versed on how to deal with information pollution, is crucial (§ 5). Still, we want children of all ages to become self-sufficient; that is empowered to detect, deal with, and/or bypass information pollution regardless of the purpose of the search (i.e., leisure vs. learning). Looking into children's natural sense of relevance we see that situational relevance and the motivational/affective "inherent characteristics of relevance behaviour" (in [41]) are those that better capture the way children assess the quality of retrieved results when performing a search task assigned by their teacher, who is providing extrinsic motivation for it. The motivational/affective dimension keeps the child intrinsically engaged with the search and involved with the selection of relevant results. In [42, 43], the authors explore how primary school children perceive relevance by having them engage with a drawing exercise to reveal the qualities they associate with good and bad search results. Children embraced the angel and evil dichotomy as a strong binary representation of good and bad information, with the angel hinting at trustworthy and safe information versus the evil standing for harmful material that should be avoided at all costs. Material featuring implicit or explicit bullying or violence could fall under this second category because it is not only inappropriate and unhelpful for young searchers, but it may also be harmful because it may encourage violent and antisocial behaviour. Equally fitting is the "Switched on and off bulb - Light or darkness" pair where one child made an explicit reference to "reliable and non-reliable" material, either shedding light or bringing confusion, a clear reference to information pollution and its confusing negative effects on children's search experience. Dealing with information with the right reading level and

age-appropriate is the suggestion made by another child who portrayed a single icon, "Arrow up", to be used to discriminate between results suitable for children, and those for adults, and thus keep them visually separated.

The presence of emotions also seems to affect the way children search. Landoni et al. [27] report how emotions in titles and snippets triggered a satisfying search experience and so enabled children to discover more relevant material. Due to the possible correlation between emotional intelligence and fake news detection as "individuals who are better able to disregard the emotionally charged content of such items, better equipped to assess the veracity of the information" [44], it becomes imperative for search engines to account for an effective dimension of relevance as an attempt to mitigate information pollution.

It emerges from a recent study that trust plays an important role in children's decision of using an available recommendation for relevant resources retrieved in response to their online inquiries [45], hinting about their concerns to discern reputable sources and who is suggesting them. Walsh-Moorman and Hovick add that to identify credible resources, fourth graders in the US leverage the concept of expertise, encompassing "education (e.g., advanced degrees, experience, and knowledge" [46]. At the same time, the authors conclude that, in practice, source authority of online resources is not something that young searchers deal with, as it is impacted by their vocabulary skills, background knowledge, and life experiences. This completes a picture of how relevance needs to be revisited to account for the avoidance of information pollution together with the priority given to readable and reputable sources with an emotional flavour [8, 7].

5. The importance of a good guideline

Children turn to search engines for a wide range of online resources; they do so both for leisure-related reasons, as well as for learning. In the classroom, children are often restricted to access curated educational resources [9], which protects them—to a degree—from the harms of information pollution. As Pilgrim [9] mentions, children should be equipped to access online resources "in the wild". Unfortunately, research studies conducted over the last few years evince that it is hardly the case. For example, Loos et al. [47] report that when exposed to a particular website about "The Pacific Northwest Tree Octopus", only 7% of study participants (from the Netherlands, aged 13), were able to identify this site as a hoax; this percentage is even lower from the 11% of US study participants in the same age group. Similar findings resulted from the study conducted by Pilgrim et al. [48] who showed that less than 20% of the more than 300 first-to-fifth grades involved in a study were able to identify credible websites correctly, i.e., those not addressing fake news; most participants were "unable to verbalise ways to examine credibility" [48]. The issue of source reliability analysis is the focus of the findings reported in [46]. The authors noted fourth graders depend upon their reading skills to establish text authority and resource credibility. This is a concern, given that online resources are rarely at a level that young children can read and understand [8, 7].

The aforementioned findings suggest that children require better guidance, as they develop and acquire more digital skills so that they can be better equipped to deal with information pollution. Researchers across various disciplines, not just computer science, agree that there

is a need to design better digital and media literacy curricula across all school grades so that children can be prepared to best deal with information pollution and in turn mitigate related harms [49, 50, 51, 52, 53].

At the same time, Howard et al. [17] fittingly claim that “digital, media, and information literacy skills alone do not provide a foolproof solution” to counterpart information pollution. The authors suggest that the burden cannot be on children alone. Instead, it is key to turn to caregivers and teachers, who can maintain an open dialogue and “promote critical thinking among children” [17]. In [54], the authors propose the EMILIA guidelines for adopting search tools in the classroom that can be extended to all children’s caregivers. Mentoring and monitoring are two of the tasks indicated as fundamental to help children to conduct the search task and avoid information pollution. The mentoring, in particular, needs to be continuous: at the beginning, providing instructions about the search process, and as time goes on, teaching children how to address errors or interpret retrieved resources (and the risk of those that are not genuine) by reasoning together.

We cannot overlook, however, that caregivers and teachers also struggle with how to effectively utilise search engines [23, 55]. Furthermore, they have difficulty with dealing with information pollution—in general, adults are hardly better than young children and teenagers when it comes to either identifying fake news, estimating the credibility of information presented on SERP snippets, or dealing with information pollution [56, 57, 58, 59]. This is a concern; as teachers and caregivers are the ones meant to help children navigate today’s complex digital ecosystem.

6. Concluding remarks

Information pollution in web search and its mitigation is a non-trivial problem. With this work, we have aimed to add to the discussion about the various facets of information pollution; in particular, the impact of information pollution on children and web search—a task children undertake daily. We brought attention to the need of involving children as co-designers of technologies and curricula that can ultimately help them confront information pollution. Along the way, we invited the research community to revisit the concept of relevance to account for children’s view of this concept and how it contrasts with information pollution. We have also discussed the importance of guidance on this matter, particularly by the adults in children’s lives, who might themselves struggle with recognising and dealing with information pollution and therefore exacerbating this concern.

Children are a unique user group, one that could be considered ‘unbiased’ in how they judge and interact with search engines and more so, with how they see the world. Empowering them so that they can seek, critically examine, and in the end find information from the resources search engines retrieve, i.e., deal with information pollution and discern helpful vs. harmful resources to ease their path towards relevant information, which is a crucial skill for them to develop in order to thrive as digital citizens [60, 61]. Studying the problem of this user group unbiased by external factors, and meaningfully reacting to it, would enable researchers and practitioners to then extend solutions to aid other user groups. This will also contribute towards advancing research about harms associated with Web search [62].

We must recognise, however, that issues caused by information pollution are not restricted to search engines. There are plenty of other points of access to online information—from recommender systems to social platforms like Facebook, Instagram, and TikTok— that are impacted by information pollution and that have a direct reach into children, particularly teenagers [63, 64, 65, 66, 67, 68]. In a recent study focused on credible information access via TikTok on adult users, Cajas [69] reiterated the importance of advancing research work focused on younger children and teenagers on this topic as “it is unclear how they may have evaluated the information they were presented with. They may not know many facts about the world yet, they may not have developed their personalities and views, or simply may look at TikTok in a different light.” This evinces a need to continue to advance research and discourse in this area. Immediate next steps include algorithms to detect the broad ranges of information pollution and studies to capture how children, and other vulnerable user groups, perceive and react to (different aspects of) information pollution, interfaces tailored for young users that implicitly and explicitly can serve as conduits for interventions to help children improve how they engage with information pollution in the long term, in addition to curriculum bringing awareness to the perils and opportunities for children of all ages when engaging with information access systems [70, 71, 17, 49, 72, 73].

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