

# Conversational Agents and Children: Let Children Learn

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**Abstract** Using online information discovery as a case study, in this position paper we discuss the need to design, develop, and deploy (conversational) agents that can – non-intrusively – guide children in their quest for online resources rather than simply finding resources for them. We argue that agents should “let children learn” and should be built to take on a teacher-facilitator function, allowing children to develop their technical and critical thinking abilities as they interact with varied technology in a broad range of use cases.

## 1 Introduction

Children are increasingly turning to search engines to seek information on the Internet [1, 2, 3, 4, 5], but these young children (ages 6-11) are still in the process of learning literacy skills which, as argued in [6], affects how they search for and consume information. Web search for children seems like an obvious setting where an intelligent conversational agent such as a spoken dialogue system or interactive virtual agent could make the search process easier by automatically transcribing child speech into search terms (so the child doesn't have to type), performing the search, then selecting and reading aloud the information that the agent thinks that the child

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is searching for. Furthermore, web search often requires multiple iterations of query formulation and an agent could help with the steps of fine-tuning the search parameters. Such an agent could enable children to more easily access web resources for entertainment as well as educational purposes (see [7] for a review of children and voice-based conversational agents).

Following recent work [8] that explored how technology can sometimes hinder child learning, in this paper, we take the position that an automated agent should act as a facilitator in the search process, not actually perform the work of web search (including transcription) for the child because doing so can potentially hinder the development of critical literacy and technical skills. We explain some of the functionality such an agent should have and the methodology for designing the agent. Moreover, we take the stance that the agent should be perceived as an adult taking on a teacher-facilitator role — not as a child peer. Though web search seems like a relatively narrow use case for automated agents that interact with children, search is a common and important setting that children begin using early and we can derive an important guiding principle for all child-directed conversational agent research: agents should not do for children what children can do, or should learn to do, for themselves.

## 2 Web Search: A Setting for Learning Critical Skills

Web search is an important domain to consider because many children use web search tools almost daily [9, 10] and search is a setting where children’s writing and reading skills enable them to interact with a broader and increasingly important part of their digital world. Effective web search requires the application of multiple skills that are required for effective query formulation, including literacy (i.e., typing, spelling words, composing words into phrases), understanding how search results are structured, determining if a resource returned by a search engine is relevant (i.e., what they were looking for, and reformulating their query to refine their search). This follows recent work in calling for a *search as learning* paradigm [11] that focuses on what web search is good for: finding information and learning from a wealth of public resources, but doing so requires properly training children in classroom settings [12].

Some of the above-listed skills required for web search are often skipped altogether when using a conversational agent that automatically transcribes a verbal request and replies with a specific answer instead of a listing of resources. While this pattern of interaction allows children to access information more directly in a context of developing their literacy skills, one cannot assume that the agent’s response actually fulfills the child’s particular search need [13, 14]. Even children who like using Amazon Echo to request information often do not trust the information they are given [15], which highlights yet another skill that children need to acquire besides literacy and search: a healthy skepticism that technology always has the correct answer [16]. A traditional graphical web search interface is not so direct: they

don't just give the answer; rather, they lead a child searcher to potentially relevant resources, but the child has to determine if the resource fulfills their search need.

Our position, therefore, is that conversational agents can help facilitate children to accomplish tasks, but those agents should not do what children need to learn to do for themselves, but can provide scaffolding to help children learn.

### **3 Agent Facilitator: Requirements and Methods for Development**

Here we sketch some of the requirements for a child-directed conversational agent that facilitates learning about web search. The first requirement is that the agent should be viewed by the child as an adult teacher.<sup>1</sup> In [18] we showed that children prefer adult voices in correcting spelling mistakes, a small yet crucial aspect of the search process. Moreover, [19] showed that children do not prefer a virtual search agent to be a peer. This suggests that when corrections take place, it is better for the agent to have a clear role of being a teacher-like facilitator.

[19] explored child-directed (ages 9-11) search agents by asking the children to illustrate "Sonny," a fictitious virtual agent that could help them find information, then the researchers asked the children what they thought Sonny should be able to do from a list of options. While the children indicated that they wanted the agent to be able to talk (i.e., converse verbally) with them, the children also indicated that they wanted to feel safe, have fun, and that the agent should remember their previous requests and take care of privacy. We point out here that the children may have identified memory as an important aspect of the search because speech-based assistants like Alexa do not remember dialogue context beyond the current request, making the ability (or lack thereof) salient to the children. Remembering prior interactions is crucial to not only to learn about a particular child's preferences, but, perhaps more importantly, to recognize the literary and search skill levels of the child and how to help the child improve those skills.

The role of the agent should be clear to the child, and here we are advocating for a teacher-facilitator role. An agent that takes on a facilitator role should use proper pedagogical methodology because children are in a crucial developmental stage where they are learning many new things, and learning best occurs when children are given opportunities to attempt challenging tasks with proper support. If the task is too easy (i.e., the agent completes the task for the child), the child will not learn. If the task is too hard and the child is not provided scaffolded support that will help them be successful, they will become frustrated and disengaged. A facilitator agent can ensure that children are working within this "Zone of Proximal Development" (ZPD) [20] – where a task is challenging enough for them to learn while not causing excessive frustration.

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<sup>1</sup> This is not to say that child agents are never useful; see for example [17] that explored second language tutoring with a child-like agent, but researchers should take into consideration the goals and outcomes of the tutoring when deciding about agent morphology.

To illustrate how ZPD would work in a web search setting, consider an agent that recognizes a misspelling and flatly utters *that's spelled incorrectly*. This would not help a child improve their spelling and could negatively reinforce to the child that making mistakes is bad. In this instance, the child will not improve as a speller or searcher. However, if the agent simply corrects the spelling automatically without drawing any attention to the error, the child is not provided any opportunity to learn. Rather, an inquisitive attitude of *hmm, the spelling there doesn't look right, can you check the spelling of that word?*, coupled with spelling suggestions, gives the impression that being willing to make mistakes and correct them is part of the learning process. It also gives the child an opportunity to review and identify the spelling error on their own, rather than the error being auto-corrected by the system. This means that not only should the agent take on a facilitator role, but as argued in [21, 22], teachers should be part of the design process of how the agents look and how the agents act.

Recent work that focused on an “Effective reading partner” conversational agent did not just read to the child; the agent asked questions and provided feedback on a small set of topics relating to weather. The authors claim that the agent could be used to enhance the motivation for children to read [23], likely because the agent is mirroring what a good teacher does during a classroom read-aloud. Skilled teachers build engagement around a text by asking students questions, thinking-aloud, re-phrasing questions, and building connections between the text and the world. Oftentimes algorithms and models are trained to provide a specific result or classification; teachers are well-trained to scaffold and support children as they learn and apply skills (which no agent will fully replace). In some cases, teachers may answer questions directly (as Google sometimes does at the top of its search results page), but teachers also help children think about what the answers mean. Conversational agents for children need to build on both kinds of training. In order to best capture the wealth of knowledge teachers have and to better address children’s particular needs, we also advocate for a participatory design approach where diverse stakeholders can utilize their experiences, perspectives, and expertise to collaboratively co-construct a solution. The scaffolding required to effectively implement a teacher-facilitator conversational agent requires that teacher’s expertise be well represented. Additionally, children – as the intended users of the system – can also lend valuable insights into the design of technology as they co-design with adults [24].

## 4 Conclusion: Better Building Together

In this paper, we present a case for teacher-facilitator agents in the domain of information discovery. The agent should have some adult-like anthropomorphic characteristics that clearly signal their role to a child (e.g., adult voice) and the agent should operate in the Zone of Proximal Development to ensure that the child is stretched, but not overwhelmed as the child learns how literary and technical skills complement each other. We therefore advocate that teachers who have training and

experience in educating children should be part of the design process of conversational agents that interact with children, and we also believe that children should have a voice in the design process.

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