Here, There, and Everywhere

Building a Scaffolding for Children's Learning through Recommendations

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ABSTRACT

Reading and literacy are on the decline among children. This is compounded by the fact that children have trouble with the discovery of resources that are appropriate, diverse, and appealing. With technology becoming an evermore presence in children's lives, tools that can minimize choice overload and ease access to online resources become a must. A powerful but underutilized tool in regards to children that could assist in this situation is a recommender system (RS). We posit that RS could be used to impact children's learning, using them to not only suggest what children might like but what they need in regards to learning. At the same time, if scoped inappropriately, outcomes from RS could be used to alter children's outlook. The goal instead is to strive for RS that offer suggestions based off children's evolving knowledge, preferences, reading level, etc., so that with the proper intervention from an expert-in-the-loop (e.g., parents/teachers) could impact not only children's educational performance, but help them to reach the goal of learning to learn.

CCS CONCEPTS

• **Information systems** → **Recommender systems**; Personalization; • **Social and professional topics** → **Children**.

KEYWORDS

recommendation, children, learning

1 LEARNING IN THE TECHNOLOGY AGE

Technology has a lasting impact on how children learn [3]. Every year new technologies make their way into the classroom to support learning [13]. In spite of the availability of technologies and the impact they can potentially provide, by the time they enter kindergarten, 37% of children do not have the basic skills, e.g. reading readiness and letter recognition, required to foster a lifetime learning [11]. More concerning are recent reports that highlight how adult populations exhibit reading abilities that match to those of primary school children [20]. This can be more prominent in rural communities that would greatly benefit from a wider exposure to currently either unavailable or with limited access resources as a means to foster learning and directly increase literacy levels as a result [18]. However, as technology spreads and has more of an impact on education, more resources are available in a digital format. So with this vast set of resources at our fingertips, how are children not finding these resources? Children neither have the know-how needed to navigate the "information highway" nor are they necessarily offered algorithmic or instructional support if they can not find the information.

So what can be done to foster children's learning and help them find what they want and need, to be successful lifetime learners? In a classroom setting most children turn to search engines for their information discovery. While search engines are useful tools, they require users to formulate queries but to do so these users must know what they are looking for. Users, however, may not necessarily know exactly what they want to look for. This is particularly true with children, who also have the added complexity of not knowing what they need as well. Recommender systems (**RS**) may be the key, as they are designed to identify items appealing to users. While RS targeting average (i.e., adult) users have been studied for years, when it comes to children, RS are in their infancy [6, 15]. The slower pace of research and development in this area could be attributed to several factors including dataset unavailability, children's lack of focus to complete surveys when participating from user studies, and the difficulty in accounting for all stakeholders in the recommendation process [5]. Thus, the opportunity to create and study a scaffolding for children to learn to learn through the use of RS. Ideally, a RS can anticipate users' wants and needs, without requiring queries and acting as a gatekeeper to allow access to vital information. This scaffolding would not only impact children as individuals but, in an educational environment, it could also shape a generation of confident learners.

2 BUILDING A SCAFFOLDING

RS are generally associated with e-commerce–pointing out to a product or service a user might like. But what about if instead of selling, the RS would provide resources that children might find both interesting and useful. Building an RS that can aid this under-served community by acting as a guide to assist them in their learning path to ultimately impact their lives is a positive step forward. Yet, being a guide places the responsibility of creating a complex experience for a number of different contexts and many different facets that need to be regarded when dealing with children. There are several aspects that need to be accounted for providing a

dynamic system to support children learning to learn and here we will cover a few.

2.1 Readability

A sizable hurdle to learning is having the ability to comprehend the resources being provided on a variety of topics. The reading level of text plays a large role in how much children are able to comprehend from the material they read. The study presented in [2], reports a 44.8% decrease in comprehension between children reading at up to one level above their grade level and reading more than one level above their grade level. Flow theory considers the balance that needs to be struck between challenge and skill to create an engagement [17]. Based off that idea, it is important to challenge young readers with texts of growing complexity in order to push and expand their reading abilities, but not offering books too far outside their understanding as is detrimental [1]. The ability to react to a child's changing needs and creating a personalized suggestion by using an RS to offer resources would affect both information retention and reading growth. By suggesting materials that have readability levels suited for either comprehension or growth, depending on the situation, a RS would impact how children read and expand on their reading abilities. While there have been attempts to address this challenge for school-aged populations [14, 16], the focus has only been on books–overlooking other types of online resources–and the use of traditional readability formulas–which are known to have limitations when it comes to considering aspects beyond the semantics of a text to establish its level of complexity.

2.2 Access

Even though resources might exist that align with a child's readability needs, that does not mean they have access to them. In most middle-income neighborhoods in the US, there is only 1 age-appropriate book for every 300 children [7]. This is even worse when it comes to rural communities. When suitable resources cannot be found locally, children should be enabled to find them online. Although resources on sites such as Amazon may be relevant to what the child wants, they may not be accessible due to financial means. As children have a right to education [9], it is important that the resources suggested to them are accessible regardless of their socioeconomic status, as it has been shown that there is a medium level of association between socioeconomic status and academic achievement [19]. The association between these issues could be in part due to different levels of access [19]. RS can help address this concern. Ideally, by offering children free educational resources, especially Open Educational Resources (OER) [9], through suggestions that not only align with the needed reading level for the situation, but also the interested topic, the RS will impact the access children have to learning materials.

2.3 Scope of Knowledge

Most RS rely on user's past interactions with the system to provide personalization, which is well suited for information discovery for children. A continuous suggestion of resources in a topic children are interested in will foster their curiosity, as there is an association between curiosity and exploratory behavior [4], as well as facilitate teaching them how to logically work through a subject. However, this linear approach of merely focusing on topics of interest is not enough. Using personalization to understand and acknowledge what areas the child may be struggling/excelling in or not/are being exposed to would take the recommendation from a linear avenue to an expansive one, allowing for a more tailored learning experience [10]. Adding these topics that the child may be lacking information on would aid in filling knowledge gaps that may be present to encourage diversity in learning. Having a broader range of knowledge set them up for success and have a lasting impact on their lives. As RS generally suggest resources matching a user's history, the depth part of this aspect is addressed in standard systems. However the breadth aspect is often overlooked. To account for this need a RS would need to be aware of the educational curriculum, then categorize and compare the user's history to suggest the missing categorizes in a way related to the user's current task and learning trajectory.

2.4 Familiarity

Familiarity is the intersection of readability and knowledge. When children become more knowledgeable about a topic, they expand their vocabulary to include topic-specific words [12]. This expanded vocabulary within a given topic allows them to understand more complex texts about that same subject [12]. For this reason, children are able to read at a higher level than they usually do for subjects that they are familiar with. A RS could account for these differences by suggesting resources at a higher level in familiar topics or lower for unfamiliar ones. Not only would this push them into a deeper understanding of familiar topics and grow their reading success but also set them up for higher comprehension on unfamiliar topics to grow their knowledge. This dynamic approach would impact the learning of subjects children may not be strong in. To address this concern a RS would need to simultaneously consider a child's topical knowledge on the subject they are viewing, as well as their baseline reading level. Accounting for both of these aspects would lead the to RS providing content with a reading level that appropriately deviates, adjusting up or down from baseline, based on the subject of the content being provided.

3 WHAT IS THE IMPACT?

Providing a scaffolding for children to lean on as they learn to navigate a complex and confusing infrastructure of information would have both short and long term impacts on their lives. In the short term, this structure would help create a strong foundation of learning when utilized by educators in the classroom as a way that would alleviate some of the frustration in the learning process, making room for them to enjoy learning and learning to enjoy. This impact would not be limited to individual's and when implemented in an educational setting would sculpt a generation of children. Personalized learning has a pronounced impact on children's academic success. As RS have the innate ability to personalize the materials suggested to children, then it is natural to think of them as the tools that can ease personalization in their education path. However, while RS support this personalized learning structure, they should not be used in isolation as they can not solve every issue that arises in learning without the proper involvement of teachers and educators [8].

In the long term, this could impact the way schools utilize technology for education and how children exposed to this structure utilize learning for the rest of their lives. With the great transformative power this has in an educational environment comes great responsibilities. Access to a depth and breadth of knowledge that may not be feasible to find otherwise would open more avenues of exploration for children to take later in life along with creating a richer view of the world. However, if scoped too narrowly, children will instead only be presented controlled information, tailoring their opinions. Equally detrimental would be to not account for the evolution of and dynamic changes in children's learning, interests, and attitude.

Although there has not been much research on how RS impact children in general, let alone the effects RS have on their learning, the exposure that children have to RS is not going away and it has the potential to have a lasting effect. It is important that this impact is monitored and shaped to ensure that the effect RS have on children is positive. Readability, Access, Scope of Knowledge, and Familiarity are essential aspects to help design and deploy RS that can have a positive impact but are by no means exhaustive. However, these aspects are worth being explored to build the right scaffolding for children on their path towards successful learning.

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