

With a Little Help from ScratchJr/Scratch: A Systematic Review of the Effectiveness of ScratchJr/Scratch on Computational Thinking and/or Literacy

Nowadays, technology has been integrated into schools and homes to promote children's development. For example, robotics, conversational agents, and programming languages are introduced in education to help children acquire knowledge and develop different skills, such as computational thinking and literacy skills. Designed for children and adolescents aged 5 to 16, ScratchJr/Scratch has been used in more than 200 countries and has received substantial research attention. Scratch is a free block-based visual programming language that comes with a simplified version known as ScratchJr. They not only provide a platform for children to build blocks and make up stories, but also create an online community to share projects with each other. Furthermore, the advent of ScratchJr/Scratch has caused a sensation in educational technology since it contributes to equity in accessing computational resources with its free access and multiple language features.

One of the advantages of using technology is that it can promote computational thinking (CT) skills. CT is a thought process of problem-solving, encompassing decomposition, pattern recognition, abstraction, algorithmic design, and generalization. The integration of CT into child education has shown tremendous benefits, including the promotion of critical thinking, creativity, and communication.

Another potential benefit of technology use in education is that it can facilitate literacy learning. As widely recognized, literacy is an integral part of school readiness and a fundamental skill for school success. It paves the way for children to learn other subjects, express their thoughts, and discover the world around them.

Although existing research has shown that technology can promote children's CT and literacy skills, little is known about how the most popular programming language ScratchJr/Scratch plays a role in children's CT and literacy development. Focusing on ScratchJr/Scratch, the purpose of this review is to investigate the effectiveness of ScratchJr/Scratch on elevating children's CT and literacy. As such, this review is guided by two research questions. RQ1: Does using ScratchJr/Scratch improve CT and/or literacy skills for children in grades K-12? and RQ2: What are the moderators affecting the effectiveness of ScratchJr/Scratch on children's CT and/or literacy development?

This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow, involving four main stages: (1) identifying relevant literature, (2) developing criteria, (3) screening the literature (abstract screening and full-text screening), and (4) analyzing.

At stage 1, I put the search string AB = ("Scratch" OR "ScratchJr") AND AB = ("literacy" OR "reading" OR "writing" OR "storytelling" OR "English language arts" OR "ELA" OR "computational thinking") into 6 databases: Academic Search Complete, APA PsycInfo, ERIC, ACM Digital Library, IEEE Xplore, and Web of Science. Scratch was launched in 2007, so I limited the time range from 2007 through 2023. The initial search generated 2,307 records. After removing 421 duplicate records, 1,886 records were retained for screening.

At stage 2, I created the inclusion and exclusion criteria as follows. The inclusion criteria are: (1) participants are children in grades K-12; (2) study design is quantitative or mixed-method; (3) participants use programming languages that include ScratchJr/Scratch; (4) results contain participants' CT and/or literacy. The exclusion criteria are: (1) participants are college students, pre-service teachers, or teachers; (2) study design is qualitative or review; (3) participants use programming languages that do not include ScratchJr/Scratch; (4) results do not contain participants' CT and/or literacy.

At stage 3, of the 1,866 articles screened, 1,784 were excluded based on abstract screening, leaving 82 articles for full-text screening. Following the full-text screening, 18 articles were selected for the final analysis.

Below I present the preliminary results. 18 studies have explored the effects of ScratchJr/Scratch on CT, while only one study has examined their impact on literacy development. To answer RQ1, one study found no improvement in children's CT after using ScratchJr/Scratch, while one study reported partial improvement. In contrast, 16 studies demonstrated that ScratchJr/Scratch significantly enhances CT. The sole study examining the relationship between ScratchJr/Scratch use and literacy development showed positive effects of ScratchJr/Scratch on literacy improvement. To address RQ2, factors such as gender, age, teacher roles, playmate roles, types of activities involving ScratchJr/Scratch, and instructional approaches were coded as moderators for further analysis.

The preliminary results highlight the promising effectiveness of ScratchJr/Scratch in enhancing children's CT, suggesting that teachers can integrate ScratchJr/Scratch into their classrooms to foster CT development. However, the relationship between ScratchJr/Scratch use and literacy development has received limited attention. Therefore, future research should investigate the potential of ScratchJr/Scratch in supporting children's literacy development.