Chapter 6

The Effects of Digital Literacy Skills on Preschool Science Education 𝕒

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Abstract

This chapter provides a comprehensive analysis of the effects of digital literacy skills on preschool science education. Digital literacy encompasses critical elements such as information access, analytical thinking, and secure digital content creation, fostering children's abilities in critical thinking, problem-solving, and information retrieval from an early age. Particularly within preschool science education, digital literacy not only facilitates children's understanding of scientific processes but also encourages active engagement in the learning process. This study examines how digital literacy skills can be integrated into preschool science education through developmentally appropriate activities and content. The role of digital literacy in preschool science education is explored through a review of research conducted in Turkey and internationally, educational theories, and practical applications designed to help young children understand science concepts through digital tools. By connecting these findings to theoretical foundations such as Vygotsky's Social Constructivism and Piaget's Cognitive Development Theory, the chapter discusses how digital literacy contributes to children's cognitive and scientific development. Furthermore, practical recommendations and examples of digital literacy activities enriched with digital tools are presented for educators, aiming to support them in integrating digital literacy and science education in children's developmental processes. These recommendations offer a guiding framework for educators and parents to incorporate digital literacy and science education effectively. In this context, the study emphasizes the positive impacts of digital literacy on early science education and its significance in fostering children's scientific curiosity.

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1. Introduction

Raising awareness among students at the primary school level about the effective and correct use of information technologies, enabling them to use these technological tools for communication and research, fostering skills in product development, computational thinking, design, problem-solving, and inquiry through information technology, and thereby increasing their digital knowledge base, are listed among the priority activities to be implemented by the Turkish Ministry of National Education (MoNE). The digital literacy component within the early childhood education program developed for preschool classes (MoNE, 2024) includes specific goals, such as gaining knowledge about communication tools through digital environments, understanding the functions of digital tools needed in daily life, and raising awareness regarding the appropriate use of digital communication tools according to age and skill level (Ayyıldız, Yılmaz, and Baltacı, 2021). A notable feature of this new program is its emphasis on problem-solving and programming units. Special objectives reveal a significant focus on problem-solving and skills related to PC technologies (Günbatar, 2020; MoNE, 2018).

Digital literacy is defined as a competency that includes the ability of individuals to access information, evaluate information, create content, and use digital tools safely and ethically in the digital world. In this context, it can be said to include literacy areas such as "information literacy, computer literacy, technology literacy, visual literacy, internet literacy, media literacy" (Yanarates, 2020). Today, digital literacy skills have become essential not only for adults but also for early childhood.

In early childhood, digital literacy not only provides children with skills in accessing, evaluating, and securely using digital environments but also increases their active participation in science education processes. Experiences such as concept development, problem-solving, and practicing scientific process skills through digital tools help children grow into responsible individuals in the digital world. Preschool science education, supported by digital tools, encourages hands-on activities that allow children to observe and gain experience about their surroundings (Sırakaya and Seferoğlu, 2019).

The development of digital literacy skills also lays a foundation for children to manage their own learning processes. Studies have shown that children's critical thinking and independent learning skills can be fostered through the conscious use of digital resources (Pangrazio and Sefton-Green, 2021). Digital literacy not only enables access to information but also

enhances children's creative thinking and problem-solving abilities (Cohen and Livingstone, 2022).

For educators and parents, fostering digital literacy in early childhood is a critical responsibility. This responsibility begins with selecting digital environments that are age-appropriate, safe, and educational. Educators must enhance children's scientific and digital skills through content that contributes to their cognitive development while also raising awareness of the risks associated with the digital world (Gottschalk, 2019). Such digital literacy education contributes not only to children's academic and social success but also to preparing them as individuals capable of adapting to the requirements of the digital age.

2. Digital Literacy

Digital literacy is defined as a comprehensive set of abilities that enables individuals to access information in digital environments effectively, analyze and interpret this information, and produce digital content (Ng, 2019; Tingir and Özmen, 2018). These skills include an individual's proficiency in using technological tools consciously, securely, and ethically, equipping them with the necessary knowledge and skills for the digital age. The growing importance of digital literacy can be explained by the rapid digitization of information and the central role digital platforms play in daily life (Iordache, Mariën and Baelden, 2017).

Digital literacy does not only ensure access to information but also aids in developing critical thinking, problem-solving, and creative thinking abilities (Reyna, Hanham and Meier, 2018; Yilmaz, 2021). Introducing digital literacy skills in early childhood supports children in making a conscious entry into the digital world and exploring this world safely. Gaining digital literacy enables children to access accurate information in digital content, develop awareness regarding secure internet usage, and use digital tools creatively (Livingstone, Davidson and Bryce, 2021).

The acquisition of digital literacy skills during the preschool period can have positive effects on children's social, cognitive, and emotional development. For instance, children familiarized with digital tools can improve their problem-solving abilities in interdisciplinary fields such as science education, mathematics, and language (Smith and Franklin, 2020). Therefore, digital literacy is not only crucial for children's digital skills but also serves as an essential cornerstone that supports critical and analytical thinking abilities from an early age (Eshet-Alkalai, 2019).

Moreover, fostering digital literacy encourages children to act ethically and securely within the digital world. Given the various risks associated with digital environments, raising children's awareness of digital safety helps them handle issues such as cyberbullying, privacy violations, and misinformation (Park, 2021). For educators and parents, supporting children's conscious transition into the digital world and promoting the healthy use of digital resources underscore the growing importance of digital literacy.

2.1. Digital Literacy in Early Childhood Education

The preschool period is a critical time during which children develop fundamental cognitive, social, and language skills. During this period, fostering digital literacy skills enables children to make a healthy and conscious step into the digital world (Erstad, 2018). Digital literacy includes skills that support children in using digital tools safely, accessing and evaluating information, producing digital content, and gaining ethical awareness (Alper and Hodges, 2019). Establishing the foundations of digital literacy at an early age is a crucial step in helping children use technology consciously as they grow older (Hobbs and Coiro, 2020).

Developing digital literacy skills in the preschool period not only contributes to children's cognitive development but also enriches their learning experiences in fields like science education, language development, and problem-solving (Yelland, 2021). Research shows that effectively integrating digital content into early childhood education promotes creativity, critical thinking, and collaboration skills (Wartella and Robb, 2019). These skills enable children to actively participate in the learning process through digital tools, equipping them with the abilities required by the digital age.

Gaining digital literacy in early childhood also positively impacts children's social development and communication skills. Preschool is an ideal environment for children to learn how to communicate safely within digital platforms (Plowman and McPake, 2020). Children who receive digital literacy education gain awareness about potential risks in digital environments and develop knowledge of topics like safe internet use and privacy (Edwards, Nolan and Henderson, 2018). This foundation helps children handle negative aspects of the digital world, such as misinformation and cyberbullying.

The responsibility of fostering digital literacy skills in the preschool period is significant for both educators and parents. Educators should introduce children to age-appropriate digital content, fostering awareness of the proper and secure use of digital tools. The acquisition of these skills

provides a substantial foundation for children's future academic success and social lives. Establishing digital literacy in early childhood prepares children to navigate the digital world independently and safely, setting them on a lifelong learning journey (Neumann, 2020).

2.2. Digital Literacy in the Context of Preschool Science Education

The acquisition of digital literacy skills is considered an effective tool in enhancing children's interest in science education processes. Digital literacy not only facilitates children's access to and evaluation of scientific information but also helps make the conceptual content of science education more tangible (Strouse et al., 2018). Through digital tools, children can learn abstract science concepts by experiencing them through digital simulations, animations, and interactive applications. This approach not only increases children's interest in science education but also enhances their scientific thinking and inquiry skills (Hirsh-Pasek et al., 2020).

Integrating digital literacy with science education, especially during preschool, supports children's sense of curiosity and engages them in active learning. For instance, with the help of a tablet or computer, children can observe natural processes such as the water cycle, gravity, or plant growth, participating in learning experiences based on their own observations (Chau, Lee, and Jelfs, 2019). These types of interactive applications keep children's interest in science alive and improve the comprehensibility of the topics (Shin, Sutherland, and Norris, 2020).

Digital literacy skills contribute to children's ability to access information, evaluate it, and create scientific content, which in turn supports their interest in science. Additionally, these skills encourage children to ask scientific questions and utilize digital resources to seek answers. Digital tools integrated into science education allow children to explore at their own pace, enriching individual learning experiences. In this process, children also develop digital content creation skills; for example, they can record their observations by taking digital photographs or share their observations by taking digital notes (Kucirkova and Falloon, 2017).

Educators and parents play a supportive role in fostering children's interest in science through digital literacy skills. By assisting children in using digital environments safely and effectively, educators help them learn scientific knowledge in a more accessible and engaging way (O'Byrne, Schenke, and Lawless, 2020). Science education supported by digital literacy skills not only contributes to children's academic success in science classes but also enhances their critical thinking and problem-solving abilities. In

this context, the contributions of digital literacy to science education stand out as an educational tool that increases children's interest in the scientific world, encourages them to learn, and enables them to understand scientific concepts more easily.

Digital literacy plays a significant role, especially in science education, by helping children develop scientific thinking, problem-solving, and information access skills. The integration of digital tools into science education allows children to gain a deeper understanding of scientific concepts in their environment, enhancing their interest in science (Neumann, 2020). Studies examining the impact of digital literacy on science education show that children retain conceptual knowledge more effectively and meaningfully in science education supported by digital tools (Levine and Phipps, 2021).

Many studies indicate that digital literacy skills help children build a better knowledge structure in science education. For example, with digital simulations and virtual laboratory applications, children can experience scientific concepts in a concrete way. Research shows that digital tools are effective in visualizing abstract scientific concepts, enabling children to learn through experience more successfully (Hirsh-Pasek et al., 2020).

Thanks to digital literacy skills, children can closely examine scientific phenomena in their surroundings and access information about them (Smith and Franklin, 2020). By using digital tools to record their observations and analyze data, children can create scientific content. In this process, digital literacy enhances children's scientific process skills, thereby increasing their success in science education (Livingstone et al., 2021).

2.3. Integrating Cognitive Development Theory into Digital Science Education

Piaget's Cognitive Development Theory explains children's learning processes by considering their developmental stages, describing how they think, learn, and perceive their environment. According to Piaget, children go through four stages in their cognitive development: sensorimotor, preoperational, concrete operational, and formal operational stages. Preschool children are typically within the preoperational stage, covering ages 2–7, during which they acquire concrete knowledge about the world, classify objects, and begin to establish cause-and-effect relationships (Piaget, 1952). These developmental stages can be integrated into digital literacy and science education processes to support children's understanding of scientific concepts and digital skills (Livingstone et al., 2021).

Children in the preoperational stage may have difficulty understanding abstract concepts, so it is essential to use concrete, visual, and interactive materials in digital literacy and science education practices. In line with Piaget's theory, digital tools help children make abstract scientific concepts more tangible. For example, digital simulations for understanding the water cycle or animations showing the stages of plant growth allow children to observe natural phenomena in a concrete way (Neumann, 2020). These applications support children's exploration and comprehension of their experiences at their own pace, aligning with Piaget's concept of learning as an active process (Heath, 2020).

According to Piaget's theory, children learn through experimentation and problem-solving. Applications based on digital literacy and science education allow children to engage in problem-solving in digital environments and create their own experiences. For instance, using a tablet or computer, children can simulate simple scientific experiments or make observations about nature, thereby developing their digital literacy skills. Experiencing learning as an experimental process in this way provides a learning environment consistent with Piaget's cognitive development stages (Hirsh-Pasek et al., 2020). These applications strengthen children's problem-solving and exploration skills, fostering their scientific curiosity.

Furthermore, Piaget's Cognitive Development Theory emphasizes the importance of children's interaction with their environment, suggesting that active participation in digital literacy and science education applications is crucial. Educators can support children's scientific thinking by encouraging them to make observations, analyze data, and record their discoveries in digital environments (Edwards et al., 2018). This approach allows children to reach knowledge through their discoveries and supports their individual learning processes.

In conclusion, Piaget's Cognitive Development Theory offers a significant theoretical framework for structuring digital literacy and science education in early childhood. This theory helps foster critical thinking, problem-solving, and scientific process skills in the digital world by encouraging children's active involvement. Structuring digital literacy and science education based on Piaget's theory contributes to children's understanding of their surroundings and nurtures them as conscious, curious, and inquisitive individuals.

3. Digital Literacy Skills

Digital literacy is a multifaceted concept that encompasses skills such as effective access to information in the digital world, analyzing information, content creation, and safe use of digital tools (Ng, 2019). These skills allow individuals to engage actively and consciously on digital platforms, forming one of the essential pillars of modern education systems. The primary components of digital literacy include effective use of digital tools, critical thinking, information management, and ethical responsibility. Each of these aspects is closely related to individuals' ability to evaluate, create, and use the information and resources offered by digital environments in a secure way.

The first dimension of digital literacy, access to information, refers to individuals' ability to reach information quickly and effectively on digital platforms. This skill involves navigating the vast pool of information on the internet, accessing accurate information, and evaluating the reliability of sources (Livingstone et al., 2021). Information analysis and critical thinking, another critical dimension of digital literacy, enable individuals to critically evaluate information sources. This dimension supports children in coping with misinformation and encourages them to engage more consciously in the digital world (Spante et al., 2018). A third dimension of digital literacy, digital content creation, encompasses children's ability to create their own creative content in digital environments. This skill enables children to produce content in written, visual, audio, or video formats on digital platforms, fostering their creative thinking abilities (Jenkins, Ford and Green, 2018). In the preschool period, children can, for example, create their own stories, draw pictures, or express themselves on digital platforms using digital tools. These types of activities not only increase children's interest in technology but also enhance their ability to express themselves in the digital world (Neumann, 2020). The fourth and final dimension of digital literacy, digital safety and ethics, involves children's learning to navigate digital environments safely and with an understanding of ethical responsibilities. Ensuring children's safe navigation of the digital world is an essential component of digital literacy skills. This skill encourages children to protect their personal information online and adhere to ethical standards in digital environments (Edwards et al., 2018).

These dimensions reveal the multi-dimensional nature of digital literacy, emphasizing that digital skills are not merely technological proficiency but also a cognitive, social, and ethical developmental process. Instilling digital literacy skills from preschool onward provides children with essential preparation for navigating the digital world consciously (Heath, 2020).

3.1. Digital Literacy Skills in the Context of Access to Information

One of the fundamental dimensions of digital literacy skills involves individuals' ability to access information in digital environments and use this information effectively. Information access skills enable individuals to find information in digital platforms, evaluate and analyze this information (Ng, 2019). When digital literacy education begins in the preschool period, these skills support children's ability to access information and develop habits of evaluating information sources accurately. In the digital age, access to information contributes significantly to children's learning processes by enhancing their critical thinking and inquiry skills (Livingstone et al., 2021).

Information access skills are crucial in enabling children to reach reliable and accurate information in digital environments. This skill set includes selecting trustworthy sources on the internet, avoiding misleading information, and developing their analytical abilities. Developing information access skills in the preschool period prepares children for their future educational journeys and strengthens their critical thinking abilities (Heath, 2020). The core aspects of information access skills include children's selection of reliable sources, avoidance of misleading information, and ability to analyze their own knowledge (Levine and Phipps, 2021).

In the context of information access, digital literacy skills allow children to navigate the digital world effectively and equip them to handle misinformation. Children learn to question, investigate the accuracy of information they encounter on digital platforms, and seek additional information when necessary. In this process, digital literacy skills encourage children to ask questions, explore ways to access information, and understand how to apply this information in their learning (Edwards et al., 2018). Information access skills also support children's sense of curiosity, involving them in an active learning process.

Educators and parents can support children's information access skills by utilizing digital tools. For instance, introducing children to digital libraries or reliable educational applications fosters their research skills and helps them evaluate information from a critical perspective (Hirsh-Pasek et al., 2020). Such supportive practices develop children's abilities to analyze and question information in digital environments while also fostering their independence as learners (Neumann, 2020). With digital literacy education, children's information access skills strengthen, making it easier for them to reach accurate and reliable information in the digital world.

3.2. Digital Literacy Skills in the Context of Digital Safety

Digital safety, a critical dimension of digital literacy, aims to enable children to navigate the digital world securely. Digital safety skills encompass competencies such as protecting personal information online, developing awareness of digital threats, and adhering to ethical responsibilities in digital environments (Livingstone et al., 2021). These skills are especially important today, as digital platforms rapidly integrate into children's daily lives, providing them with the ability to engage in the digital world safely without encountering online risks (Edwards and Henderson, 2018).

Developing children's digital safety skills helps them recognize potential online risks, such as cyber threats, deceptive content, and cyberbullying, and encourages awareness of online security from an early age (Heath, 2020). The acquisition of digital safety awareness includes teaching children to protect their personal privacy, avoid sharing identity information, and refrain from communicating with unknown individuals online (Hobbs and Coiro, 2020).

Instilling digital safety skills from an early age encourages children to behave ethically and responsibly within the digital world. Providing children with digital safety education helps them develop awareness of issues like cyberbullying, misinformation, and ethical conduct in digital environments.

For instance, educators and parents can help children learn basic principles such as respecting others' rights in digital environments, avoiding unreliable content, and acting respectfully (Chaudron et al., 2020). Digital safety awareness enables children to not only access information but also use it responsibly in a secure manner.

Parents and educators can support children's digital safety awareness by offering age-appropriate digital safety guidance. Teaching children about potential risks on digital platforms, showing them how to use digital safety tools, and raising awareness about cybersecurity promote the development of digital literacy skills.

For example, explaining the weaknesses of simple passwords or providing suggestions for online privacy helps children learn basic security rules (Levine and Phipps, 2021). Acquiring digital safety skills helps children not only navigate the digital world securely but also engage ethically, contributing to their healthy development as responsible digital citizens.

3.3. Digital Literacy Skills in the Context of Content Creation

Another essential dimension of digital literacy skills is individuals' competency in creating content within digital environments. Content creation involves using digital tools to produce information, visuals, videos, and written materials and sharing these creations (Levine and Phipps, 2021). This competency enables children to actively contribute as creators in the digital world rather than merely being passive recipients of information. Content creation skills play a significant role in enhancing children's creative thinking, problem-solving, and self-expression abilities in the digital world (Ng, 2019).

Developing children's content creation skills allows them to produce unique digital content, supporting their cognitive development. In the context of digital literacy, content creation provides children with creative activities, such as storytelling, drawing, or recording short videos, which strengthen their self-expression abilities (Neumann, 2020). Additionally, content creation positively impacts children's learning in areas like science education, language development, and social skills. For example, activities like recording nature observations or creating scientific content with digital tools enhance children's scientific thinking abilities (Heath, 2020).

Supporting content creation skills encourages children to participate in the digital world as not only consumers but also as creators. While creating unique content in digital environments, children have the opportunity to develop creative thinking skills. This process allows children to practice problem-solving by generating new ideas, combining visual and written tools, and creating their own content (Chaudron et al., 2020). Content creation is also a valuable area for developing individual creativity, as children who prepare digital projects not only adapt to technology but also gain confidence by producing original work (Kucirkova and Falloon, 2017).

Educators and parents can support children's content creation skills by encouraging them to use age-appropriate digital tools for content creation. This approach not only enhances their creative thinking capacities but also allows them to express themselves in the digital world (Hirsh-Pasek et al., 2020). Including content creation skills in digital literacy education enables children to experience the process of creating their own digital content, moving beyond passive consumption. Integrating content creation into digital literacy education provides a strong foundation for children to become active participants in the digital age.

3.4. Digital Literacy Skills in Early Childhood Education

Early childhood is a period during which children rapidly develop fundamental cognitive, social, and motor skills. The integration of these skills into daily life is crucial for children to understand their surroundings, acquire problem-solving abilities, and form social relationships (Edwards and Bird, 2017). Digital literacy skills learned at an early age also merge with daily life, providing a solid foundation for children's educational journeys. Digital literacy skills, encompassing areas like information access, content creation, and safe internet use, contribute to children's growth as confident and conscious individuals in their daily lives (Neumann, 2020). Educators and parents play a significant role in integrating digital skills into daily life. For instance, when children access safe information through digital platforms, educators guide them toward reliable sources and support a critical approach to information. Similarly, creative digital skills like content creation are integrated into children's daily lives, fostering problem-solving and creative thinking abilities (Hirsh-Pasek et al., 2020). This integration process allows children to express themselves in digital environments, promoting their development as creative individuals.

The integration of skills acquired in early childhood into daily life positively impacts children's social relationships as well. Digital literacy skills encourage children to act responsibly and communicate safely both online and offline (Livingstone et al., 2021). Teaching these skills in early childhood not only prepares children to be responsible individuals in the digital world but also supports social skills like empathy and cooperation. Digital safety awareness enables children to navigate online environments securely and take precautions against potential risks (Levine and Phipps, 2021). Integrating digital literacy skills into daily life also provides a solid foundation for children's future educational experiences. By using digital tools responsibly in daily life, children develop a conscious approach to their surroundings and enhance their critical thinking abilities (Heath, 2020). In this process, educators can encourage children to develop their own projects using digital tools and create content connected to daily life, boosting their confidence and interest in learning. For example, children who record nature observations in a digital journal or share their scientific discoveries nurture their interest in the environment and integrate learning with daily life (Chaudron et al., 2020).

In conclusion, integrating digital literacy skills acquired in early childhood into daily life is essential for nurturing children as confident, conscious, and responsible individuals in the digital world. This integration supports the

development of both digital and social skills, preparing them for future academic and social challenges.

4. Digital Literacy Applications in Preschool Science Education

Integrating digital literacy skills into preschool science education offers teaching approaches that enable children to understand scientific concepts and use digital applications effectively. Educators are developing various digital applications to support these skills. By combining digital literacy with preschool science education, these applications not only encourage children's active participation but also enhance their learning processes (Heath, 2020). Below are examples of digital applications related to digital literacy activities.

4.1. Examples of Digital Applications through Activities

- *Digital Experiment and Observation Activities:* Digital experiment applications for preschool children are an effective tool to make scientific concepts more tangible. Educators can introduce children to simple digital simulations that allow them to observe topics such as the water cycle, plant growth, or weather events. For example, children can observe plant growth stages using a tablet application and record their observations in a digital journal. Such activities allow children to explore scientific processes at their own pace (Neumann, 2020).

- *Digital Photography and Video Journaling Activities:* Encouraging children to observe nature around them using digital devices and recording these observations helps develop their scientific thinking skills. Educators can encourage children to take photographs during nature walks with digital cameras or tablets. Children can then share these images in the classroom and discuss their experiences. For example, photographing seasonal changes or the growth stages of plants helps children observe their environment more consciously (Chaudron et al., 2020).

- *Interactive Scientific Story and Simulation Applications:* Scientific storybooks and interactive simulations are effective tools for capturing children's interest in science topics. Educators can present interactive story applications that cover scientific concepts, such as the water cycle or animal life cycles. For example, digital storybooks on topics like "Chasing a Shadow" help children understand concepts like shadow and light by interacting with the stories, turning abstract ideas into concrete experiences (Livingstone et al., 2021).

- *Basic Coding and Digital Design Applications:* Coding activities are valuable tools for enhancing children's digital literacy skills and supporting their problem-solving abilities. Tools such as Scratch Jr. or Coding Cards allow children to create digital designs and animations through basic commands. Educators can use simple coding applications to help children create stories related to science topics, such as the water cycle or animals. These activities support children's digital content creation skills (Heath, 2020).

In summary, integrating digital literacy skills into science education is an effective educational strategy that supports children's scientific thinking skills and fosters their development as conscious digital citizens. Educators can enhance children's digital literacy skills with these application examples and practical suggestions, increase their interest in science, and encourage them to explore their environment with a scientific perspective.

4.2. Digital Literacy Activities for Educators

Developing digital literacy skills during the preschool period is essential for nurturing children as conscious digital citizens. Educators can implement various digital literacy activities that integrate with science education to help children develop these skills from an early age. These activities contribute to enhancing children's digital abilities as well as their scientific thinking capacities (Heath, 2020). Below are some recommended digital literacy activities for educators.

- *Animation Activities:* These activities are effective for developing children's problem-solving, creativity, and algorithmic thinking skills. Educators can use simple tools like Scratch Jr. to help children create short animations or stories on science topics. For example, children can create an animation about the changing seasons, reinforcing both their science knowledge and content creation skills (Chaudron et al., 2020).

- *Creating Digital Nature Journals:* To help children explore nature, teachers can organize digital nature journal activities. Children can take photos of plants, animals, or weather conditions in their environment using tablets or digital cameras, recording their observations. This activity allows children to note changes in their surroundings and enhances their scientific observation skills. Educators can discuss the photos taken during nature trips in class to reinforce learning experiences (Neumann, 2020).

- *Digital Experiments and Observation Activities:* Digital simulations and experiment applications help children understand abstract scientific concepts more easily. Educators can present interactive applications on topics like the water cycle, photosynthesis, or animal life cycles. For instance, children can use a tablet to observe plant growth stages or simulate weather cycles, helping them comprehend scientific concepts (Livingstone et al., 2021).

- *Digital Storytelling and Presentation Activities*: Digital storytelling activities allow children to present scientific topics in their own words, developing both digital literacy and science knowledge. For example, children can create digital stories about themes like "Chasing a Shadow" or "A Tree's Seasonal Journey," allowing them to visually present what they've learned. During this process, children can add photos or drawings to their stories, supporting their content creation skills (Smith and Franklin, 2020).

- *Digital Safety and Ethical Awareness Games:* An essential component of digital literacy education, digital safety aims to foster safe internet use and ethical awareness in children. Educators can use digital safety games or interactive stories to teach children safe online behaviors. For instance, a story can illustrate the importance of protecting identity information online, helping children gain cybersecurity awareness (Edwards and Henderson, 2018). These activities support children in navigating the digital world safely.

With these activities, educators can help children develop digital literacy skills from an early age, nurturing them to become confident and responsible individuals in the digital world.

4.3. Digital Tools for Preschool Science Education

Enhancing digital literacy in preschool science education supports children's understanding of scientific concepts and strengthens their digital skills. Digital tools provide children with significant advantages in accessing information, making observations, recording experiences, and creating content. Below are several digital tool recommendations for supporting digital literacy and science education processes:

Scratch Jr. - Basic Coding and Scientific Storytelling

- *Purpose:* Scratch Jr. allows children to create animations and stories through simple coding, fostering creativity and problem-solving skills.

- *Features:* Children can use coding to explain scientific concepts (e.g., seasons, the water cycle) and learn science topics in an engaging way.

- *Contribution to Science Education:* By coding and animating scientific events, children can gain a better understanding of these phenomena (Chaudron et al., 2020).

Nature Cat's Great Outdoors - Nature Observation and Exploration Application

- *Purpose:* This app helps children observe nature and learn about plants, animals, and weather events in their surroundings.

- *Features:* Children can explore the outdoors and document their observations on plants, insects, and other natural elements.

- *Contribution to Science Education:* Documenting observations digitally fosters children's participation in the scientific research process and raises their environmental awareness (Livingstone et al., 2021).

Toca Lab - Interactive Experiments with Elements

- *Purpose:* Toca Lab allows children to learn basic chemistry concepts and conduct interactive experiments with elements.

- *Features:* Children explore elements by experimenting with heating, cooling, centrifuging, and observing different outcomes.

- *Contribution to Science Education:* This tool sparks curiosity in science and presents fundamental scientific concepts in an engaging format. Children gain hands-on experience with the states of elements (Heath, 2020).

Duck Duck Moose - Digital Stories on Climate and Nature

- *Purpose:* This application provides interactive stories on topics like climate changes, weather, and nature, contributing to science education.

- *Features:* Through interactive stories, children learn about weather and climate while creating their own narratives.

- *Contribution to Science Education:* This tool aids children in understanding natural events while enhancing creativity and understanding of scientific concepts (Neumann, 2020).

Seek by iNaturalist - Plant and Animal Identification Application

- *Purpose:* Seek assists children in identifying plants and animals they encounter in nature, encouraging exploration.

- *Features:* Using their cameras, children can identify species and learn more about them, documenting their observations.

- *Contribution to Science Education:* This app promotes children's interaction with nature and encourages scientific observation and awareness (Edwards and Henderson, 2018).

Bee-Bot - Simple Robotics and Science Education with Movement Commands

- *Purpose:* Bee-Bot is a programmable robot that can be used in science education activities, allowing children to use basic commands to control its movements.

- *Features:* Children can program the robot to explore science concepts, like the water cycle or food chains.

- *Contribution to Science Education:* Programming Bee-Bot helps children concretize scientific concepts and enhances coding, problem-solving, and planning skills (Smith and Franklin, 2020).

These digital tools support children's digital literacy and science education, increasing their interest in scientific topics and helping them develop as active participants in the digital world. Educators can use these tools to support children's learning processes and improve their understanding of scientific concepts.

4.4. Digital Literacy Training for Educators

Integrating digital literacy skills into preschool science education requires educators to effectively use digital tools. Digital literacy training for educators supports their adaptation to technology, helping them gain skills in digital content creation, digital safety, and data analysis. These training programs can include various workshops and seminars aimed at making science education, supported by digital skills, more effective. Below are some key components and benefits of digital literacy training recommended for educators.

Training on Digital Tool Usage and Integration into Science Education

- **Content:** This module teaches how to integrate digital tools into preschool science education. Educators learn to adapt tools like tablet applications, simulations, and simple coding tools to science topics.

- **Benefits:** Educators gain practical knowledge on using digital tools to enhance children's scientific thinking, observation, and content creation skills. For example, they learn how to use digital applications that explain science concepts like the water cycle or plant growth (Chaudron et al., 2020).

Digital Content Creation and Creative Pedagogy Training

- **Content:** In this training, educators acquire digital content creation skills, allowing them to produce digital stories, animations, and visual materials suitable for science education. The program also emphasizes teaching strategies that foster creative thinking.

- **Benefits:** Educators gain the ability to create digital stories or simple animations to explain scientific concepts to children in an understandable way, increasing their interest in science and making learning more enjoyable (Livingstone et al., 2021).

Digital Safety and Ethical Awareness Training

- **Content:** Covering topics related to digital safety and ethical use, this training provides educators with information on online security, data privacy, and digital ethics. It equips them to encourage children to adopt safe online behaviors.

- **Benefits:** This module ensures that educators are well-versed in essential digital safety knowledge, enabling them to educate children on safe online behaviors in digital environments (Edwards and Henderson, 2018).

Coding and Robotics-Based Digital Literacy in Science Education

- **Content:** This training aims to teach educators how to use basic coding and robotics applications suitable for the preschool period. It includes tools like Scratch Jr., Bee-Bot, and other robotic tools that can be integrated into science topics.

- **Benefits:** By using coding and robotics tools, educators support children's ability to create short animations or robotic tasks related to science topics. This training contributes to enhancing children's problem-solving and creative thinking skills (Heath, 2020).

Digital Pedagogy and Technology-Enhanced Learning Strategies Training

- **Content:** This training provides educators with knowledge about digital pedagogy and introduces technology-enhanced learning strategies. The focus is on effective use of digital tools, technology integration, and student-centered learning approaches.

- **Benefits:** Educators learn how to integrate digital tools using a child-centered approach, helping children develop digital literacy skills and increasing their interest in science through effective methods (Neumann, 2020).

Digital literacy training for educators enables them to participate actively in science education and enrich children's learning processes with digital tools. Such programs help educators use digital tools effectively, fostering children's development as safe, creative, and conscious individuals in the digital world.

5. Conclusion and Discussion

Integrating digital literacy into preschool science education is an important approach that enhances children's scientific thinking, problem-solving, creative content creation, and safe navigation skills in the digital world. Digital tools offer children opportunities for information access, observation, and content creation, increasing their interest in science education and facilitating their understanding of scientific concepts. Teaching digital literacy skills to children from an early age not only nurtures them as conscious individuals in the digital world but also raises their awareness of scientific processes.

In conclusion, digital literacy allows children to learn abstract scientific concepts through concrete experiences. With the help of digital tools, children can better understand concepts such as the water cycle and photosynthesis and gain knowledge about natural phenomena.

Experiments, observations, and content creation experiences with digital tools strengthen children's scientific thinking abilities and foster their curiosity about science. In this sense, digital literacy contributes to children's analytical thinking, creative problem-solving, and critical perspective on information.

Digital safety and ethical awareness training help children develop safe online behaviors and become responsible digital citizens.

Integration of Digital Literacy into the Science Curriculum: Educators can offer an interactive and engaging learning environment by integrating digital tools into science education. Adding digital literacy activities to the preschool curriculum supports children's development in scientific thinking and problem-solving (Heath, 2020).

Organizing Digital Literacy Training Programs for Educators: Supporting educators with training on the effective use of digital tools and integration into science education is essential. Workshops and seminars on digital content creation, digital safety, and data analysis can enhance educators' skills in these areas (Edwards and Henderson, 2018).

Promoting Nature Observation and Digital Journals: Encouraging children to observe nature and record their observations digitally increases their interest in science education. Digital nature journals, for instance, help children develop observation skills and environmental awareness (Neumann, 2020).

Supporting Science Topics with Coding and Robotics Activities: Simple coding and robotics tools help children better understand science topics and learn scientific concepts through hands-on experiences. Coding tools and robotics kits suitable for the preschool period provide an engaging and meaningful way to teach science concepts (Chaudron et al., 2020).

Encouraging Family Involvement and Informing Families on Digital Safety: To enhance the success of digital literacy education, family involvement is vital. Informing families about digital safety and basic internet usage rules helps children engage with digital environments more safely (Livingstone et al., 2021).

In general, integrating digital literacy skills with science education from an early age equips children with scientific thinking and digital awareness. Educators can use digital tools effectively to increase children's interest in science and support their development as safe, creative, and conscious individuals in the digital world. This integration between digital literacy and science education provides a forward-looking educational approach that supports children's academic success and social development.

6. Recommendations

Preschool science education is essential for fostering children's curiosity about the world, developing scientific thinking, and acquiring problem-solving skills. Science education supports children in developing a positive attitude toward lifelong learning by nurturing scientific curiosity from

an early age. In this process, educators and parents can use the following recommendations to attract children's interest and support their learning journey:

Encourage Nature Observations to Spark Scientific Curiosity

- *Recommendation:* Organize nature walks, garden tours, or outdoor activities to encourage children to observe nature, notice changes in their surroundings, and ask questions.

- *Implementation:* Provide children with digital cameras or tablets to observe and record environmental elements like plants, animals, and weather. Encourage them to take notes and ask questions about their observations. Such activities help children develop observation and curiosity skills (Neumann, 2020).

Additionally, tools like Google Expeditions or National Geographic Virtual Tours offer children the chance to explore ecosystems like forests or marine life. Through virtual observations, they can learn about animal species and plant diversity (Hwang and Wang, 2016).

Organize Experiential Learning Activities

- *Recommendation:* Support science education with simple experiments that promote experiential learning, as children learn by directly observing scientific processes through experiments.

- *Implementation:* Virtual chemistry lab simulations, such as Labster, allow children to create experimental setups and learn by combining different materials, fostering experiential learning (De Jong, Linn and Zacharia, 2013).

Use Digital Tools to Make Scientific Concepts More Tangible

- *Recommendation:* Utilize digital tools to create an interactive learning environment in science education. Digital simulations and animations make abstract concepts more comprehensible for children.

- *Implementation:* For example, a tablet or computer animation explaining the water cycle can help children observe processes like evaporation, condensation, and precipitation more concretely. Digital tools increase children's interest in scientific concepts and make learning easier (Heath, 2020).

Provide On-Site Experiences with Augmented Reality Applications

- *Recommendation:* Augmented reality applications allow students to examine specific objects in their physical environment or view 3D

science concepts. For example, supporting the experience of growing a plant at home with augmented reality enables children to observe each stage of growth.

- *Implementation:* With applications like Plantale AR, children can virtually care for a plant, observing each phase from seed germination to full growth (Wu et al., 2013).

Offer Science Teaching Opportunities Through Digital Games

- *Recommendation:* This study investigates how digital games can be effective tools in learning processes. It provides extensive insights into the impact of educational games on science education and how game-based learning environments enhance children's motivation.

- *Implementation:* Educational applications like BrainPOP or Tinybop allow children to play games on topics like physics, chemistry, and biology. For example, they can reinforce concepts related to the water cycle or life cycles by engaging in digital games (Gee, 2003).

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