Universiteit Leiden
The Netherlands

Opleiding Informatica

Teacher Experiences on the New Digital Literacy Learning Trajectory in Primary School Education

Milan de Boon

Supervisors:
Anna van der Meulen & Tyron Offerman

BACHELOR THESIS

Leiden Institute of Advanced Computer Science (LIACS)
www.liacs.leidenuniv.nl

25/07/2024

Abstract

This thesis investigates how teachers experience the implementation of digital literacy, which became a mandatory part of the curriculum for primary schools in the Netherlands in the summer of 2023. The study focuses on the obstacles encountered and the learning goals for Computational Thinking, including how it is taught. To gather the data, interviews were conducted with individuals actively engaged with digital literacy working in primary education. This approach provides insights into how teachers perceive and work with digital literacy. The main obstacles identified include motivating fellow teachers, the lack of knowledge among teachers and the difficulty of integrating digital literacy into the lesson schedule. These challenges highlight the current issues faced in implementing digital literacy.

Contents

1 Introduction **1**
1.1 Research Questions 1
1.2 Overview 2

2 Theoretical Framework **2**
2.1 Importance of digital literacy and its current status 2
2.2 Digital Literacy in Europe 3
2.2.1 Sweden 3
2.2.2 Finland 4
2.2.3 Flanders 5
2.3 Domains of Digital Literacy 6
2.3.1 Practical ICT Skills 6
2.3.2 Media Knowledge 6
2.3.3 Digital Information Skills 7
2.4 Computational Thinking 7
2.4.1 Plugged and Unplugged 8
2.4.2 Tools 8
2.5 Instruction and working methods 9
2.5.1 Discovery Learning and Direct Instruction 10
2.5.2 Working Methods 10

3 Method **10**
3.1 Setting and Participants 11
3.2 Procedure 11
3.3 Interviews 12
3.4 Analyses 12

4 Results **13**
4.1 Set up Digital Learning Trajectory 14
4.1.1 Previous Digital Literacy Efforts 14
4.1.2 Curriculum Development Process 14
4.1.3 Training in Digital Literacy 15
4.2 Teaching Methods in Practical ICT Skills, Media Literacy and Digital Information Skills 16
4.2.1 Practical ICT Skills 16
4.2.2 Media Literacy 17
4.2.3 Digital Information Skills 18
4.3 Computational Thinking 18
4.3.1 Learning Goals 19
4.3.2 Learning Methods 20
4.3.3 Tools 20
4.4 Experience with Teaching Digital Literacy 21
4.4.1 Positive Experience 21

4.4.2 Obstacles and Negative Experiences . . . 22

5 Discussion & Conclusion **24**

5.1 Experiences in digital literacy and Obstacles encountered . . . 25

5.2 Computational Thinking goals and teaching methods . . . 26

5.3 Limitations of the study . . . 28

5.4 Further Research . . . 28

5.5 Concluding Remarks . . . 29

References **30**

A Interview Guide **33**

1 Introduction

Digital skills are crucial in society, as everything involves technology and knowing how to use it well is a necessity. Digital literacy encompasses a wide range of skills such as working with devices, finding information and thinking critically. These skills are important and can help children throughout their lives. Digital literacy became a mandatory subject in primary education since the summer of 2023. The status of digital literacy in primary education has been monitored by various organizations. The outcomes of these monitors all agreed that digital literacy skills among primary school students are inadequate (van Rooyen, Demaret, & van Kessel, 2021). To address this issue, the Dutch government has mandated digital literacy education.

Currently, digital literacy is divided into four domains: Basic ICT Skills, Media Literacy, Digital Information Skills and Computational Thinking. While some schools have been integrating aspects of digital literacy for years, others have just started. Internationally, there is information on how digital literacy is implemented in primary education. For instance, Finland and Sweden have been working on this for some time, and Belgium, a country similar to the Netherlands, is also implementing it. These countries face various obstacles that could provide valuable lessons for the Netherlands.

There is a lot of knowledge about digital literacy teaching methods. Research suggests that direct instruction tends to work better than discovery learning (Kirschner, Sweller, & Clark, 2006). Teachers often use various tools during Computational Thinking lessons, some involving electronics and others not. Various research shows that both classes of tools could be effective if used correctly (Lin, Liao, Weng, & Dong, 2023). There are countless tools available, and schools have the freedom to make their own choices. Much information is available on which types of tools work best in different learning phases (Yu & Roque, 2018).

1.1 Research Questions

This study seeks to learn how teachers experience the new digital literacy curriculum and what obstacles they encounter. This study first aims to gain a general understanding of how schools regulate and teach digital literacy. After understanding how digital literacy is taught within schools, the study will explore teachers' experiences with the new curriculum. This leads to the following research question:

- **How do teachers experience the new digital learning trajectory and what obstacles do they experience?** [RQ1]

Part of the new digital literacy curriculum is Computational Thinking. Computational Thinking encompasses various skills such as data processing, decomposition, pattern recognition, abstractions and algorithms. These skills are often taught with tools and assignments. Schools are free to choose their teaching approach. Previous research has shown that there are common misconceptions about teaching Computational Thinking especially within the computer science community. The next research question is therefore proposed:

- **How do teachers teach Computational Thinking and what skills do they aim to convey to the students?** [RQ2]

The study includes interviews with the main parties involved in teaching digital literacy in primary schools. These parties are asked about their approach to the new curriculum and the experiences they already have with it. Section 3. provides a more detailed explanation of the methods used in this study.

1.2 Overview

This bachelor's thesis aims to provide an overview of the implementation of digital literacy in primary schools. The study was conducted in collaboration with Anna van der Meulen and Tyron Offerman at the Leiden Institute of Advanced Computer Science (LIACS). First, Section 2 provides a literature review to explore the current state of digital literacy and existing knowledge. Then, Section 3 outlines the study's methodology. Section 4 presents the results. Finally, Section 5 addresses and discusses the research questions.

2 Theoretical Framework

2.1 Importance of digital literacy and its current status

In light of global trends towards digitalization, the early acquisition of digital literacy skills is becoming increasingly important. Digital literacy refers to effectively using digital technologies for communication, information management and problem-solving. Educational institutes worldwide are tasked with integrating digital literacy into the primary education curriculum. The Curriculum Development Foundation of the Netherlands (SLO) develops the curricula for Dutch primary, special and secondary education (Ontwikkeling, 2023).

Since summer 2023, digital literacy has been an official part of the curriculum (van Algemene Zaken, 2024). While some schools have already integrated this, others have started this year. The SLO Institute has constructed a learning trajectory for digital literacy (SLO, 2022a). The SLO Institute divides the field of digital literacy into four domains. These subdomains are Practical ICT Skills, Media Knowledge, Digital Information Skills and Computational Thinking (SLO, 2022b). Practical ICT Skills involves correctly using digital systems and understanding how these systems work. Media Knowledge focuses on engaging with digital media safely and appropriately. Digital Information Skills aims at the use of digital technology to find and use information appropriately. Computational Thinking is about developing skills and strategies to formulate and solve complex problems sometimes with the aid of a computer. The SLO institute has made a list of skills children must learn for every subdomain. However, this list does not tell teachers how these subjects should be taught. The SLO Institute is still working on the issue.

Before digital literacy was a mandatory subject in primary school, the SLO conducted a monitor to assess the state of digital literacy (Advies, 2023). While digital literacy was not a mandatory subject, a substantial amount of schools had already implemented it in one form or another. The monitor sought to understand the state of digital literacy and get insight into the conditions necessary to improve digital literacy. Among the key findings, it was revealed that 62% of school principals reported that their school systematically worked on digital literacy. According to the report, 48%

of teachers used a learning trajectory or learning goals when teaching digital literacy. The monitor concludes with three main objectives that must be met to improve digital literacy. Firstly there is a need to emphasize the importance of digital literacy, 36% of the surveyed teachers did not see the importance of digital literacy. It is suggested that making digital literacy a mandatory subject within the curriculum could change this. Secondly, implementing a plan for teaching digital literacy is crucial. 34% of the surveyed schools had a digital literacy team. Establishing such teams ensures a systematic approach to digital literacy education, enhancing its efficacy. The last issue is time allocation. Teachers and schools have many responsibilities and a limited amount of time. .A concrete learning path and teaching materials will reduce the time investment required to teach digital literacy. The monitor emphasized that significant disparities exist between schools and that substantial progress must be made if digital literacy is formally integrated into the curriculum.

While the digital literacy curriculum is still under development, it continues to change and evolve. In March 2024 the SLO Institute released a draft of the core objectives of digital literacy (SLO, 2024a). This draft contains a very detailed description of all the fundamental goals that should be taught in digital literacy. The current four domains of digital literacy will be reduced to three: Practical knowledge and skills, design and create and the relationship between the student, the world and digital technology. These three domains will totally have nine core objectives. SLO mentions that the content of the original four domains is still usable.The educational field will consult on the draft of the core objectives, which are currently undergoing testing. Once finalized these core objectives will be laid down in the law. The importance of not only defining these fundamental goals but also developing corresponding learning paths and supplementary materials for effective implementation is also underlined. In the future, the SLO Institute aims to address this by developing structured learning paths and supportive materials to complement the core objectives of digital literacy. it is clear that digital literacy has only just become a mandatory part of the curriculum and that a lot is still changing even though schools are obliged to teach it. In the coming years, all core objectives will be established and hopefully, a clearer picture will emerge of what is expected of schools and teachers.

2.2 Digital Literacy in Europe

Given the global digitalization trend, countries around the world are either developing curricula in digital literacy or have already implemented it. Within Europe, the Netherlands is one of the most digitally advanced nations. It is part of a cluster of countries characterized by high levels of digitalization ("Digitalization Clusters within the European Union", 2019), including Denmark, Finland, Norway, and Sweden. These Scandinavian countries already implemented digital literacy in their curricula and have been teaching it for some time. Therefore these countries are seen as a primary example of how digital literacy could be implemented in the Netherlands (SLO, 2023a).

2.2.1 Sweden

The European Commission views Sweden as one of the most progressive countries in Europe in the field of digital literacy (Commision, 2023). In Sweden digital literacy became a mandatory subject of the curriculum in 2018 (Commision, 2018). There were three main focus areas of interest in Sweden's strategy. The first area was digital competence for everybody in the school system.

The second area was equal access and use of digital systems, and the last area was research and evaluation of the possibilities of digitalization. Media reports suggest that the implementation of digital literacy in Sweden has been quite effective. However, research shows that it was not entirely without difficulty. In 2019, one year after digital literacy became mandatory, the NAE (The Swedish National Agency for Education) conducted a monitor to assess the state of digital literacy (Skolverket, 2019). The three main findings were that digitalisation has had a greater impact in later years of compulsory school and upper-secondary schools, preschool staff and teachers feel the need to develop their digital skills and access to technical and educational support varies in preschools, schools, and municipal adult education.

The biggest obstacle to Sweden's digital transition seems to be the lack of skills teachers have in the field of digital literacy. The absence of digital skills among teachers remains one of the three primary areas of focus for digital literacy (Andric, 2023). A part of the digitalization in primary school was a mandatory replacement of all books with tablets and laptops. The Swedish government deemed this a necessary measure to advance the digitalization of education. As of 2024, the Swedish government intends to reintroduce books (och Regeringskansliet, 2024) into primary education. This decision comes from research findings indicating that the use of tablets and laptops negatively affects attention and working memory among students in combination with a big drop in the reading ability of Swedish children (Reporter, 2023). Sweden is a completely different nation than the Netherlands. Children in Sweden are introduced to the digital world from an early age, often having access to smartphones or tablets, which makes the transition to digital lessons easier (Söderqvist, Hardell, Carlberg, & Mild, 2007). Despite significant disparities between the Netherlands and Sweden, valuable insights can be drawn from Sweden's five-year experience in implementing digital literacy in education.

2.2.2 Finland

Finland is the most digital country in Europe (Commision, 2023). Finland has been teaching digital literacy for a long time and could therefore be a useful example for the Netherlands. The school system in Finland is completely different than in the Netherlands. The school days are shorter, there are no mandatory tests and children only go to primary school from the age of 7. It is also different for teachers. Teachers all have a university degree, can partly determine their curriculum and are subject to less supervision. Although the school systems between the Netherlands and Finland differ significantly, Finland's approach to teaching is widely regarded as a leading model for an ideal school system (Morgan, 2014). Finland established and updated its core curriculum in 2014, with minor updates occurring over time. The core curriculum outlines the essential subjects that children must learn. Schools and teachers have the flexibility to determine the rest of the curriculum. The core curriculum emphasizes three main areas related to digital literacy: Digital Competence, Media Literacy, and Programming Competence.

The first area, Digital Competence consists of four areas: Practical skills and personal production, Security and responsibility, Information management and inquiry-based and creative work and lastly Interaction (ePerusteet palvelu, n.d.-a). Digital Competence is a mix of the three Dutch domains: Practical ICT Skills, Media Knowledge and Digital Information Skills. The curriculum clearly states competencies and concisely outlines the tasks required within a specific timeframe. An example would be: "In grades 3-6, the pupil knows how to connect a device to a wireless network.". Media Literacy is another part of the core curriculum. Finland has been teaching Media Literacy since 2004. In 2019 the area was completely updated to better represent current day issues. Media Literacy consists of three main areas: Interpretation and evaluation of media, media production and lastly operating in media environments (ePerusteet palvelu, n.d.-b). Media Literacy bears resemblance to the media knowledge domain in the Netherlands, yet Finland's Media Literacy domain encompasses a significantly wider range of topics. Like digital competence, Media Literacy includes detailed descriptions of competence that outline the specific skills and knowledge required for acquisition. Programming competence is another element of the core curriculum. Programming competence consists of three main areas: Computational Thinking, inquiry-based work and producing and lastly programmed environments and operating in them (ePerusteet palvelu, n.d.-c). In contrast to the Dutch approach where Computational Thinking is the main focus and programming a subset, the focus is on programming with Computational Thinking as part of it. The competence descriptions are broader and less concrete compared to those for Digital Competence and Media Literacy. It is mentioned that the objectives for Programming Competence must be supplemented and enriched locally.

As mentioned the school systems of Finland and the Netherlands differ greatly, making it challenging to directly compare their primary education to the Dutch. In Finland, primary education starts at the age of 7 to 16, while in the Netherlands, it is from the age of 4 to 12. Despite the differences, the Netherlands can certainly learn from Finland's approach to digital literacy. The first thing that immediately stands out is how clear all of the competence descriptions are, making it very clear what is and is not part of the curriculum.

2.2.3 Flanders

Belgium and the Netherlands share many similarities and Belgium could therefore be a useful example of how to teach digital literacy. Belgium's educational system is divided into two different systems: Wallonia and Flanders. Due to the shared language and geographic proximity, Flanders's educational system more closely resembles the Netherlands and would be a better comparison. While digital literacy is not a mandatory component of Flanders's curriculum, ICT education is obligatory (Agentschap voor Hoger Onderwijs, n.d.). ICT translates to informatics and communication technology comparable to the Practical ICT Skills domain. Flanders ICT education also has goals from the Media Knowledge and Digital Information Skills domain, such as safe use of the internet and the ability to search and use digital information. The biggest contrast to the Dutch approach is that Flanders's curriculum does not have an integration of Computational Thinking. Currently, there are no plans to make Computational Thinking a mandatory part of the curriculum. The fact that Computational Thinking is not mandatory does not mean that primary schools do not teach this subject. The Flemish institute of education released a book on programming and Computational Thinking in education (Bastiaensen & de Creamer, n.d.). This book contains information, practical examples and tools to familiarize students with the digital world. The book also states expectations from schools in the area of Computational Thinking. Thus, schools are taking steps to include Computational Thinking in their lessons, despite it not being a mandatory subject.

According to the Dutch government the Netherlands and Flanders face similar challenges in the field of education and therefore should exchange solutions for similar problems (Ministerie van Onderwijs, 2024). In the past Flanders and the Netherlands have already worked together on privacy issues in their education systems. The Netherlands and Flanders organized an education summit in previous years, sharing ideas and initiatives (Firmagrondzaken, 2024). This year a part of the focus was on digital literacy. The Netherlands and Flanders have agreed to work together again to develop a method to make teachers more digitally skilled and increase their knowledge of digital literacy (Ministerie van Onderwijs, 2024). It appears that the Netherlands and Flanders can learn from each other. Given the similarities between the countries, cooperation would be highly beneficial.

2.3 Domains of Digital Literacy

As previously mentioned, SLO divides digital literacy into four domains within the Netherlands: Practical ICT Skills, Media Knowledge, Digital Information Skills, and Computational Thinking (SLO, 2022b). For every domain, SLO sets curriculum objectives that are mandatory components of the new digital literacy curriculum. These objectives are explained further in this section.

2.3.1 Practical ICT Skills

Practical ICT skills are the foundation of digital literacy. It provides essential capabilities for working within the other domains. The curriculum objectives are categorized into three subtopics (SLO, 2023b). The first topic is digital technology where the objective is knowledge of the impact of digital technology and its use in society. The second topic is digital devices which encompasses working with digital devices such as a keyboard and using a mouse. This topic also pays attention to well-being while using digital devices. This concerns the user's physical position towards a device or its screen time. The last topic is about apps and software. This topic encompasses managing and using apps for various tasks including internet browsing, communication, collaboration, and creating content such as drawings, text, audio, video, presentations, and spreadsheets. In summary, within the Practical ICT Skills domain, the primary learning goals include using various devices, apps, and software. A basic knowledge of ICT skills serves as a critical step toward learning the other domains.

2.3.2 Media Knowledge

Children are coming into contact with media at increasingly younger ages. Therefore, media knowledge is considered an important component of the primary school curriculum. The Media Knowledge domain is also divided into three subtopics (SLO, 2023b). The first topic is Digital Media and its content. Digital media is quite a broad concept. According to the Oxford Learner's Dictionary, the definition is: "information and entertainment products and services that use the internet" (Press, n.d.). SLO makes their definition concrete by stating that digital media is media to create, view, modify, and transfer information through digital devices. Examples would be apps, video games, websites, social media and online advertisements. The subdomain of digital media covers the use of digital media, the characteristics of digital content, and the importance of safe usage. The second topic is online communication where the goal is to learn how to communicate consciously and safely. The last topic is the Mediatization of yourself and society which is about the influence of media influence in your own life and in society. In conclusion, The Media Knowledge domain's main goal is to make it clear to children how digital media works and how they should deal with digital media to protect themselves on the internet.

2.3.3 Digital Information Skills

In the past, information was mainly found in books. Today, almost all information is available online. The Digital Information Literacy domain teaches children how to find and use this information effectively. The goals of the Digital Information Skills domain are divided into two subtopics (SLO, 2023b). The first topic is about searching, finding and selecting data. This involves various tasks, such as formulating an information request based on a need. It also involves identifying appropriate search terms, determining an effective search strategy, and selecting suitable digital sources for obtaining relevant information. Lastly, it concerns collecting and selecting digital information. This topic mainly covers how relevant information can be found. The second topic is about processing, evaluating and presenting the information. This is split into two parts: determining if the data is correct and representative and presenting the data. Presenting the data can, for example, be done through a drawing or another appropriate presentation form. In summary, Digital Information Skills is primarily about finding correct data and using it.

These domains are not strictly separate and often overlap. For example, creating a presentation involves acquiring knowledge about a presentation tool, which falls under the Basic ICT Skills domain. The ability to search for correct and useful information belongs to the Media Knowledge and Digital Information Skills domain. Despite these overlaps, the last domain, Computational Thinking, is distinct from the others. Computational Thinking overlaps less with the other three domains and will be discussed in detail with all its tools in the next section.

2.4 Computational Thinking

Computational Thinking is one of the four domains of digital literacy. The idea of Computational Thinking was introduced in an essay in 2006 by Jeannette Wing (Wing, 2006). In this essay, it was suggested that computationally thinking is a fundamental skill that everyone should learn. Wings intent was to state that Computational Thinking was mostly a thinking and not a computing skill primarily. A specific definition of what Computational Thinking is was left out. The precise definition of Computational Thinking and what is and is not included remains elusive. Currently, the main consensus is that Computational Thinking is a problem-solving approach that involves breaking down complex problems, recognizing patterns, and designing algorithms for their systematic solution, utilizing abstraction and automation to generalize solutions across domains (Selby & Woollard, 2013).

SLO defines Computational Thinking as reformulating complex problems using thinking skills and strategies so that computer technology can contribute to solving them (SLO, 2022a). The five core components of Computational Thinking include data processing, decomposition, pattern recognition, abstractions and algorithms. Data processing involves gathering, organizing and visualizing information. Decomposition consists of dividing problems into smaller parts, making solving them easier. Pattern recognition is about identifying patterns within data. Abstraction is the process of separating the important information from the irrelevant details. Finally, algorithms entail the explanation and design of step-by-step rules that solve a problem.

2.4.1 Plugged and Unplugged

As the original description of Computational Thinking indicates it is a thinking skill and not a computing primarily, a common misconception is that it is about programming. As can be seen by the description, this is not the case. Computational Thinking encompasses a broader range of skills. Currently, there are two primary approaches to developing Computational Thinking: through plugged and unplugged activities. Plugged activities refer to learning Computational Thinking with the use of computers, digital tools or other electronic devices (Grover & Pea, 2013). In contrast, unplugged activities refer to learning Computational Thinking without any of these devices. During unplugged activities Computational Thinking skills are being taught with physical materials, games and other non-electronic devices (Del Olmo-Muñoz, Cózar-Gutiérrez, & González-Calero, 2020). Plugged activities are currently the most common method for teaching Computational Thinking (Kakavas & Ugolini, 2019). However, the use of plugged activities does not prevent schools from also having unplugged activities in their curriculum. Research shows that plugged and unplugged activities can both improve children's Computational Thinking skills significantly (Lin et al., 2023). At present, there is no definitive evidence suggesting that either plugged or unplugged activities are superior for teaching Computational Thinking. Instead, both approaches offer distinct ways for learning different components of Computational Thinking. As highlighted by Lin et al: Plugged activities may excel in developing algorithmic thinking and decomposition skills, while unplugged activities seem to enhance children's representation skills, involving the interpretation and manipulation of symbolic or visual representations in programming and computational tasks."

2.4.2 Tools

During these plugged or unplugged activities, various tools are utilized. Currently, a considerable number of tools are available on the market (Yu & Roque, 2018). In their 2018 research, Yu and Roque categorized these tools into five subclasses, focusing on tools suitable for children up to the age of seven: Physical kits with electronics, physical kits without electronics, virtual kits, hybrid kits with virtual programming blocks, and hybrid kits with tangible programming blocks. Examples of physical kits with electronics include the Bee-Bot (B-Bot, 2024a), Pro-Bot (Heutink, 2024b), and Electronic Blocks (Wyeth & Wyeth, 2001). These tools are entirely physical and operate independently without requiring additional digital devices such as laptops or tablets. Physical kits without electronics, which encompass unplugged tools, include primary examples like Robot Turtles (Turtles, 2024) and Hello Ruby (Ruby, 2024). Virtual kits are designed to function solely on PCs or mobile devices, with Scratch Jr. (at Boston College & Foundation., 2024) and LightBot (Inc, 2017) being notable examples. Hybrid kits, which integrate both physical and virtual elements, are divided into two distinct groups: those with virtual programming blocks, such as Cozmo + Code Lab (Smith, Novak, Schenker, & Kuo, 2022) and Dash & Dot (Codevaardig.nl, 2017), and those with tangible programming blocks, like Strawbies (Hu, Zekelman, Horn, & Judd, 2015) and Blue-Bot (B-Bot, 2024b).

Currently, many more tools exist beyond those identified in Yu and Roque's 2018 research (Yu

& Roque, 2018). Some noteworthy additions that were not mentioned in their research due to the age limitation of 7 years, their non-existence at the time, or their availability only in Dutch, include Let's Go Code! (Educatheek, 2024), an unplugged card game designed to teach children the concepts of Computational Thinking. Another tool is Coding with Pixels (de Rolf groep, 2024), an unplugged game that familiarizes children with the principles of binary code. LEGO Mindstorms (Heutink, 2024a) is a hybrid kit incorporating programmable LEGO elements. Scratch (Scratch, 2024) is a virtual kit and the advanced version of Scratch Jr. The OzoBot (Ozobot-Benelux, 2023) is a hybrid tool featuring virtual programming blocks.

There are many more tools available on the market. As of May 2024, SLO has uploaded an example list of tools for Computational Thinking (SLO, 2024b). This list includes many of the tools previously mentioned, but it is not limited to them. It serves to provide schools with an overview of available tools without binding them to a specific one. Given the variety on the market, each school is free to select the tools that best suit their needs.
Programming is often introduced using visual programming languages like Scratch. Later the transition to text-based languages is made. This is reflected in the tools available in primary school, with block-based languages predominating in the early years and textual languages becoming more common towards the end of primary school and into secondary education. Research shows that students with block-based experience learn a new text-based language more easily than students with no block-based experience (Marcos, Marco, & Luciana, 2019). The Dutch study further suggests that starting with textual programming and then progressing to visual programming yields better educational outcomes than the reverse sequence. However, it is evident that block-based programming environments are effective at lowering the barriers to programming and motivating children (Moors, Luxton-Reilly, & Denny, 2018). Therefore, the use of block-based languages serves as a beneficial stepping stone in primary education.

2.5 Instruction and working methods

Besides choosing specific tools, instructional methods are also considered in digital literacy lessons. While the previous section focused on Computational Thinking as a specific aspect of digital literacy, this part will now cover all domains of digital literacy.

Digital literacy is a new element in education in the Netherlands. SLO recommends teaching every domain of digital literacy in every grade. This approach is necessary because the domains build on each other. For example, students learn ICT skills, such as using a presentation tool, which they will later need for Information Skills. Additionally, knowledge about using devices is often required for plugged activities in Computational Thinking. SLO does not specify which skills should be taught in which grade, allowing schools the flexibility to decide this for themselves. The domain of Practical ICT skills and Digital Information Skills are skills that must often first be explained and then used in practice to learn them properly. Media Knowledge is mostly about learning how digital media works and how they should deal with it. This is mainly information that they need to learn but not immediately apply at school. This flexibility also places a significant responsibility on schools to design their curriculum. The absence of specific guidelines from SLO underscores that schools themselves need to structure the teaching methods in digital literacy to ensure that students receive effective lessons across all domains.

2.5.1 Discovery Learning and Direct Instruction

Computational Thinking is the domain in which the discussion on what teaching methods to use is the most prevalent. Computational Thinking is different from the other three domains of digital literacy. It is primarily a way of thinking that needs to be learned, rather than a set of skills. The Computational Thinking domain includes programming, which is interpreted as a way of thinking. In the Computer Science community, particularly in programming, many individuals have taught themselves by exploring and discovering how things work. This self-directed approach is often regarded as the best way to learn Computational Thinking and is referred to as discovery learning (Hammer, 1997). However, research shows that discovery learning is not very effective compared to direct instruction (Kirschner et al., 2006).

The cognitive load theory (Sweller, 1988) partly explains why discovery learning is less effective. Minimal guidance approaches often overwhelm the working memory, making it difficult for learners to process and acquire new information. Effective learning requires integration with already existing knowledge, but minimal guidance assumes that learners already possess the knowledge and skills to make these connections themselves. In the case of young learners in primary education, this is especially relevant. They have very limited knowledge, making it difficult for them to form these connections, resulting in less knowledge acquisition. The expertise reversal effect explains why most computer scientists view discovery learning as an efficient method of learning programming (Kalyuga, Ayres, Chandler, & Sweller, 2003). Experts might benefit from less guidance due to their extensive background knowledge, while new learners typically need a more structured approach. Therefore research consistently shows that performance in the subject of programming is better when learners receive explicit instruction and guidance.

2.5.2 Working Methods

Computational Thinking is often taught using various tools, with schools having the freedom to choose among them. Digital Literacy is a new mandatory subject in the curriculum, however many Dutch schools already gave programming lessons. Therefore, there is a partial understanding of the most effective teaching methods for programming. In 2016, a Dutch study researched the form and impact of programming education in primary schools (Jeuring, Corbalan, Montfort, Es, & Leeuwestein, 2016). According to the study, support in the form of tutorials and advice helps students learn programming. This positive effect was especially clear among students with a lower socio-economic status. The study involved a relatively small group of students.

3 Method

This section describes the study's design and methods. It includes information on the research setting and the participants involved. The procedure of the study is explained. The instruments and data collection plan are described in detail. Finally, this section covers how the data is analysed.

3.1 Setting and Participants

The setting for this study comprised six primary schools around the Westland area, a municipality in the province of South Holland in the Netherlands. Four of these schools were associated with the Westland Foundation for Catholic Education (WSKO). One school was affiliated with the Protestant Christian Primary Education Westland (PCPOW) and the other with the Foundation for Christian Education The Hague (SCOH). These foundations are respectively Roman Catholic Protestant, and Catholic. The participants included two male and four female employees of these schools. All participants were involved in the creation of the digital literacy curriculum within their school. Additionally, all participants are partly or completely responsible for the carrying out of this digital literacy curriculum. Participants include five teachers with responsibilities within the digital literacy curriculum and one ICT coordinator with a teaching background. Table 1 displays the participants and their corresponding responsibilities. The IDs used here differ from those later referenced in the Results section, this ensures they can not be individually recognized."

ID	Teacher	Gender	ICT Day	Responsibility	Foundation
1	Yes	Man	Yes	Completely	PCPOW
2	Yes	Man	No	Partially	WSKO
3	Yes	Woman	Yes	Partially	WSKO
4	Yes	Woman	Yes	Partially	WSKO
5	Yes	Woman	Yes	Completely	WSKO
6	No	Woman	Yes	Completely	SCOH

Table 1: Participants and their responsibilities

3.2 Procedure

The research setup was designed through semi-structured interviews (3.2). The research design and its corresponding documents, including the interview questions and informed consent form, were reviewed by the Ethics Committee of Leiden's Faculty of Science.

Schools in and around the municipality of Westland were contacted through the email addresses listed on their websites. The email inquired whether the school had one or two teachers actively engaged in digital literacy who would be open to an interview. If a participant agreed, the informed consent form was sent before the interview. This form informed the participants about the study's goals, the interview setup, and the handling of personally identifiable information. All interviews were scheduled to take place in person at the participant's respective school. Before starting the interview, a physical print of the informed consent form was presented and signed by the participant. The participants were informed that the interview would presumably take between 20 and 30 minutes. After the interview, the participants were asked whether they had anything to add and were thanked for their participation.

3.3 Interviews

This study employs a semi-structured interview approach to collect data. This method ensures the interviewer can cover all relevant topics while allowing the order of topics to be determined by the flow of the conversation. A conversational guide was used to ensure that all necessary questions and topics were addressed. These topics were identified as relevant to the research questions.

The interview began with a discussion of the participant's background to provide context for further data. Firstly, the current implementation of the digital literacy learning trajectory was examined, along with any previous efforts in the field of digital literacy. Secondly, the interview focussed on the efforts and teaching methods in Practical ICT Skills, Media Literacy and Digital Information Skills. The research covered computational thinking in depth due to its specific interest. This included lesson description, working methods, learning goals and tools. Specific questions are asked about the tool the school used, on whether there was a preference for plugged or unplugged tools and the reasoning behind the preferences for any tools. After covering all efforts in the four domains the participant's and their colleague's knowledge about teaching digital literacy was discussed. Next, the interview explores the participant's experiences in teaching digital literacy. Experiences mentioned earlier in the interview are elaborated on in depth. Finally, the participant was asked whether there was anything they wanted to add after which they were thanked for their participation. This interview guide can be found in Appendix A.

3.4 Analyses

For the analyses of the data, a thematic analysis was used. The text was coded using labels based on relevant topics from the interview guide. Before the data was analyzed, the interview recordings were transcribed. A verbatim transcription was used, which means that hesitations, filler words, and stuttering are ignored in the transcription. To improve readability, punctuation was also added. As stated in the Informed Consent Form, personally identifiable information was pseudonymized. This includes details about the interviewees, colleagues and any mentioned schools.

The first step in the analysis involved removing irrelevant data from each transcription. The transcribed interview largely followed the interview guide, and deviations that did not contribute to the study were removed. Examples include elaborations on unrelated topics, distractions during the interview, or personal stories that are not relevant to the study.

The second step in the data analysis was to code each interview using labels. Initially, these labels were based on the interview guide, as it provided a good distribution of the topics discussed. During the labelling process, new labels were created if parts of the text did not conform to the existing labels. Examples include teachers' experiences with digital literacy and the combination of obstacles and negative experiences. Sometimes, data covered multiple aspects, so one section of text could receive multiple labels.

The third step involved combining all the interviews and organizing them by label. Each data entry includes the interview, the excerpt and the classification it received.

The fourth and final step consists of two main parts. Firstly, all themes were statistically analysed. This involved the aggregation of insights from multiple interviews to identify common viewpoints. During this phase, the relevant segments of the interviews were translated into English. For instance, discovering that five out of six schools are positive about a tool helped to highlight a common perspective. Additionally, a small summary was written to provide an overview of the key points discussed. Secondly, the identified themes were reported. This included summarizing the content of each theme and highlighting both consensus and differences among participants. Relevant quotations that illustrate these themes are used as examples.

4 Results

The interview data is summarized into four distinct themes. This section reports and summarizes the perspectives and options regarding these themes. The four themes are: the set-up of the digital learning trajectory, the three domains (Practical ICT Skills, Media Literacy, and Information Skills), Computational Thinking and experiences with teaching digital literacy. The themes identified correspond with the labels used in the analysis. The number of excerpts corresponding to each label are listed in table 2.

Theme	**Label**	**Excerpts**
Set up Digital Learning Trajectory	Teaching Responsibilities	11
	Previous Digital Literacy Efforts	24
	Curriculum Development Process	9
	Training in Teaching Digital Literacy	16
Teaching Methods in Practical ICT Skills, Media Literacy and Digital Information Skills	Basic ICT Skills Teaching Methods	14
	Media Literacy Teaching Methods	13
	Digital Information Skills Methods	12
Computational Thinking	Computational Thinking Lesson Description	18
	Computational Thinking Lesson Goals	8
	Computational Thinking Tools	24
Experience with Teaching Digital Literacy	Positive experiences Digital Literacy	21
	Negative Experiences/Obstacles Digital Literacy	35
Total		**207**

Table 2: Number of excerpts for each theme and label in interview data

In presenting interviewees' opinions, citations will be labelled L1 through L6, referring to the six interviewees. These citations clarify what is being referred to by defining its meaning within square brackets. Within the citations, any unrelated explanations are indicated by '[...]'. All citations have been translated into English as accurately as possible, but are therefore not verbatim.

4.1 Set up Digital Learning Trajectory

Five out of six participants were teachers, while the sixth was an ICT coordinator. Five out of six schools had teachers with designated ICT days. One school had two ICT coordinators with one ICT day and another had two ICT coordinators, one with one ICT day and another with three ICT days. Three schools had one ICT coordinator with one ICT day. These ICT days encompass a wide range of activities, such as developing and executing the digital literacy curriculum, repairing tools, and ensuring that all digital devices, such as teachers' computers are working. For example, one interviewee describes such a day: *"So then I do a whole lot of different things, from making Chromebooks to teaching lessons in the groups. And for the rest managing direct colleagues in the digital learning path."*(L4). In contrast to the other five schools, one school did not have a specific ICT coordinator but operated with a workgroup of four people. It is notable that all interviewees had more than five years of experience at their respective schools. In addition, all teachers have multiple years of teaching experience.

4.1.1 Previous Digital Literacy Efforts

In all schools, digital literacy initiatives have been ongoing prior to it becoming a mandatory part of primary education. Five out of six schools were already actively busy with digital literacy for multiple years. Out of these five, three have been teaching digital literacy for more than four years since it became mandatory by their foundation. The other two schools have been teaching digital literacy for more than 10 years. One of these interviewees even claims that their school was a pioneer in digital literacy (L6: *"I dare say that we as a school have always been able to do something in this area. At times we were pioneers and we always wanted to be present at the preliminary stage."*). Four out of these five schools mainly focused on Practical ICT and Digital Information Skills. The other school focused primarily on Computational Thinking (L3: *"We have made quite some progress, but mainly in the field of Computational Thinking. Which is now highly effective."*). One school was not consciously busy with digital literacy but addressed it through ICT Skills lessons. (L4: *"I don't think consciously. [. . .] They always acquire components of digital literacy in their lessons and in their daily moments. But I don't think they are working on it purposefully."*)

4.1.2 Curriculum Development Process

Five out of six interviewees stated that their school developed a core plan for digital literacy. These five interviewees were all involved in creating this plan. In two schools the ICT coordinators created this plan themselves without much feedback from other colleagues. Another school involved all colleagues before making the plan (L1: *"We have written a core plan with all colleagues. What do we find important, what do we want first?"*). After this involvement the ICT coordinators finished the plan according to the requirement SLO set (L1: *"We went through the goals and what needs to be checked off and we put that in that lesson plan"*). One school does not yet have a core plan because the domains are expected to change in the future. As one interviewee explained: *"Because I knew it was subjected to change. I thought, I shouldn't work everything fully out on paper otherwise I could do it all again soon"*(L3). To address this, the interviewee did a survey among all teachers to understand what they consider important and what is already being taught in digital literacy. This approach aims to avoid pressuring teachers to adopt new methods if they are already proficient in them. The interviewee stated: *"To find out what is already happening in the classrooms. So that I* *don't start pushing in all new things. While colleagues often already have their own solution for the goal, which often works much better."*(L3).

None of the schools have dedicated regular time in their schedules for digital literacy. Instead, they integrate it into other subjects. One of the schools that has been teaching digital literacy for many years is critical about when digital devices should be used. (L6: *We have become increasingly critical of when to use the computer and when not to use the computer. [...] And for us it is always said: There must be a learning moment. We prefer to do this as integrated into your lessons as possible. But we see with the current software. [. . .] That software is so easy to put together that the learning experience for children is too limited for our idea. [. . .] The effectiveness of the learning moment is almost zero and sometimes it is simply by writing things down."*).

Some various approaches and considerations emerged. Firstly, one school appointed Chrome Captains consisting of two children per class who assist their teacher and ICT coordinators in testing new components from the digital literacy curriculum. Secondly, another school, which has been engaged with digital literacy for more than 10 years, expressed difficulty in teaching Practical ICT Skills, Media Literacy and Digital Information Skills (L4: *"Computational Thinking. Which is now highly effective. We have tried the rest there for years, mainly looking at Media Literacy, what is a good method and what suits us. We have tried everything, but because everything moves so fast"*). Consequently, they are in a pilot program with Kennisnet, a company specializing in teaching digital literacy. This company teaches these three domains. They highly value this approach and have reduced their direct involvement in these domains (L4: *"But because we have now joined forces with them, we have now taken a little step back"*)

Two major foundations in the Westland region are currently discussing the creation of a standardized digital literacy curriculum for their schools, according to two separate interviews. Currently, within these foundations, every school has its own unique digital literacy curriculum. The goal is for every school in the Westland region to adopt a uniform format and set of requirements for digital literacy while allowing each school the flexibility to fill in its content (L2: *"It is not the intention that everywhere the same thing is done, but that the format is the same. Everybody should know what objects should be discussed. And then you give substance to the format yourself"*). However, these plans are still in the early stages, and no concrete agreements have been made yet.

4.1.3 Training in Digital Literacy

None of the interviewees received digital literacy training during their time at PABO, yet all participants feel sufficiently competent to teach it. One participant stressed that they think that the PABO is not up to date with the new curriculum: *"I think that the PABO is currently lagging behind, and that's just the way it is."* (L2). The participants acquired their digital literacy teaching skills through various programs: four out of six participants completed Google courses to become Google educators. This was a requirement mandated by their foundation. Another teacher pursued an ICT course provided by Heutink, focusing on integrating digital literacy into education and enhancing didactic approaches.

The schools have various approaches to enhancing digital literacy competence among other teachers within their schools. Four schools made the digital skills course mandatory for all their teachers. One participant explains why they made this choice: *"This year we have introduced Digital Skills that we made mandatory for children. We have also made it mandatory for everyone to demonstrate basic Google skills, showing proficiency in those areas."* (L6). Three out of six schools have designated walk-in hours where teachers could approach the coordinator to ask various questions on Digital Literacy. One school has all teachers observe the lessons given by a company. This way, they hope that these teachers will be skilled enough to teach digital literacy in a few years: *"The teacher is there because they also need to absorb that information and know what's going on because they have to learn it too. It's actually a win-win. So next year they will come again to give those presentations and lessons, so the teacher will still be there. And the year after that, they will start teaching the lessons together with the teacher. And the year after that, the teacher will have to do it themselves. So it's actually a bit of a progression towards giving more responsibility and ownership to the teachers."* (L3)

4.2 Teaching Methods in Practical ICT Skills, Media Literacy and Digital Information Skills

The interviewees were asked to identify their main teaching goals for each of the three domains: Practical ICT Skills, Media Literacy and Digital Information Skills. The participants were also asked about the lesson materials used, as well as their working and instruction methods. Notably, interviewee L3's school hires a company to teach these three domains instead of teaching them themselves.

4.2.1 Practical ICT Skills

The choice of services and platforms significantly influences the school's content of ICT curricula. Five out of six schools referred to themselves as Google schools. Als one school put it: *"We are a Google educational school. We work a lot with Google, so there they learn to search, find information and what good information is."*(L2). This emphasis on Google tools extends to the hardware used in these schools, with Chromebooks provided to students starting from group three. Multiple teachers underlined their extensive use of Chromebooks in their teaching practices. As one teacher noted, "We still have books, but we really use Chromebooks a lot. At least in the upper grades" (L2). Another interviewee highlighted the important role of Chromebooks, stating: *"I couldn't do it without them anymore." (L5)*. One interviewee questioned the focus on Google as their chosen platform. He wondered if what students learn now will remain relevant: *"We are now a Google School. But will Google still be relevant for us?"* (L6). In contrast, one school used Microsoft as their preferred service. Their ICT strategy involves providing iPads to students from classes one through four, transitioning to Flipbooks from group 5 onwards. The rationale is that using a tablet is easier for younger children. As one educator explained: *"We also have iPads, for groups one to four. In any case, they simply work faster on an iPad" (L3)*. However, as students advance to higher grades, the significance of a laptop increases as they need to learn word processing and use presentation tools. For all schools, the choice of platform was made by their foundation. In educational settings, the choice of service and platform holds significant relevance. It directly affects how students learn practical ICT skills students learn.

All interviewees emphasized that learning how word processing tools work and the ability to create presentations are the main skills they want students to acquire. One interviewee stated that this focus is to prepare their students for secondary school: *"We want to teach them that they can use a presentation and word processing tool. Those two are actually the skills we want to learn before they go to secondary school and have enough knowledge to use it."* (L3). Another interviewee also stressed the importance of knowing these tools: *"I also do not see all of these digital literacy goals as skill goals, as I believe that they should be able to do all of that by the end of primary school. [. . .]. But I do think that they should all be able to use a word processor.* (L4). Another skill mentioned in all interviews is the ability to work in the cloud. Some skills were only mentioned by specific schools but not others. Firstly, one school emphasized the importance of blind typing: *"Typing is also part of our digital skills. And we've been doing that for 25 years."* (L6). Two schools viewed the ability to create a website as a critical skill Therefore, they integrated it with other domains of the digital literacy curriculum.

The interviewees mentioned that for practical ICT skills, students usually receive a classroom-based or online explanation first. Afterwards, they often work on these skills individually. One interviewee stressed the importance of explanation. They highlighted the need to teach students specific skills: *"Look at Basic ICT Skills if you let children experiment with PowerPoint. [. . .] They will probably come up with something. But of course, you want them to be offered the things they need in secondary education."* (L3). This specific school previously did not provide much explanation and noticed a big difference in students' existing skills with these tools: *"We didn't do that before. [..] And then we said, you have to make a book review or presentation, with one group the parents have done that at home. But another group doesn't even have a computer at home. So there are quite big differences there."*.

4.2.2 Media Literacy

Five out of six schools teach Media Literacy from first through eighth grade. One school currently introduces Media Literacy in the third grade but plans to extend it to include grades one and two: *"My wish is actually for them to also do this. They will eventually expand it"* (L3). None of the schools allocated dedicated weekly time, instead they try to teach it a few times a year or in combination with other subjects. For example, four schools have multiple Media Literacy weeks, during which attention is paid to Media Literacy topics throughout the school. Another school combines Media Literacy with citizenship, which is also a new competence for primary schools. The interviewee mentions that the integrations with Media Literacy works particularly well: *"It is woven into our social skills training. We group this under the heading of citizenship. [...] It fits in perfectly with that. For each grade, there are at least two and most often four lessons in the curriculum that are about Media Literacy. But then linked to the bit of citizenship."* (L4).

Media Literacy education seems to include increasingly complex topics as students progress through higher grades. Starting in grades one and two, one school introduces "Media Little Days", where they provide teachers with materials and teaching boxes and teach about relaxing with social media. In the third and fourth grades, two schools focus on teaching on media devices and the internet. In grades five and six, one school participated in Hackshield, in which the dangers of the online world are taught. Another school mentioned teaching about news and two schools mentioned Whatshappy which focuses on online communication. For seventh and eight grade one school mentioned privacy, bullying, grooming and sexting. Additionally, two schools mentioned Mediamasters which is an online game on Digital Literacy between numerous Dutch schools.

All participants say that Media Literacy is mostly taught classroom-based. Multiple interviewees also emphasize the importance and significance of media literacy One teacher stressed the depth of a Media Literacy lesson: *“When you consider Media Literacy, it truly involves engaging in very intense conversations”* (L6). Another teacher emphasizes on the importance of teaching Media Literacy for equality of opportunity of all children: *“I think Media Literacy and the basic skills are in themselves goals[..] I don’t think that should be a content goal but really a skills goal. That we also really check with the children at the end if they have truly understood it. Because there is still quite a bit missing. The aspect of equal opportunities. [. . .] And then I think, those basic skills and Media Literacy are essential in today’s society."* (L4). One teacher also highlighted the necessity of teaching Media Literacy through direct instruction. Previously, the school did not teach digital skills, which resulted in some problems: *"We do want to teach them in advance about how to behave on a phone, WhatsApp, or social media. They also need that because if we just let them be, you can see what happens that doesn’t really work”* (L3).

4.2.3 Digital Information Skills

All participants mentioned that the main focus of Digital Information Skills is on writing projects and preparing presentations. These skills seem to be mainly used in the upper grades. As one teacher explains: *"It is really for grades 7 and 8. Before that, you don’t need to look into setting all kinds of preferences when searching on Google."* (L2).

Some schools also integrate additional elements into their education. For example, one school adopts theme-based education through VierKeerWijzer, teaching Digital Information Skills from grades one through eight. These classes cover subjects such as searching for information, making summaries and understanding plagiarism. Two other schools teach about prompts for Artificial Intelligence such as ChatGPT and voice command platforms. Another school teaches Digital Information Skills in collaboration with the library where this coincides with the competence of language. Additionally, two schools incorporate website development into their Digital Information Skills curriculum. Coincidentally, these schools engage in cross-evaluations of each other’s websites. According to one of the participants, this process is highly effective: *"Grade 8 is working on creating their own websites, which must be informative. So after 6 years of information literacy skills, it should culminate in grade 8 with building a website. Their work is evaluated by grade 7 students from another school, providing feedback on layout and imagery including copyright considerations, text quality, and creativity. Building a website is seen as an ICT skill, and these two pillars strongly emphasize their training to provide constructive feedback."* (L6)

4.3 Computational Thinking

Computational Thinking is divided into three topics. The first topic focuses on the schools and participants’ main learning goals. The second topic covers how Computational Thinking is taught and their perspectives on this approach. The final topic discusses the tools used during the teaching of Computational Thinking. Participants primarily mentioned physical tools, which are more tangible than lessons without them.

4.3.1 Learning Goals

Participants were asked about their primary learning goals within Computational Thinking. While not all participants provided concrete answers, their responses can be distilled into three main ideas regarding the lesson goals.

First of all, the two schools focused mainly on programming. One school mentions the importance of programming in their future lives: *"It looks like more than half of the children currently in the eighth grade will eventually get a job that doesn't even exist yet. Because development is happening so quickly, I believe that AI and programming will be a significant part of their future. It is crucial to teach them these skills, as they will likely encounter them frequently in their future lives"* (L1). Both interviewees question if the children realize that they are learning skills while programming. One participant describes this: *"But whether they are truly aware of the consequences, that's similar to other subjects. Sometimes they learn from one lesson and it sticks, while other times it doesn't. And that won't be any different now"* (L1). The other interviewee feels even more strongly about whether the children are really learning skills: *"With programming, when we are doing Scratch, it's of course about problem-solving. But for the children, it's something far removed from their reality, and they see it as a game. [. . . .] It's just a game to them. They don't think about how it will benefit them in their future lives. So, for them, it remains a game. You try to explain the lesson's goal, but whether they truly understand it, I don't know."* (L5).

Secondly, two other participants mentioned that their primary goal in Computational Thinking is to teach children that there is a step-by-step process for solving problems. One of these schools stressed the importance of engaging the children to think in steps: *"And really engage the children. Show them that a computer thinks in steps but can also help them personally."* (L4). The other participant mainly stresses the importance of the order of small steps, especially while using programming languages such as Scratch: *"It is important that they learn that everything they put down must have a certain order."* (L2).

Lastly, the remaining two participants provide a more comprehensive approach to teaching Computational Thinking. Both participants mentioned a constructive line in their curriculum so that it covers all the components of Computational Thinking in it. One interviewee directly states this: *"But we are also very aware that Computational Thinking requires not only the materials but also when, for example, you are making a map, you are already engaging in Computational Thinking. Because you are going through those thinking steps with the children."* (L3). The other participant mentions this comprehensive approach due to the various activities in Computational Thinking: *"It ranges from grade one to eight. It goes from bead boards to cracking codes, all the way to Scratch and Scratch Jr. And we try to incorporate that into our teaching as well."* (L6)

4.3.2 Learning Methods

Computational Thinking is contrary to the other three domains taught completely by the participating schools themselves. All participants mentioned that the application of Computational Thinking is often done in groups. This especially applies to activities including physical tools. All participants agree that this arises from the amount of tools available. Activities that use mainly digital tools such as Scratch are however mostly done individually. There are numerous other reasons why computational thinking frequently occurs in groups. One participant emphasizes the importance of working in groups because children require each other's assistance during assignments, given the varying levels of skills: *"They do need each other's help. You do notice that just like with teachers, one student is very skilled and plays a lot of games and things like that, they know a lot. Whereas the other really has no idea. They do need each other."* (L5). Another interviewee highlights the spatial demands of digital literacy lessons. Noting circuits for robots can occupy a significant amount of space in the classroom.

The participants had different views on how Computational Thinking is taught. Four out of six participants mentioned that instruction is always given before the students work on tasks in Computational Thinking. For these four participants, instruction on tools is consistently provided prior to assignments. These interviewees also all mention that instruction is given less frequently when students become familiar with tools and their software. One participant gives an example: *"Especially in the beginning, I always taught the first lesson because I knew how it should be done. [...] For example, with those Microbits, they have worked a lot with them. And then those children just know, they just pick it up and get started on their own.* (L5). Another participant stresses the importance of instruction very strongly: *"Our education is like this: Instruction matters. I really believe more in instruction when it comes to these kinds of products. It's not like we're going to discover and learn.* "(L6). The participant also emphasizes why he views discovery learning within Computational Thinking unfavourably: *"You can see that instruction matters. And that children really need to be introduced to it. Children are very skilled. Yes, they are very skilled at clicking, but sometimes that clicking is also just exploratory learning without always knowing what the button is for. They need to understand it."* (L6). One participant believes that Computational Thinking is primarily taught through discovery learning within their school. The participant suggests that the use of discovery learning is mainly due to the teachers' perceived lack of knowledge: *"Because the teachers, from what I gather, often don't feel confident or qualified and lack some knowledge. Children often quickly know more than the teacher."* (L1). The remaining participant experimented with both teaching methods. He noted that he assumes most teachers use instruction, but he incorporates both: *"So I vary a bit in teaching methods. But I think most teachers here at school still provide some instruction alongside it."* (L3). He does not favour either of these teaching methods.

4.3.3 Tools

All participants mentioned the tools that were used in school. Participants mentioned physical tools more frequently than non-physical ones, likely due to their tangibility. When conducting the interview, non-physical tools often did not come up naturally. One participant elaborates on these lessons and expresses difficulties with them: *"I encourage teachers to think even broader than just tools. Because programming doesn't have to involve a device or an app, programming can also be done by blindfolding children and having them 'program' each other. So, in that way too, I try to enrich their lessons. But I'm still exploring that. Is there a good database somewhere? They do* *exist, but it's scattered everywhere.“* (L4).

All participants use tools to teach Computational Thinking. A trend is visible in all schools. In the early years of primary school, mainly physical tools are used. Later, a transition is made to hybrid and virtual tools. There are significant differences in the number of tools available to each school. Two schools stood out. One of these schools mentioned 14 tools. The other school has a lending program with their foundation which allows them to borrow materials from the foundation. The other four schools mention occasionally lending tools from other schools, but they do not have a specific program with their foundation. One of the participants stressed that they were looking to expand their available materials but had difficulty finding suitable tools for them: *"So, we are really still searching, what can we do, what other materials are there, what else can you use. It's just difficult. There is so much on the market."* (L2). The schools can be summarized into two categories due to the amount of tools used. These are schools that specialize in a few specific tools like Scratch and are focusing deeply on them, while other schools vary more in the tools used.

Numerous tools that the school owned were mentioned by the participants. These tools can be summarized in the following: Ozobot was mentioned by participants one and five, with interviewee five noting its fragility: *"They are really worn out. They have been used for a few years. They are so delicate. None of the buttons work anymore. That's disappointing."* (L5). Microbit was referenced in every interview. Three participants used Greenscreen. One participant brought up Bluebot, 3D glasses and Loopbots. B-Bots were mentioned by all participants. One participant mentions that the B-Bots also break down after some time: *"We do notice that those Bee-Bots stop working after two, three years and then you can't reset them anymore. It's just broken. And then the makers say: you just have to buy new ones, it's written off. And then I think, that's really a shame. You just want it to last longer."* (L2). In contrast, another interviewee mentions that the B-Bots do not break down as much as other tools: *"And those Bee-Bots are also sturdy, so everything works."* (L5). Three participants mentioned various forms of Lego. One participant highlighted live coding. Three participants mentioned Scratch Jr. and Scratch, with two of those three praising its versatility. Minecraft Education was mentioned by two participants. One participant brought up a variety of tools, such as the Duplo programming train, Glow and Go, Tiny, Ozmo, Botzees, Photon, Let's Go Gode, Coding with Pixels, Virtuality, and Orboot globes. One participant highlighted Pro-Bot, praising its ability to rotate in all directions, unlike B-Bot. One participant also mentioned Kraak de Code and Code.org.

4.4 Experience with Teaching Digital Literacy

All participants were asked for their perspectives on the implementation of digital literacy in the curriculum. This includes both positive and negative experiences or obstacles that they have encountered.

4.4.1 Positive Experience

Among all participants, there was a consensus that digital literacy skills are crucial for children's futures. All interviewees viewed digital skills as essential skills for the future. As mentioned before, one participant described the tools and software as indispensable, stating they could no longer work without them. The participant also highlighted the usefulness of these skills: *"I think that you provide them with a good foundation of digital skills for a future job. That they can simply create documents, and they can make a presentation. They will need that for the rest of their lives."* (L5). Another participant highlights the importance of Computational Thinking: *"I think, just to touch on Computational Thinking, that many skills emerge which children simply need."* (L1). One participant elaborated on the reason she thinks digital literacy deserves a place within primary school: *"Our vision is that we are preparing them for the jobs of the future. That is truly our vision, and I do think that is the ultimate goal. We need to prepare them for high school, everything is online and they need to learn that. They shouldn't be thrown into the deep end and just told to swim here because it's not all safe. There are dangers involved, and we need to teach them that."* (L3). Another teacher also highlights the need for teaching digital literacy in school in contrary to leaving it to the parents at home. He believes that digital literacy creates more equality: *"I think it also offers tremendous opportunities for children who are in elementary school now. And who will enter society in 10 or 20 years from now. That's what I find the most exciting."* It's worth noting that all participants are involved in digital literacy and therefore likely enthusiastic about it. This was also highlighted by one participant when asked if she was positive about digital literacy becoming mandatory *: Yes. That's also because it's my thing, just like a math coordinator has with math. So everyone at school tries to promote their own speciality."* (L5)

All participants agreed on the enthusiasm displayed when digital literacy skills are taught or used. Multiple interviewees noted this positive aspect: *"I do notice that they really enjoy doing it."* (L1). Another participant highlights this even more strongly: *"You have the children's full attention.* (X2), *Yes, they are eagerly listening to every word."* (L2). Another participant emphasized this further: *"The enthusiasm of children. That's what I find really positive. Especially when you find something that resonates with the group you have at that moment. How many ideas they come up with."* (L4). Children's interest in digital literacy compared to other subjects was also observed by one participant, this was regarding the question of whether children are more enthusiastic about digital literacy: *"Absolutely! I dare say it's more often 'Teacher, when are we going to do Scratch?' rather than 'Teacher, when are we going to do comprehension reading?"* (L6). This interviewee also noted that this enthusiasm helps enhance learning opportunities: *"Whether it's Computational Thinking or Media Literacy, whichever, you see very high engagement because it relates to their world of experience. You immediately have the children engaged. That is a prerequisite for learning. Secondly, intrinsic motivation is there, so the opportunity to learn things is greater.* (L6)

4.4.2 Obstacles and Negative Experiences

All previous efforts mentioned in digital literacy have been mainly positive, but there are certainly also negative experiences and obstacles. The participants have encountered numerous obstacles and negative experiences. Several experiences mentioned by multiple participants include colleagues who struggle with digital literacy, colleagues who fail to see its purpose and difficulty integrating it into their schedules

Five out of six participants encounter problems with the digital literacy knowledge of colleagues. One participant explains this: *"You can clearly see that some are more ICT-skilled than others so, with certain classes, you need to provide more guidance than with others."* (L2). Another interviewee explains that not all teachers are qualified enough to teach digital literacy. One participant explains that while doing a Computational Thinking lesson the teachers have difficulty teaching with the tools: *"They still find that quite difficult, really. Yes, they really have to do that themselves. Before they truly have the feeling and self-confidence for it."* (L5). Three of these five participants mention that the difficulty with digital literacy is primarily (but not exclusively) which the older colleagues: *"Especially the older colleagues often don't feel comfortable with it. They really do need help with it."* (L1). Another teacher also notes this: *"It might sound a bit unkind, but it's often the people who are older as well.* (L4). This participant later also notes that he expects this to change in a couple of years because these teachers will eventually retire: *"Meanwhile, I also have in the back of my mind: 'In a few years, they will be gone'. I don't think it's nice to think that, but it's true. It's also a reality that I have to come to terms with myself."* (L4).

A corresponding issue is teachers failing to recognize the importance and purpose of teaching digital literacy. This obstacle is mentioned by five of the six participants. One participant struggles to motivate colleagues and states: *"Getting the teachers on board is a thing you often encounter, especially when the school grows larger."* (L2). Another participant discusses past difficulties in motivating teachers but notices a shift in ideology: *"There are always colleagues who are unwilling, who don't see the point of it. This is a process that we've been working on for years. And when 80 per cent are on board already, it becomes easier when newcomers join in. I must say, 10 years ago, things were really different. Back then, there was a lot of resistance, with people saying we're not going to do this because it's not necessary."* (L3). One interviewee finds it challenging that some teachers refuse to engage with digital literacy and its tools: *"That's the most challenging part for me. Especially with the new curriculum coming up. [. . .] I still have teachers who only use the interactive whiteboard occasionally to play a video and do nothing else with it. [. . .] Children already have skills and can figure things out on their own. They use Chromebooks, but otherwise, it's not effectively utilized. I think this is the biggest stumbling block in education."* (L4). Another participant observed that the teachers in the lower grades have less affinity with digital literacy than the teachers in the upper grades. The suggested reason is that the curriculum is different. Meanwhile, another interviewee questions the distinction between primary and secondary education in relation to digital literacy, leading colleagues to debate its importance in primary education: *"There's always the debate about what belongs in the elementary school curriculum and what doesn't. We also have to focus on the basics. Some teachers question how essential certain things really are."* (L6)

An obstacle five participants also mentioned is the issue of fitting digital literacy into the time schedule. Currently, none of the schools have structural time in the schedule for digital literacy. This implies that digital literacy should be addressed on other occasions if time permits. One participant notes that her colleagues have difficulty fitting it into their time schedule: *"I still notice that many colleagues find it somewhat challenging to fit it into their lesson schedule."* (L2). Another teacher notes the limited time schools have and the large time digital literacy takes: *Yes, far too much time. And that time needs to be facilitated, which of course just isn't there.* (L3). Often other subjects are replacing digital literacy because the teacher deems them more important. One interviewee highlights this: *"There are so many things we have to do. Besides this, we have many other obligations. Sometimes, it really comes down to making choices. I could and would like to spend much more time on this. [...] We have to choose and make cuts somewhere. I find that very challenging."* (L4). This is in line with another participant's view: *"It's really about making* *choices. That's every day. We also don't feel happy when an inspector says: You don't have this at our school. [...] We are judged on arithmetic, language, and reading. You see this happening with colleagues too. They also say Yes, digital skills are great for year 6, but basic skills must be solid."* (L6). This participant compares digital literacy with the subject of English. When English became mandatory, the subject felt extra. He expects digital literacy to also follow this trend: *"It often still feels like an extra. I think it will really take a number of years, at least another 5 years, to create that awareness."* (L6)

An obstacle encountered by three participants is the big differences in skills in digital literacy between students. All these teachers emphasize that they expect this to be the outcome of the situation at home. One participant explains this difference: *"You also see a very big difference in the classroom. We have boys who hack our entire system and so on. They are much further ahead, and we have children who barely know where the power button is. So I think the difference is also becoming greater."* (L2). Another participant who also has this issue explains that some children do not even have a computer at home while others have a lot of devices.

There are also some less-mentioned and shared obstacles that emerged in a few interviews. Three participants notice big skill differences in digital literacy between students. These three participants all highlight that they expect that this is the result of the situation at home. One participant explains this difference: *"You also see a very big difference in the classroom. We have boys who hack our entire system and so on. They are much further ahead, and we have children who barely know where the power button is. So I think the difference is also becoming greater."* (L2). : Another participant, who also faces this issue, explains that some children do not even have a computer at home, while others have numerous devices. Furthermore, Two participants highlighted their concern about the amount of screen time children get. They question whether it is a good thing that children have a screen before them the entire day: *"The question is whether all that screen time is good for those children. But I think it depends on how you offer it"* (L2). Another issue one participant mentions is the difficulty of finding tools that fit their curriculum. One participant faces obstacles none of the other interviewees mentioned. One of these challenges is that instructional materials provided by publishers are not yet created. This results in the school having to make all the lessons themselves. Another issue highlighted is the disparity between primary and secondary education when it comes to software and tools. The use of new software and materials causes problems for students transitioning to a new school.

5 Discussion & Conclusion

The goal of this study was to understand how teachers experience the new digital learning trajectory, including the obstacles they encounter, and to explore the skills teachers aim to impart in Computational Thinking and their approaches to doing so. To achieve this understanding, personnel from primary schools actively engaged in digital literacy were interviewed. Participants were questioned about the implementation of digital literacy in their schools and their experiences with the new curriculum. Through the analysis of these interviews, several recurring themes were identified among the participants. The results of this analysis enabled us to address the research questions.

5.1 Experiences in digital literacy and Obstacles encountered

The first research question centres on how teachers perceive teaching digital literacy and the challenges they encounter: "**How do teachers experience the new digital learning trajectory and what obstacles do they experience?**". Four points play a role. Firstly, the reception of digital literacy within schools is positive from the perspective of the responsible teachers in all interviews, but not so for their colleagues. The second point, which pertains to the competence of teachers in digital literacy, could be a contributing factor. Another issue is the integration within the curriculum and which working methods are effective for digital literacy.

Reception of digital literacy There's a noticeable difference in enthusiasm when it comes to digital literacy in schools. All participants and teachers with an affinity for digital literacy see how important digital literacy is for the future. However, not all teachers share this enthusiasm. Some do not see its value or think it's not their responsibility. Participants emphasize that one of their biggest challenges is making teachers understand the importance of digital literacy in primary education. Monitors conducted by SLO in recent years also describe this (Advies, 2023). It becomes clear from these reports that not everyone within schools sees digital literacy as an important part of the curriculum. However, these reports also show a growing awareness among teachers of its importance. Therefore, it is quite possible, as some participants describe, that this negative attitude will change over the coming years.

Competence in digital literacy Participants express concern that their colleagues are not sufficiently digitally competent. It is evident that some individuals adapt to digital tools easily, while others face difficulties. This issue aligns with obstacles experienced with the implementation of digital literacy abroad. In Sweden, this has been and continues to be the biggest obstacle to digital literacy (Andric, 2023). The participants highlighted several issues that arise from this digital incompetence. Teachers lack self-confidence when teaching digital literacy and do not use digital tools effectively. Efforts to enhance digital literacy, such as walk-in sessions and informational workshops are not very successful. These initiatives mainly attract teachers who are already inclined toward digital learning. One school has found success in partnering with an external company to provide digital literacy training, this initiative is viewed as highly beneficial. This obstacle seems to be widely observed as the Dutch government initiated a collaboration with Belgium to address it (Ministerie van Onderwijs, 2024). This collaboration highlights a shared concern over digital literacy competency gaps between teachers. This international effort underscores the use of a collaborative solution. By working together both countries aim to improve digital skills among teachers.

Integration in the curriculum Another aspect of implementing digital literacy involves integrating it with other subjects. Basic ICT Skills are primarily used for creating text documents and presentations, while Digital Information Skills are often applied in writing projects and preparing presentations. Computational Thinking is taught alongside various subjects, but there is not a dedicated subject for it. In contrast, Media Literacy is typically taught separately rather than integrated with other subjects. The trend of combining digital literacy with other subjects is also observed in countries such as Sweden and Finland (Skolverket, 2019). Additionally, this is becoming a common educational approach, especially in Computational Thinking (Yeni et al., 2023). When integrating digital literacy into other subjects, considerations must be made about the advantages and disadvantages of this approach. Participants highlight that integrating digital literacy into other subjects enhances educational experiences. They unanimously agree on the enthusiasm and engagement it generates among students, which significantly enhances learning opportunities. One participant captures this exactly: *"That is a prerequisite for learning. Secondly, intrinsic motivation is there, so the opportunity to learn things is greater."*. However, concerns are also raised about integrating digital literacy into the curriculum, particularly regarding screen time potentially having negative effects on other subjects. This issue is widely observed in other countries (Reporter, 2023). Furthermore, some countries such as Sweden are already scaling back on digitalization due to these issues (och Regeringskansliet, 2024). Currently, none of the participating schools have dedicated time in their schedule for digital literacy. Participants mention difficulties in integrating it into their schedules, highlighting numerous other subjects taking priority over it. Participants believe that the importance of digital literacy will be recognized in a few years. When considering the advantages and disadvantages this could eventually lead to greater inclusion in the curriculum.

Working methods Within the domains of Basic ICT Skills, Media Literacy, and Digital Information Skills, the most used method of instruction is classroom-based. Participants almost always prefer a direct instruction approach in these domains. For Basic ICT Skills and Digital Information Skills, this preference stems from the need to convey specific practical skills. Many participants stressed the importance of direct instruction in Media Literacy due to the risks associated with other methods, such as discovery learning. They argue that children should be educated about the dangers and challenges of the online world before engaging with it independently, rather than learning through potentially harmful discovery learning.The preference for teaching methods underscores the ongoing discussion about the most effective teaching methods. Research has also shown that direct instruction is an efficient approach if children are not yet very skilled in a subject (Kirschner et al., 2006). Additionally, the preference of instruction for Media Literacy reflects concerns about online safety, which is one of the core issues taught in Media Literacy. These insights are crucial for teachers to teach these subjects efficiently and safely.

5.2 Computational Thinking goals and teaching methods

The second research question focuses on the teaching methods employed for Computational Thinking and what the primary learning objectives are: "**How do teachers teach Computational Thinking and what skills do they aim to convey to the students?**". Computational Thinking seems to be challenging to implement due to its broad nature and the amount of tools available. Learning goals vary across schools, often emphasizing programming, which does not encompass the entirety of Computational Thinking. Teaching methods range from direct instruction to discovery learning, with most participants favouring direct instruction for its effectiveness, especially with younger children. Tools used to teach Computational Thinking transition from physical kits in early education to hybrid and virtual tools in higher grades, aligning with research that supports a gradual introduction to more complex computational tasks. Clearer guidelines and more concrete approaches, as seen in other countries, could help schools better implement Computational Thinking.

Reception of Computational Thinking Most participants find Computational Thinking to be the most challenging domain to implement. The broad nature of Computational Thinking and the freedom schools have in choosing their approach contributes to this. The enormous amount of tools available makes it difficult for schools to select the most appropriate ones. Contrarily, schools can also teach computational thinking without any tools, but participants struggle to find concrete databases of such exercises. In contrast, one participant noted that they find Computational Thinking the easiest to implement, likely due to their extensive experience in teaching the subject. Research suggests that familiarity and continued engagement with Computational Thinking can ease the challenges encountered when implementing it (Wing, 2006). Therefore it seems likely that schools will eventually get comfortable with teaching Computational Thinking.

Primary Learning Goals There appears to be a discrepancy in the understanding and implementation of Computational Thinking among the participating schools. The learning goals across these schools are categorized into three distinct approaches: programming, step-by-step and comprehensive approach. The comprehensive approach aligns with SLO goals with Computational Thinking. However, two schools prioritize programming as their primary learning goal. This emphasis on programming is a common misconception within Computational Thinking. Programming is an element of Computational Thinking, it does not encompass the entire concept of it. Interestingly, the new concept plan by SLO is giving programming a more prominent role. This adjustment implies that viewing programming as a central component of CT is not entirely incorrect. Nevertheless, the varied interpretations of learning goals among the schools indicate that SLO's objectives for Computational Thinking lack clarity. Other countries have encountered similar challenges when integrating Computational Thinking into their curriculum. For example, Finland has adopted a more concrete approach, which could resolve these ambiguities. By adopting clearer, more detailed guidelines, SLO could help schools better align their teaching objectives with the intended approach to Computational Thinking.

Teaching Methods The teaching methods for Computational Thinking varies significantly among teachers. This reflects the ongoing debate in educational literature between discovery learning and direct instruction. Physical tools are often used in group settings, which participants find beneficial because they allow children to help each other, and due to the limited number of tools available. In contrast, virtual programming languages are typically learned individually since they are used on personal devices. Despite the variation in methods, most Computational Thinking lessons start with direct instruction. This aligns with research suggesting that direct instruction is more effective than discovery learning, especially with young children with less prior knowledge (Kirschner et al., 2006). Despite this, some participants still employ discovery learning. They cite reasons such as the observation that children often discover solutions faster than the teachers themselves or as a means to vary their lessons. The preference for direct instruction is supported by most participants who recognize its importance. One participant, who has given the learning methods considerable thought recognizes and sees the importance of instruction in his lessons: *"You can see that instruction matters. And that children really need to be introduced to it. Children are very skilled. Yes, they are very skilled at clicking, but sometimes that clicking is also just exploratory learning without always knowing what the button is for. They need to understand it"*. These insights are crucial to place the findings in the debate on teaching methods. Direct instruction has been particularly effective for new learners. However, the integration of discovery learning could still be effective for some subjects within Computational Thinking. Understanding what kind of teaching methods should be used could help teaching Computational Thinking more effectively.

Tools The progression from physical to hybrid to virtual tools illustrates how teachers change their methods to develop Computational Thinking skills at various educational stages. This approach begins with basic logical thinking and problem-solving in the early years and advances to more advanced computational concepts and programming skills in the upper grades. Participants used a variety of tools to teach CT, with three categories being notably more frequently used: physical kits with electronics, virtual kits and hybrid kits. There were significant differences in the availability of these tools across different schools. While some educators aimed to provide a wide array of tools, others preferred focusing on a few select tools. Typically, in the early years of primary education, physical tools were predominantly used. As students progressed through grades, there was an increasing use of hybrid tools. Towards the upper grades, many participants transitioned to using purely virtual tools. This progression aligns with trends seen in research, transitioning from tangible learning experiences to more abstract text-based programming environments (Moors et al., 2018). Research suggests that the gradual introduction of these tools lowers the barriers to learning Computational Thinking skills (Marcos et al., 2019). This will eventually lead to more complex computational tasks as they advance in their education. This study reflects that research conclusion as participants explicitly highlight the structure they implement in Computational Thinking lessons, illustrating the transition from physical to virtual tools.

5.3 Limitations of the study

While this study offers valuable insights into teachers' experiences with digital literacy, it is crucial to note its limitations. The aim of the study was not to get generalisable results but to get insight into teachers' digital literacy experiences. The use of a convenience sample of six participants from around the same municipality aligns with this objective. A detailed and context-specific understanding was prioritized over generalisable results.

Furthermore, all participants in the study were enthusiastic about digital literacy and willingly participated in the interviews. This does not imply everybody involved in digital literacy sees this way. Therefore, the study sample may not have included individuals who are less interested in or involved in digital literacy. Additionally, the interview topics were constrained by both the study's guidelines and time limitations during the interview. As a result, certain topics mentioned during the interviews were only discussed by individual participants. It is plausible that other participants did not bring up these topics either because they did not consider them or due to time constraints during the interviews.

5.4 Further Research

The study offers insights into the first experiences with digital literacy and Computational Thinking in primary education. Digital Literacy has only just become a mandatory subject and a lot will change in the coming years. Further research could broaden our understanding of the various topics in which schools currently face difficulties.

Firstly, a study could be conducted to observe how teacher's attitude towards digital literacy evolves. Currently, participants notice a non-positive attitude among several colleagues. Participants suggested that this will change over time. In addition, participants from schools which have been teaching digital literacy for several years already notice this change. Further research could provide a detailed timeline of these evolving attitudes. Secondly, teacher training programs in digital literacy could be evaluated to ensure that teachers are trained correctly. Many teachers struggle with teaching digital literacy and require training in it. Conducting research could identify the most effective methods for this training. Lastly, a comparative study between countries could identify effective approaches to digital literacy. Currently, countries vary significantly in their approaches. Comparing these approaches could provide valuable insights into which methods are most effective.

By focusing on these areas in future research, educators and SLO could learn more about how to help children become better at digital literacy. This will make education better and get students ready.

5.5 Concluding Remarks

It is important to teach digital literacy in primary education. The educational program for Dutch primary schools is still under development and remains a work in progress. This study aimed to explore how teachers experience the new digital literacy curriculum and identify obstacles they encounter. The findings reveal that schools are encountering several obstacles in implementing digital literacy programs. These challenges include a lack of enthusiasm or knowledge among teachers, as well as difficulties in integrating digital literacy into the existing school schedule. The findings will benefit researchers and educational content creators by highlighting the challenges and obstacles that schools encounter in the implementation of digital literacy. We hope that this thesis provides a concise summary of the experiences and obstacles currently encountered in primary schools within the Netherlands. This list of obstacles should help identify solutions moving forward.

References

Advies, D. O. . (2023, 10). *Rapportage Monitor Digitale geletterdheid in het PO* (Tech. Rep.). Retrieved from https://ecp.nl/wp-content/uploads/2024/01/Rapportage-ECP-Monitor-Digitale-Geletterdheid-PO-16-oktober-2023.pdf

Agentschap voor Hoger Onderwijs, K. e. S., Volwassenenonderwijs. (n.d.). *Onderwijsdoelen.* Retrieved from https://onderwijsdoelen.be/resultaten?onderwijsstructuur=LO&filters=onderwijsniveau%255B0%255D%255Bid%255D%3Df7dcdedc9e9c97a653c7dba05896ef57a333480b%26onderwijsniveau%255B0%255D%255Btitel%255D%3DBasisonderwijs%26onderwijsniveau%255B0%255D%255Bwaarde%255D%3DBasisonderwijs%26bo_onderwijs_subniveau%255B0%255D%255Bid%255D%3Dc6770d35508ce6bdab180b85cb08a171f2ed94be%26bo_onderwijs_subniveau%255B0%255D%255Btitel%255D%3DBasisonderwijs%2520%253E%2520Lager%2520Onderwijs%26bo_onderwijs_subniveau%255B0%255D%255Bwaarde%255D%3DLager%2520Onderwijs

Andric, A. (2023, 7). *Sweden – National Digitalisation Strategy for the School System 2023-2027.* Retrieved from https://digital-skills-jobs.europa.eu/en/actions/national-initiatives/national-strategies/sweden-national-digitalisation-strategy-school-0

at Boston College, D. R. G., & Foundation., S. (2024). *ScratchJr.* Retrieved from https://www.scratchjr.org/

Bastiaensen, B., & de Creamer, J. (n.d.). *Zo denkt een computer. Programmeren en computationeel denken in het.* Koen Pelleriaux. Retrieved from https://onderwijs.vlaanderen.be/nl/onderwijspersoneel/van-basis-tot-volwassenenonderwijs/lespraktijk/ict-in-de-klas/zo-denkt-een-computer-programmeren-en-computationeel-denken-in-het-onderwijs

B-Bot. (2024a). *Bee-Bot.* Retrieved from https://b-bot.nl/bee-bot

B-Bot. (2024b). *Blue-Bot.* Retrieved from https://b-bot.nl/blue-bot

Codevaardig.nl. (2017, 9). *Over Dash en Dot — Codevaardig - Spelenderwijs leren programmeren.* Retrieved from https://codevaardig.nl/over-dash-en-dot/

Commision, E. (2018, 9). *Digital skills enter into Sweden schools.* Retrieved from https://eurydice.eacea.ec.europa.eu/news/digital-skills-enter-sweden-schools

Commision, E. (2023, 9). *Country reports - Digital Decade report 2023.* Retrieved from https://digital-strategy.ec.europa.eu/en/library/country-reports-digital-decade-report-2023

Del Olmo-Muñoz, J., Cózar-Gutiérrez, R., & González-Calero, J. A. (2020, 6). Computational thinking through unplugged activities in early years of Primary Education. *Computers and education/Computers education*, *150*, 103832. Retrieved from https://doi.org/10.1016/j.compedu.2020.103832 doi: 10.1016/j.compedu.2020.103832

de Rolf groep. (2024). *Rolf Originals - Coderen met pixels.* Retrieved from https://shop.derolfgroep.nl/p/rolf-originals-coderen-met-pixels/18105/

Digitalization Clusters within the European Union. (2019, 4). Granada, es: The International Business Information Management Conference. Retrieved from https://www.researchgate.net/publication/331686291_Digitalization_Clusters_within_the_European_Union

Educatheek. (2024). *Let's Go Code! Activiteitenset.* Retrieved from https://www.educatheek.nl/lets-go-code-activiteitenset-1310-ler2835?gad_source=1&gclid=

CjwKCAjw1emzBhB8EiwAHwZZxXBoFgkN5te2tzdzcdYqCxc2aL6UCy4IC6hfyFYZTOKZ4KpBVTXQRBoCF_0QAvD_BwE
ePerusteet palvelu. (n.d.-a). *The Framework for Digital Competence - Digital competence.* Retrieved from https://eperusteet.opintopolku.fi/#/en/digiosaaminen/8706410/osaamiskokonaisuus/8706431
ePerusteet palvelu. (n.d.-b). *The Framework for Digital Competence - Media literacy.* Retrieved from https://eperusteet.opintopolku.fi/#/en/digiosaaminen/8706410/osaamiskokonaisuus/8709070
ePerusteet palvelu. (n.d.-c). *The Framework for Digital Competence - Programming competence.* Retrieved from https://eperusteet.opintopolku.fi/#/en/digiosaaminen/8706410/osaamiskokonaisuus/8709075
Firmagrondzaken. (2024, 3). *Nederlands Vlaamse onderwijstop - Praktijkonderwijs.* Retrieved from https://www.praktijkonderwijs.nl/nieuws/nederlands-vlaamse-onderwijstop/
Grover, S., & Pea, R. (2013, 2). Computational Thinking in K–12 A Review of the State of the Field. *Educational Researcher*, *42*, 38–43. doi: 10.3102/0013189X12463051
Hammer, D. (1997, 12). Discovery learning and discovery teaching. *Cognition and instruction*, *15*(4), 485–529. Retrieved from https://doi.org/10.1207/s1532690xci1504_2 doi: 10.1207/s1532690xci1504\{_}2
Heutink. (2024a). *Basisset — LEGO® Education — MINDSTORMS® EV3 — 45544 — Heutink.nl.* Retrieved from https://www.heutink.nl/product/basisset-lego-education-mindstorms-ev3-45544/100_090701
Heutink. (2024b). *Pro-Bot — heutink.nl.* Retrieved from https://www.heutink.nl/product/pro-bot/100_022810
Hu, F., Zekelman, A., Horn, M., & Judd, F. (2015, 6). Strawbies. *Proceedings of the 14th International Conference on Interaction Design and Children - IDC*, 410–413. Retrieved from https://doi.org/10.1145/2771839.2771866 doi: 10.1145/2771839.2771866
Inc, L. (2017). *c.* Retrieved from https://lightbot.com/
Jeuring, J., Corbalan, G., Montfort, J. v., Es, N. v., & Leeuwestein, H. (2016). *Vorm en effect van Programmeeronderwijs in het primair onderwijs.* Retrieved from https://dspace.library.uu.nl/handle/1874/346320
Kakavas, P., & Ugolini, F. C. (2019, 12). Computational thinking in primary education: a systematic literature review. *REM*, *11*(2), 64–94. Retrieved from https://doi.org/10.2478/rem-2019-0023 doi: 10.2478/rem-2019-0023
Kalyuga, S., Ayres, P., Chandler, P., & Sweller, J. (2003, 1). The expertise reversal effect. *Educational psychologist :/Educational psychologist*, *38*(1), 23–31. Retrieved from https://doi.org/10.1207/s15326985ep3801_4 doi: 10.1207/s15326985ep3801\{_}4
Kirschner, P. A., Sweller, J., & Clark, R. E. (2006, 6). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, Problem-Based, experiential, and Inquiry-Based teaching. *Educational psychologist :/Educational psychologist*, *41*(2), 75–86. Retrieved from https://doi.org/10.1207/s15326985ep4102_1 doi: 10.1207/s15326985ep4102\{_}1
Lin, Y., Liao, H., Weng, S., & Dong, W. (2023, 9). Comparing the effects of plugged-in and unplugged activities on computational thinking development in young children. *Education and information technologies*. Retrieved from https://doi.org/10.1007/s10639-023-12181-x doi: 10.1007/s10639-023-12181-x

Marcos, J. G., Marco, M., & Luciana, B. (2019, 1). Text-based Programming in Elementary School A Comparative Study of Programming Abilities in Children with and without Block-based Experience. *ACM Proceedings*, 402–408. Retrieved from https://jglobal.jst.go.jp/en/detail?JGLOBAL_ID=202002237720404923

Ministerie van Onderwijs, C. e. W. (2024, 3). *Nederland en Vlaanderen gaan samen digitale vaardigheden leraren verbeteren.* Retrieved from https://www.rijksoverheid.nl/actueel/nieuws/2024/03/26/nederland-en-vlaanderen-gaan-samen-digitale-vaardigheden-leraren-verbeteren

Moors, L., Luxton-Reilly, A., & Denny, P. (2018, 4). Transitioning from Block-Based to Text-Based Programming Languages. *International Conference on Learning and Teaching in Computing and Engineering*. Retrieved from https://doi.org/10.1109/latice.2018.000-5 doi: 10.1109/latice.2018.000-5

Morgan, H. (2014, 11). Review of Research: The education system in Finland: A success story other countries can emulate. *Childhood education*, *90*(6), 453–457. Retrieved from https://doi.org/10.1080/00094056.2014.983013 doi: 10.1080/00094056.2014.983013

och Regeringskansliet, R. (2024, 2). *Government investing in more reading time and less screen time.* Retrieved from https://www.government.se/articles/2024/02/government-investing-in-more-reading-time-and-less-screen-time/

Ontwikkeling, S. L. (2023, 6). *Over SLO.* Retrieved from https://www.slo.nl/over-slo/

Ozobot-Benelux. (2023, 12). *Ozobot Benelux - Op een educatieve wijze leren programmeren.* Retrieved from https://ozobot-benelux.nl/

Press, O. U. (n.d.). digital media noun - Definition, pictures, pronunciation and usage notes — Oxford Advanced Learner's Dictionary at OxfordLearnersDictionaries.com.. Retrieved from https://www.oxfordlearnersdictionaries.com/definition/english/digital-media

Reporter, G. S. (2023, 9). *Switching off: Sweden says back-to-basics schooling works on paper.* The Guardian. Retrieved from https://www.theguardian.com/world/2023/sep/11/sweden-says-back-to-basics-schooling-works-on-paper

Ruby, H. (2024). *Een avontuurlijk sprookje over programmeren — Hello Ruby.* Retrieved from https://www.helloruby.com/nl

Scratch. (2024). *Scratch - imagine, program, share.* Retrieved from https://scratch.mit.edu/

Selby, C., & Woollard, J. (2013, 1). *Computational thinking: the developing definition* (Tech. Rep.). Retrieved from http://people.cs.vt.edu/~kafura/CS6604/Papers/CT-Developing-Definition.pdf

Skolverket. (2019, 2). *Digital kompetens i förskola, skola och vuxenutbildning* (Tech. Rep.). Retrieved from https://www.skolverket.se/publikationsserier/rapporter/2019/digital-kompetens-i-forskola-skola-och-vuxenutbildning?id=4041

SLO. (2022a, 10). *Inhoudslijnen primair onderwijs digitale geletterdheid.* Author.

SLO. (2022b, 4). *over digitale geletterdheid.* Retrieved from https://www.slo.nl/sectoren/po/digitale-geletterdheid-po/digitale-geletterdheid-po/digitale-geletterdheid/vier-domeinen/

SLO. (2023a, 7). *Digitale geletterdheid in het curriculum po - SLO context juni 2023.* Retrieved from https://www.slo.nl/zoeken/@22341/digitale-geletterdheid-curriculum-po-slo/

SLO. (2023b, 10). *Inhoudslijnen met aanbodsdoelen.* Retrieved from https://www.slo.nl/sectoren/po/digitale-geletterdheid-po/digitale-geletterdheid-po/inhoudslijnen-doelen/

SLO. (2024a, 3). *Kerndoelen Digitale geletterdheid* (Tech. Rep.). Retrieved from https://www.slo.nl/@23474/conceptkerndoelen-digitale-geletterdheid/

SLO. (2024b, 5). *leermaterialen.* Retrieved from https://www.slo.nl/sectoren/po/digitale-geletterdheid-po/digitale-geletterdheid-po/leermaterialen/computational-thinking/

Smith, S., Novak, E., Schenker, J., & Kuo, C.-L. (2022). *Effects of Computer-Based (Scratch) and Robotic (Cozmo) coding instruction on seventh grade students' computational thinking, competency beliefs, and engagement*. Retrieved from https://doi.org/10.1007/978-3-030-98404-5_31 doi: 10.1007/978-3-030-98404-5\{_}31

Sweller, J. (1988, 4). Cognitive load during problem solving: Effects on learning. *Cognitive science*, *12*(2), 257–285. Retrieved from https://doi.org/10.1207/s15516709cog1202_4 doi: 10.1207/s15516709cog1202\{_}4

Söderqvist, F., Hardell, L., Carlberg, M., & Mild, K. H. (2007, 6). Ownership and use of wireless telephones: a population-based study of Swedish children aged 7–14 years. *BMC public health*, *7*(1). Retrieved from https://doi.org/10.1186/1471-2458-7-105 doi: 10.1186/1471-2458-7-105

Turtles, R. (2024). *Robot Turtles — The Board Game that Teaches Programming to Kids.* Retrieved from http://www.robotturtles.com/

van Algemene Zaken, M. (2024, 4). *Digitale geletterdheid op school.* Retrieved from https://www.rijksoverheid.nl/onderwerpen/digitalisering-onderwijs/digitale-geletterdheid-op-school

van Rooyen, L., Demaret, N., & van Kessel, M. v. K. K. (2021). *Rapport praktijkonderzoek digitale geletterdheid po-vo* (Tech. Rep. No. 1.7982.803). Retrieved from https://www.slo.nl/@18856/rapport-praktijkonderzoek-digitale/

Wing, J. M. (2006, 3). Computational thinking. *Communications of the ACM*, *49*(3), 33–35. Retrieved from https://doi.org/10.1145/1118178.1118215 doi: 10.1145/1118178.1118215

Wyeth, P., & Wyeth, G. F. (2001, 1). Electronic blocks: Tangible programming elements for preschoolers. *Proceedings of the Eighth IFIP TC13 Conference on Human-Computer Interaction*, *1*, 496–503. Retrieved from https://espace.library.uq.edu.au/view/UQ:96423/Electronic_blocks.pdf

Yeni, S., Grgurina, N., Saeli, M., Hermans, F., Tolboom, J., & Barendsen, E. (2023, 9). Interdisciplinary Integration of Computational Thinking in K-12 Education: A Systematic review. *Informatics in education*. Retrieved from https://doi.org/10.15388/infedu.2024.08 doi: 10.15388/infedu.2024.08

Yu, J., & Roque, R. (2018, 6). A survey of computational kits for young children. *ACM*. Retrieved from https://doi.org/10.1145/3202185.3202738 doi: 10.1145/3202185.3202738

A Interview Guide

Inleiding

- Voorstellen interviewer en leerkracht.

- Ga een aantal vragen stellen voor de implementatie van de digitale leerlijn op de basisschool die sinds dit jaar een verplicht onderdeel is van het curriculum.
- De informatie is vertrouwelijk.
- Het interview zal ongeveer 20 tot 30 minuten duren.
- Er zal een geluidsopname van het gesprek gemaakt worden, nadat er toestemming is gegeven.
- Bij het beantwoorden van de vragen kunt u uw eigen ervaringen en leerlingen in het achterhoofd nemen.

1. Achtergrond leerkracht

1. Hoeveel jaar bent u leerkracht op deze school?
2. Wat zijn uw taken binnen de digitale leerlijn op school?
3. Geeft u ook les?
   Zo ja:
   A. Aan welke groepen?
   B. Hoeveel uur per week geeft u les?

2. Implementatie digitale leerlijn

1. Werd er de afgelopen jaren al iets gedaan op uw school in het kader van digitale geletterdheid?
   Zo ja:
   - Wat voor lessen werden hierin gegeven? Denk aan programmeerlessen of mediawijsheid.
   - Zijn er veranderingen in hoe digitale geletterdheid gegeven wordt sinds vorig jaar? Zo ja, wat zijn deze veranderingen?
2. Wie heeft het binnen uw school het lesplan voor digitale geletterdheid opgesteld?
3. Hoe is uw school te werk gegaan bij het opstellen van het leerplan voor digitale geletterdheid?
   - Wie waren hierbij betrokken?
   - Wat zijn de overwegingen geweest?
   - Is er feedback van u of andere leerkrachten gevraagd?

3. Les in digitale geletterdheid

1. Zoals u misschien wel weet bestaat digitale geletterdheid formeel uit 4 domeinen. Bent u daarmee bekend?
   Zo nee:

   - Licht alle 4 de domeinen toe met plaatje.

   Zo ja:

   - Herhaal de 4 domeinen met plaatje alsnog en bevestig dat deze overeenkomen met de perceptie van de docent.

2. Wordt er aan alle 4 de domeinen wat gedaan? Wat wordt er aan de 4 domeinen gedaan?
   Zo ja, kunt u dit toelichten?

   - Bij deze vraag bijhouden welke domeinen de leerkracht uit zichzelf al benoemt. De andere domeinen nog specifiek navragen wat daarin gedaan wordt (ICT-basisvaardigheden, Mediawijsheid, Digitale informatievaardigheden en Computational thinking).

3. Welke werkvormen worden gebruikt om les te geven in Mediawijsheid, Digitale informatievaardigheden en ICT-basisvaardigheden (één voor één langsgaan)?

   - Wordt er uitleg gegeven of moeten kinderen het zelf ontdekken?
   - Wordt er klassikaal gewerkt?
   - Werken kinderen samen of individueel?

4. Les in Computational thinking en programmeren

In ons onderzoek zijn we speciaal geïnteresseerd in hoe in Computational thinking en programmeren les wordt gegeven. De volgende vragen zullen daarom specifiek over dit domein gaan.

1. Kunt u beschrijven hoe een les Computational thinking er bij u uitziet?

2. Wat zijn de lesdoelen voor Computational thinking en programmeren?

3. Welke vaardigheden willen jullie de kinderen hierbij overbrengen?

4. Welke werkvormen worden gebruikt om les te geven in Computational thinking?

   - Wordt er uitleg gegeven of moeten kinderen het zelf ontdekken?
   - Wordt er klassikaal gewerkt?
   - Werken kinderen samen of individueel?

5. Worden er tools gebruikt tijdens de lessen in Computational thinking en programmeren? Bij tools kunt u denken aan programmeertalen zoals Scratch, robots, robot kits, spellen, etc.
   Zo ja:

A. Welke tools worden er gebruikt? Zijn deze digitaal of zonder elektronica?
B. Waarom worden deze tools gebruikt?
C. Zijn er ook tools die wel gebruikt zijn maar nu niet meer en waarom?
D. Heeft u het gevoel dat deze tools de leerlingen vaardigheden bijbrengen?

Zo nee:

A. Waarom niet?
B. Zijn er in het verleden wel tools gebruikt?

6. Eigen ervaring en achtergrond digitale geletterdheid

1. Bent u geschoold in het lesgeven over digitale vaardigheden?
   Als antwoord Ja, via de PABO of via een cursus:

   - Wat heeft u voor les hierin gehad? Over welke domeinen gaat dit dan?
   - Heeft u het gevoel dat deze lessen bijdragen in het geven van les in digitale vaardigheden?

   Als antwoord Ja, en zelf via het internet:

   - Over welke domeinen gaat dit dan?

7. Ervaring in het lesgeven

Tenslotte zijn we specifiek geïnteresseerd naar uw persoonlijke ervaring in het lesgeven van digitale geletterdheid. U kunt hier uw eigen lessen en persoonlijke ervaringen in gedachten houden.

1. Hoe ervaart u het om in dit gebied les te geven?

   - Wat zijn hier de positieve punten?
   - Wat zijn hier de minder positieve punten?
   - Zijn er obstakels die u tegenkomt tijdens het lesgeven in digitale geletterdheid?
   - Hoe effectief denkt u dat de lessen zijn als het gaat om de leerlingen vaardigheden in de verschillende digitale geletterdheid gebieden bijbrengen?

2. Heeft u het gevoel dat u voldoende geschoold bent in het geven van digitale geletterdheid?
   Zo nee:

   A. Hoe komt dat?
   B. Welke kennis of ervaring hierin mist u dan?

8. Afsluiting

1. Zijn er nog dingen die u graag kwijt wilt of wilt toevoegen?

2. Bedanken.