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Understanding Primary Teachers' Perceptions, Self-Efficacy and Integration Practices of Computational Thinking in Finland

A Cross-Sectional Survey Study

Department of Teacher Education
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Abstract

The thesis explores how primary school teachers in Finland perceive and integrate computational thinking (CT) into classroom practice, their self-efficacy in relation to CT, as well as the opportunities and challenges they encounter in doing so. As CT has gained increasing attention in national and international curricula, understanding its practical implementation at the primary level is essential for supporting teacher development and fostering 21st-century skills in students.

The study was conducted as a cross-sectional survey, in which the survey included multiple-choice items, four 5-point Likert scales, and open-ended questions addressing teachers' self-written definitions of CT, their perceptions of CT and their own integration practices, and perceived opportunities and challenges related to CT integration. 32 teachers answered the survey.

Findings suggest that while teachers generally acknowledge the importance of CT, their understanding varies, and integration practices are generally limited. Many teachers reported a lack of confidence, insufficient training, and unclear curriculum guidelines as key challenges. On the other hand, they recognized CT's potential to enhance students’ problem-solving and critical thinking skills, as well as opportunities for creativity.

The study highlights the need for quality and sustained professional development opportunities. Supporting teachers with clear guidance and collaborative opportunities is essential for meaningful CT integration in primary education.

Key words: Computational Thinking (CT), perception, self-efficacy, integration practices, opportunities, challenges, Finland, primary teachers.

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List of Abbreviations

CT	Computational Thinking
FNAE	Finnish National Agency for Education
FNCC	Finnish National Core Curriculum
ICT	Information and Communication Technology
MOOC	Massive Open Online Course
PCK	Pedagogical Content Knowledge
PD	Professional Development

1 Introduction

The focus on computational thinking (CT) could be traced back to Seymour Papert's (1980, 1991) work on the LOGO programming language for younger audiences, in which CT is believed to allow students to develop procedural thinking through the learning of programming (Humble & Mozelius, 2023; Shute et al., 2017; Tikva & Tambouris, 2021; Voogt et al., 2015). However, it was Wing's (2006) seminal paper that led to significant attention to the discussion of CT in education. Wing (2006) argued that CT should be integrated into the curriculum at an early age because it is a skill as fundamental as literacy and numeracy. Beyond programming, she emphasizes CT as a mode of problem-solving that enhances logical reasoning, the ability to structure problems, and an understanding of computational processes.

Recognizing its significance, many international education frameworks have emphasized CT, influencing curriculum reforms across various countries (Bocconi et al., 2018; Niemelä et al., 2022; Voogt & Roblin, 2012). Given the increasing role of digitalization in society, CT is increasingly considered a foundational competence for 21st-century learners. Consequently, introducing CT to students early is considered vital for equipping them with the mindset and problem-solving skills necessary for navigating a technology-driven world. Teachers, as key agents in educational reform, play a crucial role in ensuring the successful implementation of CT in the curriculum (Pörn et al., 2021). Thus, it is important to gain insight into teachers' understanding of CT content knowledge, pedagogical knowledge, and integration into practice for developing effective professional development initiatives (Mäkitalo et al., 2024; Yadav et al., 2014).

CT has been included in Finland's National Core Curriculum (FNCC) for Basic Education since 2016 (Finnish National Agency for Education [FNAE], 2016). The approach that is adopted to understand CT in Finland is "something more than programming, encompassing key 21st century competences like problem solving, logical thinking and creativity" (Bocconi et al., 2018, p. 3). Within the Finnish context, the term algorithmic thinking *(algoritminen ajattelu)* is used synonymously with computational thinking *(ohjelmoinnillinen ajattelu).* The term 'ohjelmoinnillinen ajattelu' can also be translated into programming thinking, which might create the confusion whether computational thinking and programming are the same.

In the FNCC, computational thinking is generally integrated in the transversal competences for all subjects, particularly the information and communication technology (ICT) competence (T5), and explicitly emphasized in mathematics (starting in Grade 1) and crafts (starting in Grade 3 onwards, particularly in robotics and automation) (Niemelä et al., 2022). For example, in mathematics, the emphasis is on developing algorithmic and computational thinking skills, such as creating a basic sequence of instructions, coding a simple program in visual programming environment, with Scratch being the most popular environment (Brennan & Resnick, 2012; Dúo-Terrón, 2023; Kakavas & Ugolini, 2019).

Despite these curricular developments, the explicit definition of CT remains absent from the FNCC for Basic Education (FNAE, 2016), which has led to ambiguity in its interpretation and implementation in educational settings. Prior research has pointed out that many teachers lack a clear and shared understanding of CT, contributing to inconsistencies in how it is taught (Pörn et al., 2021). For example, Ausiku and Matthee (2023) suggest that understanding the CT curriculum is insufficient, and there needs to be mapping to the subject areas where CT can be used. Pörn et al. (2021) also emphasize the need to make the connection between mathematical content and computational thinking more visible for teachers, as their views on the subject may vary widely. The absence of clear guidelines can create challenges for teachers, as certain aspects of CT remain undefined, contributing to uncertainty regarding what to teach, how to teach, and how to assess student learning (Kakavas & Ugolini, 2019; Korhonen et al., 2023; Mäkitalo et al., 2024; Ukkonen et al., 2024).

To address these challenges, there is a growing call for a shared definition of CT that enables effective communication and collaboration among key educational stakeholders, including teachers, researchers, and policymakers (Bocconi et al., 2018). This study aims to bridge this gap by investigating Finnish primary school teachers' perceptions and classroom applications of CT. Through examining their perspectives, the study seeks to provide insights into how CT is currently understood and implemented, what challenges and opportunities arise, and what additional support teachers may need.

In Finland, although there is a tutor-teacher system and massive open online courses (MOOCs) (e.g., Toikkanen & Leinonen, 2017) designed to support pedagogical innovation and digitalization, teachers' ICT competencies have not significantly improved despite their own positive self-assessments (Tanhua-Piiroinen et al., 2020). Additionally, Tanhua-Piiroinen et al. (2020) also did not recognise any significant change in students' level of competence in their report. These findings highlight the importance of investigating teachers' perceptions of CT to identify areas where additional support, training, or professional development may be required. Addressing these concerns is crucial for ensuring that CT education is effectively integrated into Finnish primary schools, ultimately benefiting both teachers and students.

By exploring teachers' views, this study aims to inform teacher education programs, curriculum development, and policy initiatives to strengthen CT education in Finland. Supporting teachers in developing their CT teaching practices and addressing their challenges can help ensure that students receive high-quality instruction and develop essential CT skills.

To achieve these objectives, this study seeks to answer the following research questions:

1. What are teachers' perceptions of CT?
    a. How do teachers integrate CT into their practices?
    b. What are the perceived opportunities and challenges in the integration of CT?
2. What is teachers' self-efficacy in relation to CT and its integration?

2 Theoretical Background

2.1 Defining Computational Thinking

Despite its prominence in educational initiatives nowadays, computational thinking is still a fluid concept, and it is challenging to find a unified definition for many reasons. Previous studies have consistently shown that CT is a concept with diverse interpretations, an evolving understanding, and a lack of a single, universally accepted definition (Haseski et al., 2018; Kakavas & Ugolini, 2019; Tikva & Tambouris, 2021). This lack of consensus on its core components presents a challenge for educators and policymakers. Having a clear definition would help teachers and other educational stakeholders better understand what they are expected to deliver to students (Yadav et al., 2014).

To address this issue, many systematic literature reviews have attempted to synthesize existing definitions and identify the core elements of CT. For example, Shute et al. (2017) highlight common core components such as problem decomposition, abstraction, algorithmic thinking, pattern recognition, and generalization. However, definitions often differ in emphasis, particularly regarding the role of technology, the integration of programming, and the broader cognitive and pedagogical implications.

The definition of CT has evolved over time, reflecting its interdisciplinary nature and broadening applications. This also reflects the shifts in educational priorities and technological advancements. Haseski et al. (2018) identified three key phases in the evolution of CT definitions: before 2006, between 2006-2010, and after 2011. Early definitions primarily focused on thinking processes, suggesting an initial understanding of CT as a cognitive process or a specific way of thinking. CT was originally defined as “solving problems, designing systems, and understanding human behaviour by drawing on the concepts fundamental to computer science” (Wing, 2006, p. 33). This perspective sees CT as a way of thinking rather than a technical skill, aligning it with problem-solving and logical reasoning.

After 2006, CT definitions increasingly emphasised problem-solving and technology. Between 2006 and 2010, definitions began incorporating elements of information technology (IT) knowledge and utilization, reflecting the growing importance of digital tools in education. This period saw a stronger link between CT and programming, as coding became the most common means of developing CT skills (Brennan & Resnick, 2012).

From 2011 onwards, the definition of CT expanded further, moving beyond a focus on thinking and technology to include broader sociocultural and interdisciplinary aspects (Haseski et al., 2018). This shift aligns with the rise of 21st-century skills, which emphasize competencies such as creativity, collaboration, communication, and critical thinking (Bocconi et al., 2018; Voogt et al., 2015). CT is also explicitly identified as an important 21st-century skill by many studies (see e.g., Ausiku & Matthee, 2023; Voogt & Roblin, 2012).

Moreover, Fagerlund et al. (2022) highlight that CT overlaps with other competence areas, such as mathematics and scientific inquiry, reinforcing its interdisciplinary relevance. This expansion is also reflected in educational policies. For example, Finland introduced CT into its core curriculum in 2016, explicitly linking CT with 21st-century competencies in its transversal competencies (Korhonen et al., 2023).

As reflected in its evolution, CT is more and more closely linked with technology, and the term is usually confused as a part of computer science, with programming being assumed to be the most common way to acquire CT. Wing (2006) positioned CT as a fundamental thinking process, not just a technical skill. Therefore, it is crucial to note that “CT and computer science are not one and the same and should not be used as synonyms” (Humble & Mozelius, 2023, p. 2). It encompasses a broader scope than computer science education, while programming is an important tool to help develop CT skills (Shute et al., 2017).

Most researchers agree that the following are essential components of CT skills: using algorithms to solve problems, decomposing tasks into smaller units, examining various abstraction levels, and using models to display information (Ausiku & Matthee, 2023). These components underscore CT's potential to enhance students’ problem-solving capabilities across disciplines. As such, CT is increasingly viewed not only as an important part of digital education but as a vital 21st-century competence that can be fostered through both digital and unplugged approaches from an early age (Dúo-Terrón, 2023).

Given the conceptual diversity in the literature, this study adopts a synthesized definition of CT from the systematic literature review by Shute et al. (2017). They defined CT as “the conceptual foundation required to solve problems effectively and efficiently (i.e., algorithmically, with or without the assistance of computers) with solutions that are reusable in different contexts" (p. 151). With this definition, CT can be viewed as a logical way of thinking rather than only certain skills learned through programming. CT frameworks have 6 main facets, namely decomposition, abstraction, algorithms, debugging, iteration, and generalization as identified and summarized by Shute et al. (2017) in Table 1 below.

Table 1 Summary of CT framework, adapted from Shute et al. (2017, p. 153)

Facet	**Definition**
Decomposition	Dissect a complex problem/system into manageable parts. The divided parts are not random pieces, but functional elements that collectively comprise the whole system/problem.
Abstraction	Extract the essence of a (complex) system. Abstraction has three sub-categories: • *Data collection and analysis:* Collect the most relevant and important information from multiple sources and understand the relationships among multilayered datasets; • *Pattern recognition:* Identify patterns/rules underlying the data/information structure; • *Modelling:* Build models or simulations to represent how a system operates, and/or how a system will function in future.
Algorithms	Design logical and ordered instructions for rendering a solution to a problem. The instructions can be carried out by a human or computer. There are four sub-categories: • *Algorithm design:* Create a series of ordered steps to solve a problem; • *Parallelism:* Carry out a certain number of steps at the same time; • *Efficiency:* Design the fewest number of steps to solve a problem, removing redundant and unnecessary steps; • *Automation:* Automate the execution of the procedure when required to solve similar problems.
Debugging	Detect and identify errors, and then fix the errors, when a solution does not work as it should.
Iteration	Repeat design processes to refine solutions, until the ideal result is achieved.
Generalization	Transfer CT skills to a wide range of situations/domains to solve problems effectively and efficiently.

2.2 CT in Education: Rationale and Importance

One of the major rationales for integrating CT in education is its recognition as a fundamental 21st-century skill. Scholars and policy documents increasingly position CT alongside literacy and numeracy as a foundational competency for all learners (Bocconi et al., 2018; Fagerlund et al., 2022; Grover & Pea, 2013; Tikva & Tambouris, 2021). Grover & Pea (2013) describe CT as a cognitive skill comparable to writing and reading, while Tikva and Tambouris (2021) argue that it should be added to the traditional trio of "reading, writing, and arithmetic" as a basic analytical ability.

CT is also valued for its emphasis on problem-solving and system design. Wing (2006) initially defined CT as involving the processes of solving problems, designing systems, and understanding human behaviour through concepts rooted in computer science. Building on this, later studies highlight that CT includes cognitive strategies such as decomposition, abstraction, generalization, algorithmic design, debugging, and iteration (Fagerlund et al., 2022; Humble & Mozelius, 2023; Kong et al., 2020). These skills enable learners to analyse and solve real-world problems using computational methods.

A growing body of research underscores the importance of CT in preparing students for future workforce demands and active participation in a digital society. The increasing ubiquity of digital computing systems across sectors calls for educational systems to respond accordingly (Niemelä et al., 2022). CT is seen as a key factor in fostering digital literacy, civic engagement, and technological fluency. At the societal level, a workforce proficient in CT contributes to a nation’s global competitiveness (Dúo-Terrón, 2023; Shute et al., 2017), while at the individual level, CT may help prevent a so-called “digital handicap” in future generations (Humble & Mozelius, 2023).

Moreover, CT is inherently interdisciplinary and applicable beyond programming or computer science. It supports cross-curricular learning by fostering analytical thinking, creativity, and problem-solving in subjects such as mathematics, science, language, crafts, and the arts (Fagerlund et al., 2022; Niemelä et al., 2022; Voogt et al., 2015; Yadav et al., 2014). For instance, students may use abstraction in social studies, algorithms in science, and automation in mathematics (Tran, 2019). This integrative potential supports the argument that computational thinking is a general problem-solving approach that enriches understanding across disciplines.

In line with broader educational goals, CT is also linked to the development of computational competencies and digital agency. Introducing CT through programming can help bridge the gap between traditional curricula and the needs of modern learners (Bocconi et al., 2018). CT helps students understand what computers can and cannot do, how to interact with technology effectively, and how to use digital tools to solve complex problems (Fagerlund et al., 2021). This not only supports academic achievement but also prepares students to be critical users and creative producers in an increasingly digital world.

From a pedagogical standpoint, CT has the potential to enhance learning efficiency and foster engagement. Studies have shown that learner-centred methods commonly used in CT education, such as visual programming with Scratch, can make learning more efficient and enjoyable (Ausiku & Matthee, 2023; Humble & Mozelius, 2023). CT can serve to both modernize and reinforce existing teaching practices, thereby improving student motivation and changing negative perceptions, particularly in subjects like mathematics.

Finally, CT contributes to the development of systematic and analytical thinking, which is valuable both within and beyond STEM education. By fostering the ability to design systems and solve complex problems, CT complements mathematical and engineering thinking while extending its utility to broader contexts (Voogt et al., 2015)

Despite challenges, the overall consensus across the sources is that CT is a crucial skill for navigating the 21st century, fostering problem-solving abilities, and preparing students for a digitally driven world across various disciplines.

2.3 CT Integration: Practices, Challenges, and Opportunities

Despite growing interest in CT, challenges remain in determining effective instructional strategies, equipping teachers with the necessary skills, and assessing students’ CT competencies. Across different educational systems, various models and strategies have emerged for embedding CT into classroom practice, each with its own implications, challenges, and opportunities.

2.3.1 Integration Practices

Many countries, including those in the Nordic region, have chosen to integrate CT into existing subjects, particularly mathematics and science, rather than introducing it as a standalone subject (Ausiku & Matthee, 2023; Bocconi et al., 2018; Niemelä et al., 2022). In Finland, CT is embedded in the mathematics and crafts curricula, as well as in the transversal competence area of ICT (FNAE, 2016). Similarly, Sweden incorporates CT into mathematics and language subjects, while also exploring its integration into technology education (Niemelä et al., 2022). This approach reflects a broader pedagogical strategy of developing CT as a cross-curricular competence that supports transversal learning objectives (Bocconi et al., 2018).

Some countries, such as Denmark and Norway, have piloted CT as part of new, purposely designed elective subjects in lower secondary education, with aspirations to eventually embed CT more broadly (Bocconi et al., 2018). These varied approaches illustrate the flexible nature of CT and its potential to be tailored to different national curricula and educational goals.

Interestingly, teachers often already engage in CT-related activities without explicitly labelling them as such. For example, problem-solving in mathematics, technology, and natural sciences often aligns with CT principles (Fagerlund et al., 2021). CT can be introduced through both "plugged" (technology-based) and "unplugged" (non-digital) methods (Ausiku & Matthee, 2023; Kakavas & Ugolini, 2019). Plugged activities often involve the use of visual programming environments such as Scratch, which provide accessible, hands-on experiences for both students and teachers (Brennan & Resnick, 2012). These tools are particularly effective in reducing entry barriers to programming and fostering CT practices such as debugging and iteration.

Unplugged activities, on the other hand, allow students to interact with core CT concepts, such as abstraction, decomposition, and algorithmic thinking, without the use of digital devices (Kong et al., 2020). These methods are especially beneficial in contexts with limited technological resources or where teachers have limited prior experience with programming (Chiazzese et al., 2019). In mathematics education, for example, unplugged approaches have been found to support conceptual understanding and foster engagement with CT principles (Bocconi et al., 2018).

One of the ongoing debates in CT education is the relationship between CT and programming. While programming is often associated with CT, it is not the only way to develop computational thinking skills (Voogt et al., 2015). Programming provides a powerful tool to implement CT concepts, but CT also includes problem-solving approaches that can be applied in non-programming contexts.

CT has demonstrated its versatility by being effectively integrated across a variety of subject areas. In mathematics, CT reinforces students’ understanding of problem-solving processes and digital tools (Kjällander et al., 2021; Voogt et al., 2015). In science, CT supports data collection, analysis, and interpretation, aligning well with inquiry-based learning practices (Voogt et al., 2015). In language arts, CT is applied through processes such as abstraction and data representation (Yadav et al., 2017), while arts and crafts subjects provide opportunities to explore CT in physical and virtual creative domains (Bocconi et al., 2018). Some projects adopt an interdisciplinary approach, integrating CT concepts across science, art, and digital storytelling (Kakavas & Ugolini, 2019). Yet, computer-based activities, especially programming in a visual environment like Scratch, dominate the landscape of CT pedagogy.

A significant portion of the literature emphasizes integrating CT within STEM disciplines, particularly computer science (CS), robotics, and science (Kakavas & Ugolini, 2019). This STEM-centred approach is evident in the Finnish primary school context, where studies like Pörn et al. (2021) focused primarily on programming activities, despite acknowledging a broader definition of CT that extends beyond coding. For that reason, cultivating CT skills in other disciplines, such as English or social studies, remains underexplored.

In Finnish schools, CT exploration primarily occurs through Scratch programming (Pörn et al., 2021). However, some teachers express challenges related to limited resources, insufficient content knowledge, and a somewhat unclear understanding of CT or programming in general. While programming offers valuable learning experiences, this overemphasis may overshadow the potential of unplugged activities (e.g., puzzle-solving, Bebras tasks), which can foster CT skills without requiring any technical devices. This reliance on programming also explains the concentration of research on this specific aspect of CT.

2.3.2 Common Challenges and the Critical Need for Professional Development

Despite the potential of CT integration, teachers often face numerous challenges. A primary concern is the lack of teacher knowledge and confidence, which is particularly acute at the primary level (Kong et al., 2020; Mäkitalo et al., 2024; Tikva & Tambouris, 2021). Many teachers are interested in CT but struggle to understand how to apply it in practice (Ausiku & Matthee, 2023; Tikva & Tambouris, 2021). Furthermore, misconceptions about CT, such as viewing it solely as the use of digital tools or programming, can hinder the integration as they might think of it as unnecessary or unwilling due to a lack of competence (Grover & Pea, 2013).

While Rijke et al. (2018) established a correlation between developmental age and appropriate CT skills to introduce, there remains a lack of clarity regarding specific CT concepts and skills that should be taught at different grade levels (Pörn et al., 2021). Additional challenges include the lack of clear curricular guidance, instructional resources, and age-appropriate progression models (Pörn et al., 2021). Teachers often express uncertainty about which CT concepts are suitable for younger learners and how these should develop over time. Assessment also remains problematic, as teachers lack tools and frameworks to effectively evaluate students' CT competencies (Ukkonen et al., 2024).

The difficulty in assessing CT is linked to the lack of a universally accepted definition and to debates on whether CT should be assessed within specific subjects or as a standalone skill. Ukkonen et al. (2024) highlight that teachers find CT assessment challenging due to its broader scope beyond coding. This is consistent with the study by Iwata et al. (2020), which indicates that teachers and facilitators need to be aware of CT concepts to provide opportunities for learners to understand and apply CT practices. Professional development and clearer assessment guidelines could help teachers with CT assessment.

Moreover, integrating CT into subject-specific contexts requires teachers to master both content-specific pedagogy and computational concepts (Voogt et al., 2015). Teachers need a clear understanding of CT, its educational goals, and effective instructional methods. Without sufficient training, teachers may lack confidence in teaching CT concepts, particularly if they do not have a background in computer science (Yadav et al., 2014, 2017). Teachers also mention time constraints to adopt CT as barriers to sustained integration (Humble &

Mozelius, 2023; Tikva & Tambouris, 2021). Overall, a lack of consensus on CT definitions and progression across grade levels, combined with assessment challenges, adds further complexity to integrating CT into classroom practices in primary schools (Pörn et al., 2021; Ukkonen et al., 2024).

Given the challenges teachers face in understanding and implementing computational thinking, professional development (PD) plays a pivotal role in enabling effective integration into classroom practice (Bocconi et al., 2018; Dúo-Terrón, 2023; Yadav et al., 2017). Research underscores that effective PD should be sustained, hands-on, and contextually relevant, focusing on both the development of content knowledge and pedagogical strategies (Kong et al., 2020). Active participation in such programs has been shown to significantly enhance teachers' confidence, competence, and readiness to engage with CT in meaningful ways (Amante et al., 2023; Kong et al., 2020). In general, PD opportunities are important in shaping teachers' attitudes and their willingness to integrate CT into their teaching (Ausiku & Matthee, 2023; Tikva & Tambouris, 2021).

Effective PD should not only focus on technical content but also address Pedagogical Content Knowledge (PCK)—the understanding of how to teach CT concepts, such as abstraction or decomposition, in ways that are developmentally appropriate and pedagogically sound (Kong et al., 2020). However, despite these benefits, many existing PD programs have been short in duration, overly focused on programming content, and lacked collaboration with school leadership, limiting their long-term impact (Kong et al., 2020). There is a pressing need for empirically grounded, pedagogically rich PD that includes opportunities for reflection, collaboration, and real-world classroom application.

Future PD initiatives should also place greater emphasis on unplugged CT approaches that allow students to develop computational thinking skills before engaging in coding, as well as on developing teachers' understanding of CT assessment practices (Kong et al., 2020; Ukkonen et al., 2024). Overall, when thoughtfully designed and supported, PD has the potential to mitigate many of the barriers to CT integration by equipping teachers with the tools, mindsets, and pedagogical strategies necessary to foster meaningful CT learning in primary classrooms.

2.3.3 Opportunities

Although there are many challenges to overcome, the integration of CT offers multiple pedagogical and educational benefits. CT strengthens subject learning by introducing new strategies for problem-solving and reinforcing conceptual understanding (Humble & Mozelius, 2023; Voogt et al., 2015). It promotes the development of higher-order thinking skills and fosters students' abilities to solve complex, real-world problems (Fagerlund et al., 2021; Tran, 2019).

The potential for integrating CT goes beyond STEM and programming. Examples from Yadav et al. (2014) and Ausiku and Matthee (2023) demonstrate the possibility of incorporating CT into creative writing and English lessons, respectively. These findings encourage a broader perspective on CT education, paving the way for a more comprehensive and inclusive approach to benefit all learners.

CT also enhances engagement through learner-centred and creative approaches such as game design, robotics, and storytelling (Weber et al., 2022). Many students find these activities motivating and enjoyable, which can improve attitudes toward traditionally challenging subjects such as mathematics (Voogt et al., 2015).

The interdisciplinary nature of CT supports holistic education and cross-subject collaboration, contributing to students' preparation for the digital society (Bocconi et al., 2018; Kong et al., 2020; Ukkonen et al., 2024). Moreover, CT fosters the development of digital citizenship by helping learners understand the ethical and societal implications of technology. From a broader perspective, CT equips students with transferable skills, including abstraction, logical reasoning, and algorithmic thinking, which are valuable in both academic and professional contexts (Bocconi et al., 2018).

Overall, the integration of CT into primary education and across subjects is a multifaceted endeavour. While teachers face substantial challenges related to confidence, clarity, and curriculum, there is strong evidence that CT can enhance learning, foster engagement, and support the development of critical 21st-century skills.

2.4 Conceptual Framework

To understand how teachers understand and engage with CT, this study examines their perceptions and self-efficacy in relation to CT. The term “perception” is defined as “a belief or opinion, often held by many people and based on how things seem” (Cambridge Dictionary, n.d.). Research shows that perceptions are shaped by individuals’ prior knowledge and experiences, which influence how they interpret new information (Humble & Mozelius, 2023; Ukkonen et al., 2024). In the study by Humble and Mozelius (2023), perception refers to how teachers view, understand, and relate CT to their own teaching and learning practices. More broadly, in the context of CT, perception encompasses how teachers interpret and reflect on CT, its related concepts, its relevance, its classroom applications, and its assessment.

Self-efficacy, as defined by Weber et al. (2022), refers to a domain-specific belief in one’s ability to complete particular tasks successfully. In the context of CT, Kong et al. (2020) describe it as an individual’s perceived competence in applying CT effectively. Drawing on Bandura’s self-efficacy theory, Kaya et al. (2020) define teachers’ self-efficacy as their awareness of their own potential and capabilities to achieve specific goals. They further highlight that self-efficacy can be strengthened through access to appropriate teaching materials and professional development. A teacher with high self-efficacy in CT may feel confident in designing and delivering CT-based learning activities. High self-efficacy is often associated with greater persistence, adaptability, and a proactive attitude toward adopting new practices in the classroom. In contrast, teachers with low self-efficacy may hesitate to implement CT or avoid it altogether, even when they acknowledge its value (Ausiku & Matthee, 2023; Pörn et al., 2021).

To further investigate these dimensions, this study draws on the model presented by Yadav et al. (2014) which identifies three key aspects of CT in education (see Figure 1). The first dimension, view of CT, captures teachers’ fundamental understanding of what CT entails. The second dimension, integrating CT into the classroom, examines teachers’ attitudes toward the practical implementation of CT in the classroom and their self-efficacy in incorporating CT practices. The third dimension, the relationship of CT to other disciplines, explores teachers’ beliefs about the connection between CT and other subject areas, highlighting their perceptions of its broader relevance and integration potential.

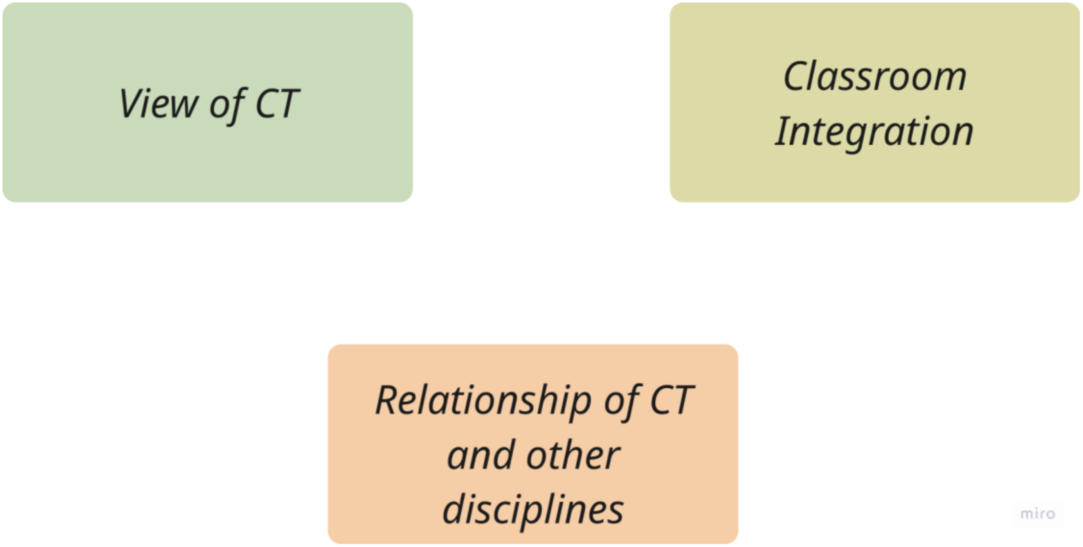

Figure 1 Yadav et al. (2014)'s Model of Understanding CT in Education

This model provides a structured foundation for understanding teachers' views on CT and informs the development of the study's conceptual framework. Given the Finnish educational context, where CT is embedded within mathematics, handicrafts, and the transversal competence of ICT, this study focuses on the first two dimensions: teachers' views of CT and their integration of CT into the classroom. The relationship between CT and other disciplines is not explicitly addressed in the curriculum, which is why it is not a primary focus of this research.

Drawing from the Yadav et al. (2014) model and other studies, the conceptual framework underpinning this study is presented in Figure 2 below. Teachers' perceptions of CT encompass how they define and interpret CT, as well as the value they assign to it in education. These perceptions form the foundation for their integration practices. This study looks into teachers' knowledge and experiences with CT, such as how they define it, what CT entails, and whether it is important for students' learning. Prior research suggests that teachers with a broad, comprehensive understanding of CT are more likely to integrate it meaningfully into their teaching practices (Kong et al., 2020; Voogt et al., 2015; Yadav et al., 2017). Conversely, misconceptions or overly narrow definitions may limit the scope of integration.

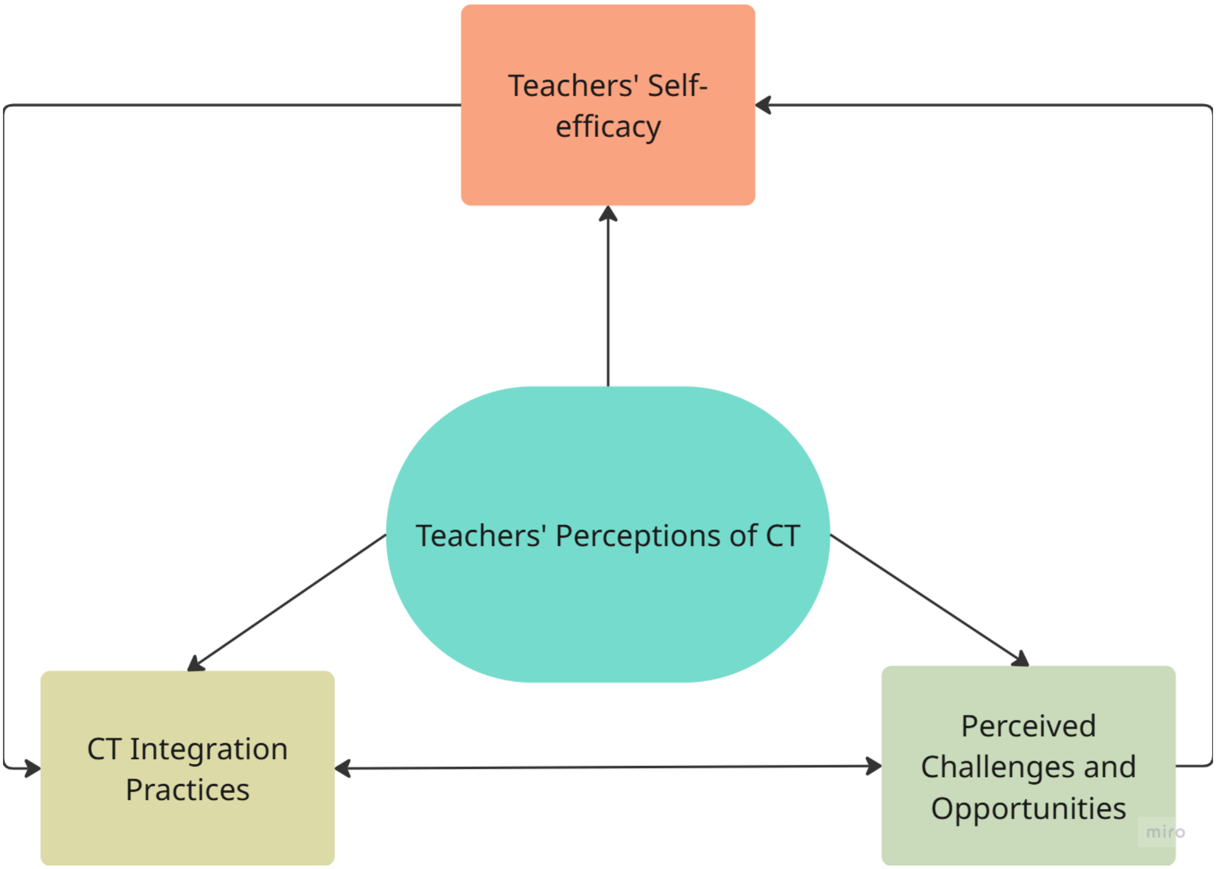

Figure 2 Conceptual Framework of the Study

Teachers’ self-efficacy, defined as their confidence in their ability to integrate CT into their classroom practices, has been identified as a key predictor of successful implementation (Ausiku & Matthee, 2023; Korhonen et al., 2023; Shute et al., 2017; Weber et al., 2022). Teachers with low self-efficacy may avoid integrating CT due to a lack of confidence, whereas those with high self-efficacy are more likely to experiment with and embed CT concepts into their curriculum (Weber et al., 2022). Self-efficacy beliefs strongly influence pedagogical decision-making and teaching strategies (Boulden et al., 2021; Kaya et al., 2020; Weber et al., 2022).

Perceived challenges and opportunities further shape both self-efficacy and integration practices. Teachers may encounter barriers such as limited resources, lack of professional development, or time constraints, which negatively affect their attitudes and self-efficacy (Ausiku & Matthee, 2023; Korhonen et al., 2023; Tikva & Tambouris, 2021). However, they may also recognize opportunities, such as the potential of CT to enhance problem-solving skills and interdisciplinary learning, which could positively reinforce their perceptions and willingness to integrate CT (Mäkitalo et al., 2024; Shute et al., 2017; Voogt et al., 2015). Previous studies show that professional development and exposure to positive experiences positively impact teachers' self-efficacy, which in turn, supports the willingness for effective and sustained integration practices.

This conceptual framework positions teachers' perceptions of CT at its core, influencing their self-efficacy, instructional strategies, and how they interpret challenges and opportunities. Integration may take various forms, from embedding CT into existing subjects, such as mathematics or science, to interdisciplinary CT-focused activities, such as a project-based learning week. Their instructional choices and strategies for incorporating CT into their classrooms are influenced by how they conceptualize CT, their confidence in teaching it, and the perceived barriers or enablers in their teaching environment (Fagerlund et al., 2021; Kaya et al., 2020; Ukkonen et al., 2024; Weber et al., 2022).

By outlining these interconnected components, the framework provides a lens through which the study's findings will be analysed and interpreted. It supports the examination of teachers' perceptions of CT, how those perceptions shape their integration practices, their self-efficacy, and what challenges and opportunities influence these processes. The framework will help in identifying patterns and possible gaps in teachers' experiences with CT integration, ultimately contributing to a deeper understanding of the factors that facilitate or hinder its adoption in primary education.

3 Methodology

This chapter outlines the research design, sample selection, data collection and analysis procedures, and limitations. The study investigates Finnish primary school teachers' perspectives on computational thinking (CT) and its integration into teaching practices.

3.1 Research Design

This study originally aimed to employ a mixed-methods approach, combining a quantitative survey (with some qualitative questions) with qualitative follow-up interviews, to investigate the practices and perspectives of primary school teachers in Finland regarding computational thinking (CT). The initial rationale was that the mixed-methods design would allow for a comprehensive understanding - using quantitative data to "examine current attitudes, beliefs, opinions or practices" (Creswell, 2012, p. 377) and qualitative data to provide in-depth insights into the phenomena under study.

However, due to the lower-than-expected response rate and the lack of interview participants, the design was revised to a survey study where data were gathered from participants at one point in time (Fraenkel et al., 2012), with embedded qualitative elements. This change was necessary to ensure that the study could proceed despite the challenges in recruiting participants for follow-up interviews. The design is well-suited for exploring, in this study, the current state of teachers' views and practices concerning computational thinking in primary schools in Finland. Although the study now primarily relies on quantitative data, the qualitative items may allow for supplementary insights. These qualitative responses offer additional context to the quantitative findings, even though they do not constitute a full qualitative phase.

3.2 Participants

The target population for this study is class teachers teaching grades 1-6 in Finnish primary schools. A combination of purposive and convenience sampling was used to recruit participants. Potential participants were contacted via direct email or through distribution from school administrators and student teachers' organizations, resulting in a sample of 32 teachers. Detailed information on participants' demographics can be found in Table 2 below.

Table 2 Summary of participants' demographics

Characteristics		**Frequency**	**Percentage**
Gender	Male	9	28.1
	Female	23	71.9
Age Group	20-29	11	34.4
	30-39	8	25.0
	40-49	6	18.7
	50-59	5	15.6
	60 and above	2	6.3
Years of Teaching Experience	0-5 years	16	50.0
	6-10 years	3	9.4
	11-15 years	4	12.5
	16-20 years	1	3.1
	More than 20 years	8	25.0
Taught Grade Levels	Grade 1-2	22	68.8
	Grade 3-4	28	87.5
	Grade 5-6	24	75.0

The sample included 71.9% female (N=23) and 28.1% male (N=9) teachers, which reflects approximately the gender composition of primary school teachers in Finland as reported by Paronen and Lappi (2018). The most frequent age range is 20-29 (N=11, 34.4%). Participants' years of teaching experience ranged from less than 5 years to more than 20 years. The largest group of participants had between 0–5 years of teaching experience (N=16, 50%). Teachers reported teaching various grade levels within primary education, with the largest group teaching grades 3-4 (N=28, 87.5%).

3.3 Data Collection Instrument and Process

To collect data for this study, a survey was developed, targeting all primary school teachers (grades 1-6) in Finland (see Appendix 1). The survey consisted of nine multiple-choice items, four scales of 5-point Likert-scale questions asking for agreement (from 1-Strongly Disagree to 5-Strong Agree), and two qualitative items, allowing participants to elaborate on their responses if they wanted to. The structure of the survey is illustrated in Table 3 below.

Table 3 Survey Structure

Section of the Survey	What data does it collect?
Demographic information	Questions on gender, age group, teaching experience, and grade level taught.
Perceptions of CT	Teachers’ familiarity with the term CT, prior experiences, perceived definitions and integration practices.
Self-efficacy	Teachers' confidence in their ability and their willingness to integrate computational thinking (CT) into their teaching.
Opportunities	Opportunities in integrating CT into Classroom Practices – Factors that support or facilitate teachers’ integration of CT into their teaching.
Challenges	Challenges in integrating CT into Classroom Practices – Barriers or difficulties teachers encounter when implementing CT.

The survey items were developed based on the research questions and the study’s conceptual framework, as well as insights from previous literature. Examples of items from each section are presented in Table 4, and the full survey is available in Appendix 1 in English and Appendix 2 in Finnish. The perception scale consists of six items, combining multiple-choice questions with a 5-point Likert scale comprising four items. The self-efficacy scale includes eight items, all measured using a 5-point Likert scale. There are 6 and 7 5-point Likert items in the CT opportunities and CT challenges, respectively. The survey was originally designed in English and then translated into Finnish with the help of a Finnish native speaker after realising its low response rate. This individual is studying to become a primary school teacher in an English-medium program in Finland, which helps in understanding both the content and language dimensions of the survey construction. Their assistance helped ensure clarity and accessibility for participants. To further improve its quality, my supervisor reviewed the English version of the items, provided feedback, and suggested modifications. Participants could choose to respond in the language they were most comfortable with. While efforts were made to ensure accuracy, minor discrepancies in terminology may exist due to translation limitations. However, no formal pilot test was conducted.

Table 4 Sample items from the survey

Section of the Survey	Sample items
Demographic information	Gender Age Group Grade level taught Years of Teaching Experience
Perceptions of CT	How familiar are you with the term “Computational Thinking” (CT)? In your own words, how would you define CT?
Self-efficacy	To what extent do you agree or disagree with the following statements? • I feel prepared to answer students’ questions related to CT. • I would benefit from additional profession development focused on CT. • I am able to adapt existing teaching materials to include CT content.
Opportunities	To what extent do you agree or disagree with the following statements about opportunities that CT may offer your students? • Enhances students’ problem-solving and critical thinking skills. • Makes learning more engaging via the use of technology and real-life applications. • Makes learning more relevant for students through solving complex real-life problems.
Challenges	To what extent do you agree or disagree with the following challenges when integrating CT into your teaching? • Lack of clear guidelines for CT integration in the curriculum. • Lack of clear learning objectives for CT in the curriculum. • Increased workload due to the integration of CT in the curriculum.

The survey was created, administered via Webropol, and then distributed to prospective participants in November 2024 and remained open until mid-January 2025. A research permit was applied for in the City of Tampere in order to collect data. Given the language of the original survey, it was first distributed to international and bilingual schools in Finland, mostly in the regions of Uusimaa and Southwest Finland, either directly to teachers' email or school administrators, requesting them to forward it to their teachers. Additionally, student teacher organizations were contacted, as they have connections with schools and could assist in distributing the survey.

To ensure ethical processes, a consent form was provided at the beginning of the survey, outlining the purpose of the study and participants' rights before they proceeded to answer the questions. The survey was anonymous. Although the survey was available for nearly three months, the overall response rate was lower than anticipated, likely due to the holiday season being in the middle of the survey period.

3.4 Data Analysis

The data collected in this study were analysed using both quantitative and qualitative methods. Factor analysis was not conducted due to the limited sample size. Since some of the responses to qualitative items were provided in Finnish, they were translated into English before conducting the analysis. The data analysis focused mainly on descriptive statistical methods to examine the variables.

The quantitative data were analysed using IBM SPSS Statistics (Version 29). Based on the research questions, descriptive statistics were used to summarize participants' responses. Open-ended responses were analysed using content analysis (Fraenkel et al., 2012) to identify recurring themes and patterns in teachers' definitions of computational thinking and their experiences integrating it into classroom practices. These qualitative insights provide additional context for interpreting the quantitative findings.

3.4.1 Reliability

To assess the internal consistency of the survey, a reliability analysis was conducted on three constructed scales: teachers' self-efficacy of CT, opportunities for students in integrating CT, and challenges in integrating CT.

The results showed acceptable reliability for opportunities and self-efficacy scales, with Cronbach's alpha values of α=.88 and α=.82, respectively, indicating that the items within the scale consistently measured the same construct.

For the challenges scale, the initial Cronbach's alpha was α=.64. The last item in the scale, which is indicated with an asterisk (*) in Appendix 1, had a low item-total correlation of -0.084, indicating it did not align well with the overall scale. Removing this item increased Cronbach's alpha from 0.64 to 0.74. As a result, this item was excluded to ensure a more reliable measure of challenges.

The perception scale included different types of items: Likert-scale items, four multiple-choice questions, and one open-ended question. Reliability was calculated for the four Likert-scale items, giving a Cronbach's alpha of α=.39. This is lower than the commonly accepted level of 0.70, which may be due to low number of items and low number of responses. Because of this, the results from the Likert-scale items should be interpreted with caution and considered alongside other data.

3.4.2 Internal Validity

Internal validity refers to the extent to which a study accurately establishes relationships between variables without being affected by confounding factors (Fraenkel et al., 2012). Several potential threats to internal validity must be considered and addressed in this study to ensure the accuracy of findings.

One major concern is selection bias, where the sample may not fully represent the entire population of primary school teachers in Finland. To mitigate this, demographic questions were included to capture participant diversity in terms of age, teaching experience, and grade levels taught. Although the sample consists of more female than male teachers, this distribution reflects the actual gender composition of primary school teachers in Finland.

Measurement bias occurs when survey items do not accurately measure the intended constructs. To ensure validity, survey items were developed based on prior research.

Another potential issue is translation-related bias, as the survey was translated from English to Finnish. Minor variations in wording could have unintentionally altered the meaning of some questions. To minimize this risk, the translated survey was reviewed by native Finnish-speaking educators, who provided feedback on the clarity and accuracy of the items.

Social desirability bias may occur if participants respond in a way they perceive as more socially acceptable rather than providing their true opinions. To reduce this risk, the survey was anonymous, ensuring participants could respond freely without concern for judgment.

Participants were informed about their consent to the study prior to data collection. Following the General Data Protection Regulation (GDPR), responses were anonymised, securely stored, and used solely for research purposes. Participants were informed of their right to withdraw at any stage and were provided with contact information for any inquiries.

3.4.3 Limitations and assumptions

One key limitation is the potential for minor translation inaccuracies, as neither the researcher nor most participants are native English speakers. However, certain terminology or phrasing may have led to unintended variations in interpretation in the Finnish version. This could have affected how some respondents understood and answered specific survey items.

The factor structure of the survey was not validated through factor analysis due to the limited sample size. A larger dataset would be necessary to confirm the underlying structure of the subscales measured in the survey. Future research with a broader participant pool could help validate and refine the factor structure of the instrument.

The low reliability of the Likert-scale items measuring teachers' perceptions of CT is another limitation of the study (Cronbach's alpha α=.39). This suggests that the items may not have worked well together to measure the same idea. This could be because there were only a few items, the topic was broad, or the questions were understood in different ways. Because of this, the results from these items should be viewed with caution. Since the scale also included different types of questions, like multiple-choice and open-ended items, it was not possible to calculate an overall reliability score. Still, using different formats helped provide a more complete picture of teachers' perceptions. Future research could improve the scale by adding more items and testing them in advance.

Another limitation of this study is that the survey did not address the assessment of CT, despite its significance in the literature. While prior research highlights various challenges related to assessing CT in primary education, this aspect was not included in the survey, limiting the study's ability to explore teachers' perspectives on CT assessment.

In addition, the survey was sent to schools in certain regions of Finland, not all, which doesn't represent the whole country. The relatively small sample size (32 respondents) also limits the generalizability of the findings. The low response rate, likely influenced by the holiday season, further restricts the representativeness of the sample.

Moreover, while the study provides valuable insights into teachers' perspectives on CT, the absence of a qualitative interview phase means that certain aspects of teachers' experiences may not be fully explored. It is also assumed that participants of the study answered the survey honestly.

4 Results

This chapter presents the findings of the study, drawn from both quantitative and qualitative data collected through the survey. Descriptive statistical analyses were conducted on the multiple-choice and Likert-scale items to examine teachers' perceptions, opportunities, and challenges related to computational thinking (CT). Additionally, content analysis was utilised to analyse open-ended responses to gain deeper insights into teachers' perspectives.

The results are structured to address the research questions that the study aims to answer:

1. What are teachers' perceptions of CT?
    a. How do teachers integrate CT into their practices?
    b. What are the perceived opportunities and challenges in the integration of CT?
2. What is teachers' self-efficacy in relation to CT and its integration?

By organizing the findings around these questions, this chapter provides a comprehensive overview of the data and highlights key insights related to teachers' experiences with CT.

4.1 Teachers' Perceptions of CT

Approximately 44% (N=14) of the respondents reported that they were either slightly familiar or not familiar at all with the term CT, despite its introduction to the curriculum since 2016 (FNAE, 2016). Given that the Finnish curriculum provides flexibility in how CT is implemented and the high level of autonomy of teachers in Finland, the lack of centralized teacher training may contribute to inconsistencies in teachers' lack of familiarity with CT.

Regardless of their familiarity with the term CT, most participants acknowledged the importance of teaching CT to primary students, either very important (N=13, 40.6%) or somewhat important (N=13, 40.6%). Given its inclusion in the Finnish national curriculum as part of digital competence and cross-curricular learning, participants recognized CT's role in developing students' problem-solving skills, logical thinking, and digital literacy. Table 5 presents the distribution of teachers' familiarity with the term CT and their perceptions of its importance for students' learning.

Table 5 Summary of participants' perceptions of CT

Questions	Results (%)	
Question 6. How familiar are you with the term "Computational Thinking" (CT)?	Very familiar	9.3
	Somewhat familiar	46.9
	Slightly familiar	21.9
	Not familiar at all	21.9
Question 8. In your opinion, how important is it for students to learn computational thinking in primary school?	Very important	40.6
	Somewhat important	40.6
	Slightly important	18.8
	Not important at all	0

Participants were also asked to write their own understanding of the term CT. Despite recognizing its importance, they showed varying levels of understanding when being asked to define computational thinking. Some provided responses closely aligned with established definitions, referencing problem-solving, logical reasoning, and algorithmic thinking. However, others displayed uncertainty; as 10 of them used vague terms such as "guessing" or explicitly stated that they were "not sure" what CT entails, for example:

> *A guess: Using sequences of logical thinking to break down complex problems.*
>
> *I guess, a set of skills, techniques and or practices that are needed to unravel some form of complex problem.*
>
> *Maybe as how you use your thinking to solve problems in a systematic way.*

This may explain why some statements were mainly answered as "Neutral", as one of the participants wrote in their response:

> *I have no idea what CT is, and the definition/explanation was not given. So I answered "neutral" to many questions because I cannot express my opinion on something I don't know.*

While CT is often introduced through programming in Finnish primary schools (see Tanhua-Piiroinen et al., 2020; Toikkanen & Leinonen, 2017), most teachers in this study associated it more with problem-solving skills rather than coding. While only one participant explicitly defined CT as "related to programming and coding" in their survey response, others emphasised problem-solving, logical reasoning, and algorithms. Some examples from teachers' responses can be found below.

> *Breaking down learning goals and processes into manageable pieces derived from computer science. For instance, taking a math problem and breaking it down into different sets of techniques, strategies and logical patterns.*
>
> *Process where you define problems so that you can then answer them.*

Participants’ responses to the items in the scale of teachers’ perceptions indicated a moderate level of agreement, with an overall mean score of 3.18 (SD=1.04). The distribution of participants’ responses about their perceptions of CT is shown in Table 6.

Table 6 Distributions of teachers' perceptions of CT

Items	**Mean**	**SD**
I am familiar with the key concepts that define CT.	2.91	1.15
CT primarily involves learning programming and coding.	3.09	1.00
I understand clearly how CT aligns with the Finnish National Core Curriculum (FNCC).	2.78	1.21
CT skills are useful to all students, regardless of their future career aspirations.	4.00	1.02

Two statements, “I am familiar with the key concepts that define CT” (M=2.91, SD=1.15) and “I understand clearly how CT aligns with the Finnish National Core Curriculum (FNCC)” (M=2.78, SD=1.21), have relatively low mean scores, which align with participants’ responses to Question 6 about their familiarity with the term CT (see Table 5) and their written responses of CT definition.

Conversely, the highest mean scores were scored for the statements “CT skills are useful to all students, regardless of their future career aspirations” (M=4.00, SD=1.02). This aligns with participants’ responses to Question 8 regarding their perceptions of the importance of CT, reinforcing the widely recognized value of CT skills in education.

One participant expressed concern about the impact of CT on students' fine motor skills, stating:

> *I'm worried of decreasing fine motor skills of pupils. That's why I have chosen not to use as much ICT with pupils as I did before.*

This response suggests that the participant may associate CT primarily with the use of digital devices. While CT can involve technology, it also includes problem-solving approaches that do not necessarily require ICT.

4.1.1 Teachers' integration of CT into their classroom practices

Although CT is included in the curriculum, not all participants have incorporated activities they perceive as related to CT in their classroom practices. This may be due to an incomplete understanding of what CT entails. Notably, in their own definitions of the term, several participants frequently used the word *"guess"* or even stated that they had *"no clue."*

Among the 32 responses, approximately 69% (N=22) reported having integrated activities they considered related to CT into their classroom practices. Among those, the most common activities were mathematics (N=16) and problem-solving (N=15). Table 7 below displays the distribution of all activities that teachers identified as incorporating CT. This aligns with the curriculum, in which CT is embedded within the mathematics curriculum (FNAE, 2016). It also aligns with participants' written definitions of CT, which often emphasized logical reasoning and structured problem-solving. In addition, some participants also mentioned in their written responses that they integrated CT into a bigger learning project, such as a multidisciplinary project or a project-based learning module involving applied knowledge from STEM fields.

Table 7 Activities that teachers integrated CT

Activities	Frequency	Percentages (%)
Through programming lessons	8	36.4
In problem-solving activities	15	68.2
In mathematics lessons	16	72.7
In handicraft lessons	6	27.3

One participant also mentioned their integration in Finnish language classes, where students practice writing instructions for a "teacher robot".

> *I have used with students how to teach a teacher-robot small tasks such as drinking from a glass of water. It is useful to illustrate to the students what happens if the machine or "teacher robot" does not receive the correct instructions, e.g. water spills on a shirt or falls in the wrong place. Students may*

> *often forget instructions such as open mouth, tilt water glass, pour water in mouth, close mouth, swallow, put glass down on table.*

This response provides a strong example of integrating CT into teaching practices, as it aligns with multiple dimensions of CT outlined in the framework by Shute et al. (2017) (see Table 1). The activity involves writing an algorithm to complete a task (e.g., drinking water), allowing students to engage in key CT processes such as identifying and correcting errors (e.g., forgetting to open/close mouth), thereby applying debugging skills as well.

4.1.2 Opportunities and challenges that arise in integration

Descriptive statistics were calculated to explore teachers' perceptions of opportunities for their students when integrating CT into their teaching and are displayed in Table 8 below.

The overall mean score for teachers' perceived opportunities to integrate CT into their teaching was 3.96 (SD=0.73), indicating a general positive stance towards adopting CT into their classroom practices. Among the listed opportunities, the highest mean score was for the statement that CT "prepares students with skills to navigate the evolving challenges of modern society" (M=4.22, SD=0.55), suggesting that teachers strongly recognize CT's role in equipping students for future challenges. Conversely, the lowest mean score was for the statement that CT "makes learning more relevant for students through solving complex real-life problems" (M=3.81, SD=0.64), indicating relatively lower agreement on this aspect.

Table 8 Distributions of teachers' perceived opportunities when integrating CT into classroom practices

Items	Mean	SD
Enhances students problem-solving and critical thinking skills.	4.06	.62
Prepares students with skills to navigate the evolving challenges of modern society.	4.22	.55
Makes learning more engaging via the use of technology and real-life applications.	3.91	.78
Provides opportunities for creative and innovative approaches to solving problems	4.03	.90
Helps students develop computational literacies.	3.97	.78
Helps students become responsible digital citizens.	3.72	.81
Makes learning more relevant for students through solving complex real-life problems.	3.81	.64

Descriptive statistics for teachers' perceptions of challenges when integrating CT into their teaching are shown in Table 9. The mean scores for the perceived challenges are relatively similar, ranging from 3.16 to 3.84, indicating that teachers generally perceive these barriers to be of comparable significance. This also suggests that no single challenge overwhelmingly dominates, but rather, multiple factors, including curriculum guidelines, professional development, and resource availability, contribute to the difficulties or reluctance of integrating CT into teaching practices.

Table 9 Distributions of teachers' perceived challenges when integrating CT into classroom practices

Items	**Mean**	**SD**
Lack of clear guidelines for CT integration in the curriculum.	3.75	.88
Lack of clear learning objectives for CT in the curriculum.	3.69	.86
Limited access to appropriate teaching resources and materials.	3.44	.91
Lack of professional development opportunities focused on CT.	3.84	.88
Difficulty coordinating CT with the content of other subjects in a cross-curricular approach.	3.16	.99

In the open-ended responses, 20 participants elaborated on the opportunities and challenges they had observed from their personal experiences. Most of their answers aligned with the statements included in the survey. For example, they highlighted a lack of resources and the need for professional development.

> *I feel like teachers need to develop their CT skills as well.*
>
> *It is good to apply CT in primary education, helping students and teachers to prepare for future advanced technologies.*
>
> *It would be good to know more about the subject in advance to make the answers more realistic.*
>
> *I think this is an important skill to be incorporated in teaching and learning nowadays due to the ever-changing world.*

Overall, the responses reinforced the main themes identified in the survey, highlighting persistent challenges such as resource limitations and the need for professional development.

These insights provide valuable context for understanding teachers' perspectives and suggest areas that may require further support or intervention.

4.2 Teachers' self-efficacy in relation to CT

Descriptive statistics for teachers' self-efficacy in relation to CT are shown in Table 10 below.

The overall mean score for teachers' self-efficacy was 3.17 (SD=1.02), indicating a moderate level of confidence among participants in their ability to integrate CT into their teaching practices. This suggests that while teachers may not feel entirely unprepared, there is still uncertainty or inconsistency in their perceived competence.

Table 10 Distributions of teachers' self-efficacy in relation to CT

Items	Mean	SD
I am comfortable explaining the fundamental concepts of CT to my students.	3.00	.98
I believe I can integrate CT concepts into a variety of subjects effectively.	3.13	.94
I am interested in exploring new ways to incorporate CT in my teaching practices.	3.59	1.16
I am able to adapt existing teaching materials to include CT content.	3.06	.88
I know where to find resources and tools to support CT in my classroom.	2.72	.96
I feel prepared to answer students' questions related to CT.	2.75	1.05
I would benefit from additional professional development focused on CT.	4.09	1.03
I know how to introduce CT concepts in my lessons without requiring advanced technology.	3.03	1.12

Another relatively high-scoring item was "I am interested in exploring new ways to incorporate CT in my teaching practices" (M=3.59, SD=1.16). While the mean suggests general interest in innovating with CT, the larger standard deviation implies a wider variation in responses, possibly reflecting differences in prior experience or comfort with CT. This may indicate that some teachers are hesitant or uncertain about how to proceed with CT integration, even if they are curious or open to it. This resonates further in their written responses:

> *It is very hard to add or change one's own teaching, including applying more of CT because of the lack of time/ support/ structure/ education*

> *[...] but it would be good to know more about the subject in advance to make the answers more realistic.*
>
> *I don't have any experience with the use of computational thinking and would like to learn more about it.*

In contrast, the items with lowest mean scores were “I know where to find resources and tools to support CT in my classroom” (M=2.72, SD=.96) and “I feel prepared to answer students’ questions related to CT” (M=2.75, SD=1.05). These results highlight a lack of confidence in both resource awareness and content knowledge, which may directly contribute to teachers’ reluctance to use CT in their instruction. The relatively low means suggest that without adequate support and accessible materials, teachers may not feel ready to take on the challenge of teaching CT, even if they see its value.

5 Discussion

The purpose of this study was to explore primary school teachers' perceptions and self-efficacy of CT in Finland and to examine how those relate to their integration practices, as well as the opportunities and challenges that arise in implementing CT in their teaching.

Previous studies have shown challenges in defining CT (Haseski et al., 2018; Kakavas & Ugolini, 2019; Shute et al., 2017), and the issue is repeated in the present study. Many participants appeared to struggle with expressing a clear definition of CT themselves. Among the responses, problem-solving and various dimensions of CT, such as decomposition, logical thinking, or algorithmic thinking, are mentioned frequently. It reflects the current trend in understanding of CT as identified by Haseski et al. (2018), focusing on its problem-solving orientation and its cross-curricular applicability. The responses also align with how CT is adopted in the FNCC (FNAE, 2016), as CT is a part of its general transversal competences.

While most teachers acknowledged the importance of CT, their integration practices varied widely. Interestingly, one of the most common approaches to integrate CT in primary school from previous studies is through programming (Pörn et al., 2021; Toikkanen & Leinonen, 2017); however, programming lessons were not the most popular CT integrated activities in participants' responses. It may be because programming was not yet established in school practices in Finland (Tanhua-Piiroinen et al., 2020), or teachers might feel anxious or unprepared due to a lack of knowledge, clear guidelines, and resources (Korhonen et al., 2023; Pörn et al., 2021; Toikkanen & Leinonen, 2017).

An interesting finding was the predominance of unplugged or cross-curricular CT activities, especially in mathematics and Finnish language. This corresponds with the inclusion of CT in the mathematics curriculum in Finnish basic education and reflects international trends in which CT is integrated into existing subjects rather than being taught as a standalone domain (Bocconi et al., 2018; Niemelä et al., 2022). Despite the challenges, teachers identified various opportunities related to CT integration. Many saw CT as a way to promote problem-solving, creativity, and higher-order thinking skills.

Chiazzese et al. (2019) state that CT is considered "an effective additional tool for preparing students to deal with future challenges" (p. 2). Its role is also highlighted in developing 21st century competences by many studies (see e.g., Dúo-Terrón, 2023; Iwata et al., 2020; Korhonen et al., 2023; Lai et al., 2023). In line with these findings, participants in this study most commonly perceived CT as a way to equip students with the necessary skills to navigate an increasingly digital world. However, contrary to some earlier research that highlights CT's potential to enhance engagement (see e.g., Ausiku & Matthee, 2023; Chiazzese et al., 2019; Fagerlund et al., 2021; Kong et al., 2020), it was the least agreed-upon item in the theme of opportunities in the study. Consistent with participants' self-written definition of CT, the study found strong agreement on the benefits of CT in enhancing problem-solving and critical thinking skills, as well as its potential for fostering creative and innovative approaches. These views are also in line with how CT is represented in the FNCC, particularly in craft education.

Teachers also identified several barriers to effective CT integration, including a lack of confidence, limited instructional time, and unclear curricular guidance. These challenges are well-supported in prior studies (Humble & Mozelius, 2023; Ukkonen et al., 2024). Furthermore, participants expressed a strong need for further professional development, reinforcing findings from previous studies that cite insufficient training as a major obstacle to CT implementation (Kong et al., 2020; Lai et al., 2023; Tran, 2019).

The ambiguity in participants' responses may indicate a lack of familiarity with the concept of CT among teachers. Findings from this study show a strong agreement among participants that they would benefit from additional professional development focused on CT, while simultaneously acknowledging a lack of available opportunities. It aligns with earlier findings in the literature that emphasize the role of professional development in boosting teachers' self-efficacy and confidence in applying CT in the classroom (Kaya et al., 2020; Weber et al., 2022).

As prior research has highlighted, a shared and practical understanding of CT is essential for meaningful engagement with the concept (Bocconi et al., 2018; Fagerlund et al., 2022; Grover & Pea, 2013). However, such understanding alone does not necessarily translate into effective practice. It must be coupled with ongoing, targeted professional development (Ukkonen et al., 2024), which once again highlights the critical need to provide teachers with accessible and sustained learning opportunities. While there is general interest and willingness to learn, actual implementation of CT is likely being hindered by limited training, insufficient resources, and lack of confidence in practical application. These aspects may explain the moderate overall self-efficacy score and point to important areas for professional development and support structures moving forward.

There were no items in the survey about assessment, and none of the participants mentioned assessment-related challenges when expressing the difficulties of integrating CT into their teaching in the open-ended questions. This contrasts with previous studies, which frequently highlight assessment as a key challenge in CT education (e.g., Shute et al., 2017; Tikva & Tambouris, 2021; Ukkonen et al., 2024). The absence of this concern in participants' responses could suggest that teachers may not yet see assessment as a pressing issue or may not feel confident in assessing CT skills, possibly due to a lack of clear guidelines or practical assessment tools in the curriculum. This finding underscores the need for further research to examine how CT assessment is perceived and implemented in Finnish primary education. On the other hand, not all participants were familiar with CT, and they probably did not think about assessing CT as they did not have a comprehensive understanding of CT. However, it should be kept in mind that if there were an item in the survey about assessment, it could have reminded participants of assessment issues.

Overall, the results highlight a need for clearer curriculum guidance and targeted support for teachers. Given the interdisciplinary nature of CT, teacher education programs should prioritize both content and pedagogical training, especially in the context of subject integration. Many professional development opportunities have proved to show positive impacts in the way teachers view CT and implementing it (Amante et al., 2023; Ausiku & Matthee, 2023); therefore, school leaders and policymakers should ensure that teachers have access to high-quality PD and adequate planning time to experiment with CT in their classrooms.

Moreover, the study highlights the need to revisit how CT is presented in the FNCC, particularly given that many participants were either unaware of its definition or could only guess what it might be in the survey. Clearer articulation of CT competencies, along with examples of integration across subjects and grade levels, could enhance both teacher understanding and instructional coherence. Curriculum designers may consider providing practical tools, such as sample lesson plans, assessment tools, and subject-specific examples, to help teachers visualize how CT can be embedded into their daily practices.

At the same time, any support materials or guidelines must be carefully designed to respect the professional autonomy of teachers. Finnish teachers are known to have a high degree of autonomy and professional responsibility; therefore, it is important to consider whether providing more structured tools might be perceived as limiting that autonomy or implying a lack of trust. Future curriculum development efforts should balance clarity and support with flexibility, allowing teachers to adapt CT integration in ways that align with their pedagogical values and local teaching contexts. This kind of curricular refinement may be particularly important as digital competencies continue to evolve in response to technological and societal shifts. For instance, as technologies such as artificial intelligence and automation become more embedded in everyday life, curricula must adapt to ensure that students are equipped with relevant and transferable skills. In the context of CT, this means not only updating content but also integrating CT meaningfully across subject areas, fostering interdisciplinary applications that reflect real-world problem solving.

6 Reflection

I was initially drawn to the topic of CT while I was taking programming courses as part of my elective studies. It reminded me of a conversation I had a few years ago with my cousin, who was then in primary school and struggling with a Scratch homework assignment. She told me how difficult it was for her and that she didn't see the point of learning it. While this reaction was perhaps typical of a child, it made me think about how digital competencies are becoming more and more relevant in all educational reforms. In Vietnam, where I come from, I observed that there is a heavy focus on robotics and coding. This led me to question whether robotics and coding are really at the core of digital competencies, or there is something else that I was not aware of, which ultimately led me to learn about CT.

Through the research process, I learned that CT is not limited to programming or technology use but can also be taught through unplugged activities and integrated into various subject areas. As a future teacher, that was one important thing I learned through this journey, so that I myself can prepare to integrate CT into the classroom more engagingly and effectively for students.

That said, the process was often overwhelming. One of the most challenging aspects was organizing the literature, which was absolutely the backbone to guide me in further stages of the study, such as designing the survey. Even though I tried my best, I realized that I overlooked the aspect of assessment in CT. If I were to do this study again, I would revise the survey more carefully, perhaps pilot it beforehand and hope for a higher number of responses to allow for more sound data analysis. I also had to revise my methodology due to limited responses, which reminded me of what my friends told me, that doing research is not a linear process. The idea helped me a lot to stay resilient and flexible, and in the end, things worked out!

Overall, this has been a valuable experience, not only in learning how to carry out and report research, but also in developing my critical thinking. I enjoyed seeing how all the pieces slowly came together, despite being a long journey and a lot of struggles to arrive at.

In the future, I'm considering pursuing a PhD, which was partially influenced by doing this study, although I'm still unsure of the specific topic I would want to explore in depth. This thesis process has equipped me with a range of research skills that I hope to apply in the future, whether as a researcher or as a teacher. I believe these skills will help me remain flexible and open to learning, especially as technology continues to evolve at a rapid pace.

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Appendices

Appendix 1 Survey – English

Teachers' Views of Computational Thinking and its Integration into their Teaching in Primary Schools in Finland

Mandatory questions are marked with a star (*)

Hello! My name is Nguyen Ta, and I am a student at the Department of Teacher Education in the University of Turku. The purpose of this master's thesis study is to investigate teachers' views of computational thinking (CT) and its integration into their teaching in primary schools in Finland. Computational thinking has gained significant attention and is at the heart of global curriculum reformation. It was introduced as an essential element in the Finnish National Core Curriculum (FNCC) for Basic Education in 2016. However, there seem to be no official guidelines or standardized understanding for teaching or integrating CT broadly.

This study aims to explore how teachers perceive CT and its role in education, hoping to inform future professional development and curriculum design.

Your participation in this study is voluntary and anonymous. You will be asked to complete an online survey that will take approximately 10–15 minutes. You are free to stop answering the survey until submission at any point. If you are willing to participate in a follow-up interview, you will be asked to provide your contact information at the end of the survey. By submitting your responses, you consent to the data used for research purposes as part of this study. Please refer to the following Privacy Notice for more information: https://seafile.utu.fi/f/8edfda34554b47649867/.

If you have any questions about this study, please do not hesitate to contact me at the following email address: thngut@utu.fi. You may also contact me anonymously. The study is supervised by Professor, Ph.D. Çiğdem Haser at the University of Turku. In case you have any questions or concerns, please contact her at cigdem.haser@utu.fi.

Thank you!

1. **I have read the form above and consent to participate in the survey. ***

☐ Yes

☐ No

2. **Gender: ***

☐ Male

☐ Female

☐ Other:

☐ Prefer not to say

3. **Age Group: ***

☐ 20-29

☐ 30-39

☐ 40-49

☐ 50-59

☐ 60 and above

4. **Years of Teaching Experience: ***

☐ 0-5 years

☐ 6-10 years

☐ 11-15 years

☐ 16-20 years

☐ More than 20 years

5. **What grade levels have you taught? (Select all that apply) ***

☐ Grade 1-2

☐ Grade 3-4

☐ Grade 5-6

6. **How familiar are you with the term “Computational Thinking” (CT)? ***

☐ Very familiar

☐ Somewhat familiar

☐ Slightly familiar

☐ Not familiar at all.

7. In your own words, how would you define Computational Thinking? *

____

____

____

8. In your opinion, how important is it for students to learn computational thinking in primary school? *

☐ Very important

☐ Somewhat important

☐ Slight important

☐ Not important at all.

9. To what extent do you agree or disagree with the following statements? *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am familiar with the key concepts that define CT.	1	2	3	4	5
CT primarily involves learning programming and coding.	1	2	3	4	5
I understand clearly how CT aligns with the Finnish National Core Curriculum (FNCC).	1	2	3	4	5

CT skills are useful to all students, regardless of their future career aspirations.	1	2	3	4	5

10. Have you integrated activities that you consider to be related to computational thinking into your classroom practices? *

☐ Yes

☐ No

11. If yes, how have you integrated computational thinking into your teaching? (Select all that apply):

☐ Through programming lessons

☐ Through problem-solving activities

☐ In mathematics lessons

☐ In handicraft lessons

☐ Other (please specify):

12. To what extent do you agree or disagree with the following statements about opportunities that CT may offer your students? *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Enhances students problem-solving and critical thinking skills.	1	2	3	4	5
Prepares students with skills to navigate the evolving challenges of modern society	1	2	3	4	5

Makes learning more engaging via the use of technology and real-life applications.	1	2	3	4	5
Provides opportunities for creative and innovative approaches to solving problems	1	2	3	4	5
Helps students develop computational literacies.	1	2	3	4	5
Helps students become responsible digital citizens.	1	2	3	4	5
Makes learning more relevant for students through solving complex real-life problems.	1	2	3	4	5

13. To what extent do you agree or disagree with the following challenges when integrating CT into your teaching? *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Lack of clear guidelines for CT integration in the curriculum.	1	2	3	4	5
Lack of clear learning objectives for CT in the curriculum.	1	2	3	4	5
Limited access to appropriate teaching resources and materials.	1	2	3	4	5

Lack of professional development opportunities focused on CT.	1	2	3	4	5
Difficulty coordinating CT with the content of other subjects in a cross-curricular approach.	1	2	3	4	5
Increased workload due to the integration of CT in the curriculum. (*)	1	2	3	4	5

14. To what extent do you agree or disagree with the following statements? *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am comfortable explaining the fundamental concepts of CT to my students.	1	2	3	4	5
I believe I can integrate CT concepts into a variety of subjects effectively.	1	2	3	4	5
I am interested in exploring new ways to incorporate CT in my teaching practices.	1	2	3	4	5
I am able to adapt existing teaching materials to include CT content.	1	2	3	4	5

I know where to find resources and tools to support CT in my classroom.	1	2	3	4	5
I feel prepared to answer students' questions related to CT.	1	2	3	4	5
I would benefit from additional professional development focused on CT.	1	2	3	4	5
I know how to introduce CT concepts in my lessons without requiring advanced technology.	1	2	3	4	5

15. Is there anything else you would like to add regarding your experience with or thoughts on computational thinking in primary education? *

____

____

____

16. Would you be willing to participate in a follow-up interview to elaborate on your views and experiences with teaching and learning CT? *

☐ Yes

☐ No

17. If yes, please provide your preferred contact information:

First name	
Last name	
Mobile	
Email	

Appendix 2 Survey – Finnish

Opettajien näkemykset ohjelmoinnillisesta ajattelusta ja sen integroimisesta opetukseensa suomalaisissa peruskouluissa

Mandatory questions are marked with a star (*)

Hei! Nimeni on Nguyen Ta ja opiskelen Turun yliopiston opettajankoulutuslaitoksella. Tämän maisterintutkielmani tarkoituksena on tutkia opettajien näkemyksiä ohjelmoinnillisesta ajattelusta (Computational thinking, tai CT) ja sen integroimisesta opetukseen suomalaisissa peruskouluissa. Ohjelmoinnillinen ajattelu on saanut merkittävää huomiota ja on maailmanlaajuisen opetussuunnitelmien uudistamisen keskiössä. Se otettiin olennaiseksi osaksi suomalaisen perusopetuksen kansallista perusopetuksen opetussuunnitelmaa vuonna 2016. Näyttää kuitenkin siltä, että tietokonepohjaisen ajattelun opettamiseen tai integroimiseen laajasti ei ole olemassa virallisia ohjeita tai standardoitua ymmärrystä.

Tässä tutkimuksessa pyritään selvittämään, miten opettajat näkevät tieto- ja viestintätekniikan ja sen roolin opetuksessa, ja toivotaan, että näin saadaan tietoa tulevasta ammatillisesta kehittämisestä ja opetussuunnitelmien suunnittelusta.

Osallistumisesi tähän tutkimukseen on vapaaehtoista ja anonyymiä. Sinua pyydetään vastaamaan verkkokyselyyn, joka kestää noin 10-15 minuuttia. Voit vapaasti keskeyttää kyselyyn vastaamisen missä vaiheessa tanhunsa kunnes se lähetetään. Jos olet halukas osallistumaan jatkohaastatteluun, sinua pyydetään antamaan yhteystietosi kyselyn lopussa. Lähettämällä vastauksesi annat suostumuksesi siihen, että tietoja käytetään tutkimustarkoituksiin osana tätä tutkimusta. Lisätietoja on seuraavassa tietosuojaselosteessa: https://seafile.utu.fi/f/8edfda34554b47649867/.
Jos sinulla on kysyttävää tästä tutkimuksesta, ota minuun yhteyttä: thngut@utu.fi. Voit ottaa minuun yhteyttä myös nimettömänä. Tutkimusta valvoo professori, FT Çiğdem Haser Turun yliopistosta. Jos sinulla on kysyttävää tai huolenaiheita, ota häneen yhteyttä osoitteeseen cigdem.haser@utu.fi. Kiitos!

1. **Olen lukenut yllä olevan lomakkeen ja suostun osallistumaan kyselyyn. ***

☐ Kyllä

☐ Ei

2. **Sukupuoli: ***

☐ Mies

☐ Nainen

☐ Muut

☐ En halua sanoa

3. **Ikäryhmä: ***

☐ 20–29

☐ 30–39

☐ 40–49

☐ 50–59

☐ 60 tai yli

4. **Opetuskokemusvuodet: ***

☐ 0–5 vuotta

☐ 6–10 vuotta

☐ 11–15 vuotta

☐ 16–20 vuotta

☐ Yli 20 vuotta

5. **Mitä luokka-asteita olet opettanut? (Valitse kaikki soveltuvat) ***

☐ 1–2

☐ 3–4

☐ 5–6

6. **Kuinka hyvin tunnet käsitteen ”ohjelmoinnillinen ajattelu”? ***

☐ Hyvin

☐ Jokseenkin

☐ Hieman

☐ Ei lainkaan

7. Miten määrittelisit ohjelmoinnillisen ajattelun omin sanoin? *

____

____

____

8. Kuinka tärkeää mielestäsi on, että oppilaat oppivat ohjelmoinnillista ajattelua peruskoulussa? *

☐ Hyvin tärkeää

☐ Jokseenkin tärkeää

☐ Hieman tärkeää

☐ Ei lainkaan tärkeää

9. Missä määrin olet samaa tai eri mieltä seuraavista väittämistä? *

	Täysin eri meiltä	Eri mieltä	Neutraali	Samaa mieltä	Täysin samaa mieltä
Tunnen ohjelmoinnillisen ajattelun keskeiset käsitteet.	1	2	3	4	5
Ohjelmoinnillinen ajattelu käsittää ensisijaisesti ohjelmoinnin ja koodauksen oppimisen.	1	2	3	4	5
Ymmärrän selvästi, miten Ohjelmoinnillinen ajattelu vastaa	1	2	3	4	5

Suomen kansallista perusopetussuunnitelmaa (POPS).					
Ohjelmoinnillisen ajattelun taidot ovat hyödyllisiä kaikille opiskelijoille riippumatta heidän tulevista uratoiveistaan.	1	2	3	4	5

10. Oletko sisällyttänyt luokkahuonekäytäntöihisi toimintoja, joiden katsot liittyvän ohjelmoinnilliseen ajatteluun? *

☐ Kyllä

☐ Ei

11. Jos vastasit kyllä, miten olet sisällyttänyt ohjelmoinnillisen ajattelun opetukseesi? (Valitse kaikki soveltuvat vaihtoehdot):

☐ Ohjelmointituntien avulla

☐ Ongelmanratkaisutehtävissä

☐ Matematiikan oppitunneilla

☐ Käsityötunneilla

☐ Muu (tarkenna):

12. Missä määrin olet samaa tai eri mieltä seuraavien väittämien kanssa mahdollisuuksista, joita ohjelmoinnillinen ajattelu voi tarjota oppilaillesi? *

	Täysin eri meiltä	Eri mieltä	Neutraal i	Samaa mieltä	Täysin samaa mieltä
Parantaa oppilaiden ongelmanratkaisu- ja kriittisen ajattelun taitoja.	1	2	3	4	5

Valmentaa oppilaita hallitsemaan nyky-yhteiskunnan kehittyviä haasteita.	1	2	3	4	5
Tekee oppimisesta kiinnostavampaa teknologian ja tosielämän sovellusten avulla.	1	2	3	4	5
Tarjoaa mahdollisuuksia luoviin ja innovatiivisiin lähestymistapoihin ongelmien ratkaisemiseksi.	1	2	3	4	5
Auttaa oppilaita kehittämään laskennallista lukutaitoa.	1	2	3	4	5
Auttaa oppilaita kehittymään vastuullisiksi digitaalisiksi kansalaisiksi.	1	2	3	4	5
Tekee oppimisesta merkityksellisempää oppilaille ratkaisemalla monimutkaisia tosielämän ongelmia.	1	2	3	4	5

13. Missä määrin olet samaa vai eri mieltä seuraavista haasteista, jotka liittyvät ohjelmoinnillisen ajattelun sisällyttämiseen opetukseen? *

	Täysin eri meiltä	Eri mieltä	Neutraali	Samaa mieltä	Täysin samaa mieltä
Selkeiden suuntaviivojen puuttuminen ohjelmoinnillisen	1	2	3	4	5

ajattelun integroimiseksi opetussuunnitelmaan.					
Opetussuunnitelmasta puuttuvat selkeät oppimistavoitteet ohjelmoinnillisen ajattelun osalta.	1	2	3	4	5
Sopivien opetusresurssien ja -materiaalien rajallinen saatavuus.	1	2	3	4	5
Ohjelmoinnilliseen ajatteluun keskittyvien ammatillisten kehittämismahdollisuuksien puute.	1	2	3	4	5
Vaikeudet koordinoida ohjelmoinnillista ajattelua muiden oppiaineiden sisältöjen kanssa oppiainerajat ylittävässä lähestymistavassa.	1	2	3	4	5
Lisääntynyt työmäärä, koska ohjelmoinnillinen ajattelu on sisällytetty opetussuunnitelmaan. (*)	1	2	3	4	5

14. Missä määrin olet samaa tai eri mieltä seuraavista väittämistä? *

	Täysin eri meiltä	Eri mieltä	Neutraali	Samaa mieltä	Täysin samaa mieltä
Minusta on helppoa selittää ohjelmoinnillisen ajattelun peruskäsitteitä oppilailleni.	1	2	3	4	5

Uskon, että pystyn integroimaan ohjelmoinnillisen ajattelun käsitteitä eri oppiaineisiin tehokkaasti.	1	2	3	4	5
Olen kiinnostunut tutkimaan uusia tapoja sisällyttää ohjelmoinnillista ajattelua opetuskäytäntöihini.	1	2	3	4	5
Pystyn mukauttamaan olemassa olevia opetusmateriaaleja niin, että ne ohjelmoinnillista ajattelua sisältävät.	1	2	3	4	5
Tiedän, mistä löydän resursseja ja työkaluja ohjelmoinnillisen ajattelun tueksi luokkahuoneessani.	1	2	3	4	5
Tunnen olevani valmis vastaamaan opiskelijoiden kysymyksiin ohjelmoinnillisesta ajattelusta.	1	2	3	4	5
Hyötyisin ammatillisesta täydennyskoulutuksesta, jossa keskityttäisiin ohjelmoinnilliseen ajatteluun.	1	2	3	4	5
Osaan ottaa ohjelmoinnillisen ajattelun käsitteitä käyttöön oppitunneillani ilman kehittynyttä teknologiaa.	1	2	3	4	5

15. Haluaisitko lisätä jotakin muuta kokemuksistasi tai ajatuksistasi ohjelmoinnillisesta ajattelusta perusopetuksessa? *

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16. Olisitko halukas osallistumaan jatkohaastatteluun, jossa voisit kertoa tarkemmin näkemyksistäsi ja kokemuksistasi ohjelmoinnillisen ajattelun opetuksesta ja oppimisesta? (englanniksi) *

☐ Kyllä

☐ Ei

17. Jos vastasitte myöntävästi, ilmoittakaa haluamanne yhteystiedot:

Etunimi	
Sukunimi	
Puhelin	
Sähköposti	