Chapter

Critical Thinking, Problem-Solving and Computational Thinking: Related but Distinct? An Analysis of Similarities and Differences Based on an Example of a Play Situation in an Early Childhood Education Setting

Francesca Granone, Elin Kirsti Lie Reikerås, Enrico Pollarolo and Monika Kamola

Abstract

In the twenty-first century, four important different and intertwined domains for children's skills have been identified: cognitive, interpersonal, intrapersonal and technical. In the cognitive domain, key terms such as critical thinking, problem-solving and computational thinking have been highlighted. Although these terms have been identified as fundamental for preschool children, the literature draws attention to early childhood teachers' difficulty in including them in curriculum activities, which can therefore hinder children's learning. This chapter aims to analyse the similarities and differences in the characteristics of the three terms computational thinking, problem-solving and critical thinking. Such analysis of the terms will be of importance, both for further research in the area and for clarification in communication with teachers. In this way, the concepts may be more accessible for teachers. In particular, in this chapter, the concepts will be analysed and explained through an example from an educational setting where a group of children and a teacher play together with a digital toy.

Keywords: computational thinking, problem-solving, critical thinking, ECEC, teachers' competence

1. Introduction

In a rapidly changing world, supporting children in developing specific skills that help them understand and make choices in various situations has been recognised as essential. These skills have been identified as twenty-first-century skills [1]. Amongst the skills classified as cognitive competencies, critical thinking, problem-solving and computational thinking have been highlighted and considered part of higher-order thinking skills [2–4]. These terms have been identified as fundamental for preschool children [1, 5, 6], especially when mathematics is the learning goal [7, 8]. Granone et al. conducted a study in Norway on early childhood education settings (ECECs), where some terms, such as problem-solving and critical thinking, are known and well-introduced [8, 9], whereas computational thinking at an educational level is only mentioned in the curriculum for schools [10].

Wing, who introduced for the first time the term "computational thinking" [11], stressed the importance of making this term accessible, to allow teachers not only to use it but also to understand its meaning in all its parts without only carrying out procedures [12]. Some attempts have been made in the literature to analyse the similarities between the constituent characteristics of the three terms computational thinking, problem-solving and critical thinking [13] but never through a detailed analysis of the different elements that characterise each of them. Moreover, each of these terms has been analysed through Bloom's taxonomy [14] or the revised Bloom's taxonomy [15], but never all together [16–18]. However, the taxonomy seems to be a possible key for analysing all these terms together.

This chapter intends to present this analysis to identify any common aspects. Such an analysis of the terms will be of importance, both for further research in the area and for clarification in communication with teachers. In this way, the concepts may be more accessible for teachers, and this will help them to support children's acquisition of problem-solving, critical thinking and computational thinking skills more effectively [7, 8]. In this chapter, the concepts are analysed and explained through an example from an educational setting.

2. Problem-solving, critical thinking and computational thinking

The three skills that we analyse (problem-solving, critical thinking and computational thinking) can all be enhanced in different ways; they can also be enhanced through technology [7, 19]. Children's learning of these skills is considered fundamental, and teachers' roles have been highlighted in the literature as essential [20–22]. Hence, we explain these terms through an example taken from an educational setting where a group of children and a teacher play together with a digital toy.

A possible way to compare these terms seems to be offered, as anticipated, from the revised Bloom's taxonomy [15].

This taxonomy is a framework elaborated by Bloom [14] and modified by Anderson and Krathwohl for expressing skills through verbs. It consists of six major categories for describing learning skills: three defined "lower-order skills" (remember, understand and apply) and three defined "higher-order skills" (analyse, evaluate and create). Each category contains subcategories:

- Remember
    - Recognising: Locating knowledge in the long-term memory that is consistent with the presented material.
    - Recalling: Retrieving relevant knowledge from long-term memory.

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- Understand
    - Understand: Changing from one form of representation (e.g. numerical) to another (e.g. verbal).
    - Exemplifying: Finding a specific example or illustration of a concept or principle.
    - Classifying: Determining that something belongs to a category.
    - Summarising: Abstracting a general theme or major point(s).
    - Inferring: Drawing a logical conclusion from the presented information.
    - Comparing: Detecting correspondences between two ideas, objects and the like.
    - Explaining: Constructing a cause-and-effect model of a system.
- Apply
    - Executing: Applying a procedure to a familiar task.
    - Implementing: Applying a procedure to an unfamiliar task.
- Analyse
    - Differentiating: Distinguishing relevant from irrelevant parts or important from unimportant parts of the presented material.
    - Organising: Determining how elements fit or function within a structure.
    - Attributing: Determining a point of view, bias, value or intent underlying presented material.
- Evaluate
    - Checking: Detecting inconsistencies or fallacies within a process or product; determining whether a process or product has internal consistency; detecting the effectiveness of a procedure as it is being implemented.
    - Critiquing: Detecting inconsistencies between a product and external criteria; determining whether a product has external consistency; detecting the appropriateness of a procedure for a given problem.
- Create
    - Generating: Coming up with alternative hypotheses based on criteria.
    - Planning: Devising a procedure for accomplishing some task.
    - Producing: Inventing a product.

2.1 Problem-solving

Children's problem-solving is presented as a key element in Norwegian ECECs [9].

The term problem-solving has been used for identifying a cognitive activity (what problem-solvers do), a learning goal (something to be taught) and an instructional approach (something to teach through) [23]. Furthermore, it has also been highlighted that problem-solving is a quite complex term that presents many nuances and that has been described according to many interpretations [24].

For example, the literature presents problem-solving from different points of view, referring to it as a cognitive process. It has been presented as a process that has as a goal to find a way out of difficulties or as a variety of cognitive processes, such as attention, memory, language and metacognition [25–27].

If we consider problem-solving as a learning goal, it has been described as a competence that children can reach through very different approaches, such as technology [7], or during outdoor activities [28].

However, problem-solving can also be identified as an instructional approach for helping children learn, for example, mathematics [29].

If we look at the evolution of the problem-solving framework [30], it is possible to see that it has been a development from the original definition introduced by Polya [31]. For example, we can find a model that identifies six steps instead of four [32] or a model that focuses more on the solver than on the process [33]. Because we are more interested in the process than in the solver and because Schoenfeld phases can be related to Polya's phases, we choose Polya as a reference for the analysis in our study. The three first phases of Schoenfeld ("read", "analyse" and "explore") can be related to Polya's phase "understand the problem", whereas the other phases are clearly similar.

In addition, recent literature still uses Polya as the main reference [7, 25–29]. Hence, we analyse Polya's problem-solving process, aiming to increase accessibility to this term.

Polya describes problem-solving through four phases: understand the problem, make a plan, carry out the plan and look back. Each phase is important because it leads to a different understanding of the problem and the process [31] (**Table 1**).

2.2 Critical thinking

Children's critical thinking is another key element presented in ECECs [9].

Critical thinking has been defined in different ways in the literature, and a consensus has not been reached [34]. In particular, some authors consider the terms critical thinking and problem-solving components of separate domains, whereas others include problem-solving in the term critical thinking or vice versa [34]. The term problem-solving has also been used as a synonym for thinking and as related to creative thinking and critical thinking [35]. This is because creative thinking is described as the ability to generate an idea that can be used to solve a problem, whereas critical thinking is more on evaluating ideas that can be used to solve a problem.

With the aim of describing in more detail critical thinking through the roots that he has in academic disciplines, three separate academic strands can be identified: the philosophical approach, the cognitive psychological approach and the educational approach [34].

The focus of the philosophical approach is on the critical thinker rather than on the actions that a critical thinker performs. This approach describes a critical thinker

	Polya's subphases	**Description**
Understand the problem	Getting acquainted	The problem has to be understood, identifying what is known and unknown and what is allowed. The problem has to be seen as a whole without concerning the details too much. The problem should stimulate memory and prepare for the recollection of previous knowledge.
	Working for better understanding.	The principal part of the problem can be isolated. Then, each part has to be considered in turn in various combinations and in relation to the main problem. The problem's details can be identified.
Make a plan	Generalisation	The phase "making a plan" means understanding the steps, at least in a rough way, that leads to determining what is unknown. This "bright idea" needs to be based on past experience, formerly acquired knowledge and formerly solved problems. Generalisation refers to seeing the problem more generally to find if there are similar aspects, in some related problems.
	Specialisation	This implies that a possible answer or a possible solution can be tried out if we know that it is incomplete. In any case, this leads to a new situation that must be reanalysed to elaborate a new strategy for finding the solution.
	Analogy	Analogy is used to identify connections amongst various problems, identify similar elements and determine how they can help in solving similar problems.
	Dropping a part of the condition.	All elements are not considered, and the problem is seen as a similar but simplified one.
Carry out the plan	Insight	The plan must be carried out carefully, checking each step. The correctness of each step can be checked intuitively.
	Formal proof	The correctness of each step can be checked formally.
Look back	Solution improvement	The results and the process have to be checked. The solution can always be improved (a solution that can need less time, fewer steps, ...).
	Understanding improvement	The understanding of the solution will improve. Re-examining both the solutions and the process (results and arguments) will consolidate knowledge and develop the ability to solve problems because they will use the same process for solving other problems.

Table 1.
Polya's phases. Ref: Polya [31].

as a person who is open-minded, flexible and interested in being well informed and in understanding other perspectives [36]. Some researchers have defined this approach as not always in accordance with reality [37].

The cognitive psychological approach is instead more focused on the thoughts and mental processes used to solve problems [37], identifying the critical thinker by the action or behaviour that they have [38]. An important element recognised is the ability to see both sides of an issue [39].

The educational approach is based on years of experience and observations and has Bloom's taxonomy as a key element [40], where the three highest levels are related to critical thinking. However, this approach has been criticised for being too undefined [34].

Because these approaches are quite different, we refer to the definition presented in Lai's literature review [34], where critical thinking is identified through skills that include both cognitive skills and dispositions. In this article, we focus only on cognitive skills (abilities) for analysing which common aspects can be identified amongst problem-solving, computational thinking and critical thinking (**Table 2**).

2.3 Computational thinking

Even if the term computational thinking is not explicitly present in the.

Norwegian Framework Plan for Kindergartens [9], other similar concepts, such as digital practice and the use of digital tools, are presented.

The term computational thinking was introduced by Wing as "a fundamental skill [...] that involves solving problem, designing systems and understanding human behavior, by drawing on the concepts fundamental to computer science" [11].

The definition has evolved, and the literature presents various models that can be used to describe the computational thinking process. A framework is presented by Angeli [41], where computational thinking is described as a process where various steps occur, such as algorithmic thinking, modularity, debugging, pattern recognition, generalisation and abstraction.

In contrast, another framework points out abstraction, decomposition, debugging, remixing and productive attitudes against failure as the elements that should be considered for describing computational thinking [42].

Another model describes computational thinking as composed of the ability to think algorithmically in terms of decomposition, generalisations, abstractions and evaluation [43].

The models presented have some common aspects but also some differences. The description presented originally by Wing is broader and contains all the aspects presented later in various models [11]. The step "reformulating or reduction/transformation" is in relation to "remixing" [42]; "decomposition or thinking recursively" is in relation to "modularity" and "algorithmic thinking" [41, 43]; "choosing a representation" is in relation with "pattern recognition" [41]; and "learning" is in relation with "debugging" [41, 42], "productive attitudes against failure" [42] and "evaluation" [43].

Hence, we analyse the description of the different phases of computational thinking, starting from Wing's definition (**Table 3**).

3. Method

Four stages that compose a content analysis method have been followed in content analysis [44]. These stages are "decontextualisation", "recontextualisation", "categorisation" and "compilation". Decontextualisation is the stage in which meaningful units are identified. After reading a whole text to understand its meaning, a small part is identified and coded. Each researcher wrote a coding list to avoid changing during the analysis. The articles were analysed through an inductive approach, identifying the keywords that describe the various steps of each term. On the contrary, the practical example was analysed deductively, trying to identify the different parts in the transcription used as an example. The decontextualisation process was conducted repeatedly to guarantee stability.

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Critical thinking skills		Description
Cognitive skills	Analysing arguments, claims or evidence.	The ability to investigate the various elements that can, for example, explain or be part of a problem or a situation.
	Making inferences using inductive or deductive reasoning.	The ability to connect various elements and understanding connections to find an explanation or a solution.
	Judging or evaluating	The evaluation of an argument or a process in each single and basic part.
	Making decisions or solving problems.	The implementation of the strategies identified as suitable to answer a question or solve a problem.
	Asking and answering questions for clarification.	The ability of using dialogue for completely understanding a question or a problem.
	Defining terms	The importance of understanding the problem through a clear definition of each element.
	Identifying assumptions	To identify the ideas that are "taken for granted" in order to evaluate them and eventually open up to other strategies and solutions.
	Interpreting and explaining.	The evaluation of a process and the analysis of results or the explanation of a solution.
	Reasoning verbally, especially in relation to the concepts of likelihood and uncertainty.	The ability to think constructively to verbalise (and then probably understand) a question or a problem.
	Predicting	To anticipate what the result might be.
	Seeing both sides of an issue.	To analyse more than one aspect in each question or problem.
Dispositions	Open-mindedness Fair-mindedness The propensity to seek reason Inquisitiveness The desire to be well-informed Flexibility Respect for and willingness to entertain others' viewpoints.	

Table 2.
Critical thinking skills. Ref: Lai [34].

Steps in computational thinking	Description
Stating of the difficulty of a problem.	To understand if the problem can be understood and solved and how approximate the solution can be.
Reformulation or reduction/ transformation.	The ability of describing the same problem in a different way (more understandable) or to transform the problem into another problem.
Decomposition or thinking recursively.	The process of dividing a problem into smaller problems so that they can be solved one by one, in sequence. This is connected to what is called modularisation.
Choosing of a representation.	To choose a representation (a pattern) that can be identified as a model for describing a possible solution/procedure.
Generalisation	To identify the common elements amongst various patterns or problem-solving situations.
Abstraction	The process of eliminating information that is not fundamental in order to shape a procedure that can be used in another problem-solving situation.
Heuristic reasoning	The approach of solving a problem through shortcuts, strategies and through estimation.
Planning	Following the different steps described before for reaching the goal.
Learning	A result of applying computational thinking is learning how to solve a problem.

Table 3.
Steps in computational thinking. Ref: Wing [11].

Recontextualisation is necessary to ensure that all aspects of the content have been covered. This foresees that the text is read in its whole again, and that all the uncoded parts are evaluated with attention to understanding if those can also be coded. If those parts are evaluated again, not in relation to the aim of the study, they are then definitively excluded.

The categorisation process indicates when the codes are condensed and assembled into categories and themes. The themes should be chosen to avoid data that fit into more than one group or that fall between two themes.

Compilation is the process of choosing the appropriate units for each theme.

As suggested in the content analysis, each stage was performed several times to guarantee the quality and trustworthiness of the analysis. To draw realistic conclusions, different authors checked the keywords identified, as well as the connections amongst them. This is necessary for maintaining the quality of the process, assuring both the validity and the reliability of the study and avoiding mistakes or biases.

A content analysis of a vignette from an educational setting, including a group of children and a teacher playing together with a digital toy, was the basis for developing a comparison of the three terms. The play situation was in an early childhood setting, with four children aged 4–5 years and their teacher. They were all participants in the larger project DiCoTe "Increasing professional digital competence in early childhood teacher education with a focus on enriching and supporting children's play with coding toys", which the present study is a part of. The teacher and the parents of the children gave written permission to participate.

A second comparison starts from the results of the previous analysis and discusses a possible explanation of those results through the revised Bloom's taxonomy [45].

4. Results and discussion

Given that the purpose of this study was to highlight any similarities and differences between the terms problem-solving, critical thinking and computational thinking in an understandable way, we made two types of comparisons.

As indicated in the methods chapter, the analysis shows a comparison of the three terms based on practice, that is, on an example from an educational setting, where a group of children and a teacher play together with a digital toy. The use of technology is useful for having a greater chance to identify all three terms. The results are reported in **Table 4**.

The second comparison starts from the results of the previous analysis and discusses a possible explanation of those results through the revised Bloom's taxonomy [45]. The results are presented in **Table 5**.

Example from the field of practice	Problem-solving	Critical thinking	Computational thinking
The teacher asks the children to remember what they did before with the arrows and how the robot moved on each arrow.	Getting acquainted.		Stating the difficulty of a problem.
The teacher asks the children to explain what they have understood in order to check if they know how to proceed with the activity.	Working for a better understanding.	Asking and answering questions for clarification. Defining terms. Reasoning verbally, especially in relation to the concepts of likelihood and uncertainty.	Reformulating or reduction/ transformation.
The teacher invites the child to look at each step, trying to exemplify how the robot can move on each arrow to go through the whole path.	Working for a better understanding.		Decomposition or thinking recursively.
To solve the problem, the teacher invites the children to observe the situation and try to understand if the present problem is similar to some situation previously encountered.	Analogy	Analysing arguments, claims or evidence. Making inferences using inductive or deductive reasoning.	Choosing a representation.
Having identified some similarities, the teacher invites the children to use the same solution previously used, trying not to be too focused on the differences and observing if something has to be modified.	Generalising		Generalisation Abstraction
The teacher then asks the children to guess how to build a new path based on their experience.	Insight	Predicting	Heuristic reasoning
Then, the children must build a new path using the same approach previously used.	Analogy	Making inferences using inductive or deductive reasoning.	

Example from the field of practice	Problem-solving	Critical thinking	Computational thinking
The children then try out the new solution.		Making a decision or solving a problem.	
The teacher invites the children to apply the solution that they have learned to a new situation (a new starting point and arrival point).	Analogy Formal proof		
The teacher invites the children to observe the robot moving on the path that they have built.	Analogy Formal proof		
The children are invited to analyse the solution they have chosen and distinguish relevant from irrelevant parts or important from unimportant parts.	Dropping a part of the condition.		
The teacher observes what the children have done in building the path and challenges them to think differently without following some unrevealed limitation that they have decided.	Specialisation	Identifying an assumption.	
The robot moves on the path but suddenly turns right when it is supposed to go forward. The teacher asks the children if they identify some errors, if everything is how they thought, or if they think that another solution could have been better.	Formal proof	Judging or evaluating. Interpreting and explaining.	Learning
The robot moves on the path but suddenly turns right when it was supposed to go forward. The teacher invites the children to observe each step in the path that they have built to see whether they can identify any errors. Then, she asks if someone can change the arrow that seems wrong and asks for an explanation of the error.	Formal proof	Judging or evaluating. Interpreting and explaining.	Learning
The teacher invites the children to find a new path that starts at the same point and arrives in the same arrival point but that is shorter.	Solution improvement.	Seeing both sides of an issue.	
The teacher decides on a new starting point and arrival point and asks the children to explain to her the path that they want to build, planning their strategy.			Planning
The teacher asks the children to invent a path and justify their choice.	Understanding improvement.		

Table 4.
Example from the field of practice analysed through the terms.

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Problem-solving	Critical thinking	Computational thinking	(Anderson & Krathwohl, [45])
Getting acquainted.		Stating the difficulty of a problem	Recognising
Getting acquainted.			Recalling
Working for a better understanding.	Asking and answering questions for clarification. Defining terms. Reasoning verbally, especially in relation to concepts of likelihood and uncertainty.	Reformulation or reduction/ transformation.	Interpreting
Working for a better understanding.		Decomposition or thinking recursively.	Exemplifying
Analogy	Analysing arguments, claims or evidence. Making inferences using inductive or deductive reasoning.	Choosing a representation.	Classifying
Generalising		Generalisation Abstraction	Summarising
Insight	Predicting	Heuristic reasoning	Inferring
Analogy	Making inferences using inductive or deductive reasoning.		Comparing
	Making a decision or solving a problem.		Explaining
Analogy Formal proof			Executing
Analogy Formal proof			Implementing
Dropping a part of the condition.			Differentiating
			Organising
Specialisation	Identifying an assumption.		Attributing
Formal proof	Judging or evaluating. Interpreting and explaining.	Learning	Checking
Formal proof	Judging or evaluating. Interpreting and explaining.	Learning	Critiquing
Solution improvement.	Seeing both sides of an issue.		Generating
		Planning	Planning
Understanding improvement.			Producing

Table 5.
Discussion based on the revised Bloom's taxonomy. Ref: Anderson and Krathwohl [45].

4.1 Comparison based on an example from practice

The present vignette is an example of a play situation in an early childhood setting with four children aged 4–5 years and their teacher.

> *The teacher is sitting on the floor in a circle with four children. They have a coding toy in the centre of the circle. The coding toy is a robot that can be programmed without a screen through tactile arrows that can be puzzled on the floor and on which the robot moves. It is not the first time that the group is playing with the coding toy, so the teacher asks the children to remember what they did the day before, when they observed the movement of the robot on each arrow. To ensure their understanding, the teacher asks the children to verbally explain what they have learned, step by step. The teacher asks the children to build a path from a decided starting point to an arrival point. The children start building the path, and the teacher asks them after each step why they are choosing those arrows. A child puts an arrow that is for a "forward" movement, but he says verbally that the robot is going to turn. The teacher asks the child to reflect on a similar situation that happened the day before to help him see the similarity of the two problems and invite him to use the same solution that he used the day before. Then, the teacher asks for a verbal explanation of the error and of the correcting process. To help them further, the teacher highlights that when they have to find a solution, it is wise to try to remember similar problems without focusing too much on details. The teacher points out that many solutions are good, but sometimes, some solutions are better, maybe because a solution needs fewer arrows or maybe because it is faster. The teacher asks them to build a path from the same starting point and to the same arrival point, but that is shorter.*
>
> *The teacher challenges the children to build a new path but asks them to guess what they need before building the real path. The children suggest a solution and build it.*
>
> *The teacher then challenges the children again to use the same building strategy, suggesting a new starting point and a new arrival point. Whilst the robot moves on the path, the teacher invites the children to observe the robot and asks them if some elements could have been different because not every arrow may not be necessary. Then, the teacher challenges the children to think differently, going beyond some decisions and limitations that were correct but not necessary.*
>
> *As a last challenge, the teacher asks the children to decide on a new path, define the starting point and the arrival point, describe it verbally and justify how they will build it.*

Each part of the vignette was analysed through the three terms to highlight how each step of each term can be visible in a practical situation. The results in **Table 4** present a clear explanation.

4.2 Comparison based on the revised Bloom's taxonomy

To understand the results presented in Section 4.1 more clearly, we focus on the verbs used in each description to analyse whether they can be put in relation to Bloom's taxonomy in his revised form [45]. When the teacher asked the children to remember and describe what they learned through a verbal explanation, she was clearly helping the children to understand the problem [31], to reason verbally [34] and to decompose the problem [11]. Looking at the verbs used, we can identify a connection with the thinking skills "remember" and "understand" from the revised Bloom's taxonomy (Anderson and Krathwohl, [45]). In the same way, the teacher invited the children to think about similar problems and try out similar solutions. This can be seen as an invitation to think in analogy [31], making inferences [34] and choosing representation [11]. Then, she explained that the solutions could be different, that another solution can be better, and that it is important to reflect and analyse the situations to identify errors or possible improvements. This can be seen as a suggestion for a solution improvement [31], and a process of judgement and evaluation [34] or a learning process [11]. The thinking skills that can be identified here are "apply", "analyse" and "create".

However, from a more detailed analysis based on the specific verbs used in each step of each term and on each thinking skill, important considerations can be deduced.

Table 5 presents a discussion about how computational thinking, problem solving and critical thinking can be related to the educational goals that are relevant for the 21st-century skills [1], which are related to higher-order skills (Brookhart, [2]).

In our analysis, we can see that the three terms problem-solving, critical thinking and computational thinking have similar elements, but they do not completely overlap. For example, the element "identifying assumptions" [34] can be considered as a way for "understanding the problem" [31]. However, because of the specificity of the definitions, we did not include it in the first line of the table. This can, in our opinion, reduce the bias related to our point of view. The same consideration can be done for "planning" [11] and the step in problem-solving called "carry out the plan" [31].

The description that Polya gives on the step "make a plan: specialisation", and that can be identified through the guiding questions reported in the second part of his publication [31], point to a quite creative approach. It is not an approach composed only of various steps that are compiled recursively (as in the step "decomposition or thinking recursively" [11]) or a heuristic approach, but is connected to the question "What can I do with an incomplete idea?" [31]. This means having a plan that may not be complete yet, but that can be tried out for developing a different plan when a partial answer is acquainted.

Similarly, we were not able to create a relation between the various steps of computational thinking and one element that composes the critical thinking definition. The element "seeing both sides of an issue" [34] implies a broader analysis of a situation than the one that is in the step "stating the difficulty of a problem" [11]. This is because a path must be chosen to apply a computational thinking approach. This means that it should not be possible to change the condition during the process or analyse both sides of an issue at the same time.

What can be highlighted is that some skills can be supported simultaneously through enhancing children's problem-solving, critical thinking or computational thinking skills. However, some skills can be supported merely by enhancing children's problem-solving (recalling, executing, implementing, differentiating and producing), others by merely enhancing children's critical thinking (explaining) and others by merely enhancing children's computational thinking (exemplifying and planning).

This provides evidence of the importance of supporting all these skills, for example, by playing activities in ECEC. The analysis presents the key role of the teacher in supporting children's learning through questions and guidance. What seems to be highlighted is that different skills can be supported depending on the type of questions or guidance that the teacher uses.

5. Conclusions

The aim of the present article was to investigate the existing relationship amongst three important twenty-first-century skills: problem-solving, critical thinking and computational thinking. The results indicate a significant degree of congruence between the concepts but also highlight some differences. In particular, the analysis shows that all three terms can stimulate skills that can be described through Anderson and Krathwohl's taxonomy [45], but those skills are different if problem-solving, critical thinking or computational thinking is enhanced. The analysis, based on a correlation amongst a practical example from a play situation in an early childhood setting with four children aged 4–5 years and their teacher, shows that all three skills can be stimulated. However, the role of the teacher and how she stimulates and supports children's learning seem crucial. The example analysis suggests that a teacher's questions and guidance can lead children to learn various skills. This points out the fundamental aspects of a teacher's knowledge and awareness.

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Conflict of interest

The authors declare no conflicts of interest.

Author details

Francesca Granone*, Elin Kirsti Lie Reikerås, Enrico Pollarolo and Monika Kamola
University of Stavanger, Stavanger, Norway

*Address all correspondence to: francesca.granone@uis.no

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