Computational thinking enhancing socio-emotional learning by connecting the mind and the heart

Anisoara DUMITRACHE[1], Andreea VISAN[1], Beatrice ALMASAN[1], Mihaela GHEORGHE[2]

[1] University of Bucharest,
Faculty of Psychology and Educational Sciences, Bucharest, Romania
anisoara.dumitrache[at]fpse.unibuc.ro; andreea.visan[at]fpse.unibuc.ro;
beatrice.almasan[at]fpse.unibuc.ro

[2] University of Bucharest, ODL Department, Bucharest, Romania
mihaela.gheorghe[at]credis.unibuc.ro

Abstract: *Our everyday activity involves problem solving. Very often, to solve them, we resort to all kinds of technological devices: phones, tablets, ATMs, etc. Devices are created and programmed by humans who have the ability to understand what can be transferred to non-human tools and how these tools can be programmed. Before tackling a problem, the problem itself must be first clearly understood.*

Computational thinking is what allows us to take a complex problem, understand it and solve it step-by-step. However, developing a skill is not the same as teaching a notion or concept. Every skill we want to cultivate is a process that requires exercise, practice, feedback and the ability to make adjustments. Therefore, in order to develop computational thinking skills for early ages it is mandatory for teachers of all subject areas to be confident and competent computational thinkers themselves.

Developing computational thinking skills should be done keeping in mind that humans are social beings, which means that schools must also be socio-emotional institutions, helping students to become both programmers and computational thinking savvy.

Keywords: Computational Thinking, Socio-Emotional Learning, Education, Pedagogy.

1. Introducing the Concepts: Computational Thinking and Socio-Emotional Learning

"Computational Thinking" (CT) is a concept that has gained popularity over recent years. Not so long ago, computing was seen as a skill possessed by specialists such as computer engineers, scientists, mathematicians, and people from similar disciplines. However, nowadays, regardless of age, everyone is expected to possess basic computing skills in line with the latest technological developments.

The basic definition of CT was defined by Wing: solving problems, designing systems and understanding human behaviour by drawing on the concepts of computer science" (Wing, 2006).

According with the International Society for Technology in Education (ISTE) and Computer Science Teacher Association (CSTA) CT is described as "A problem-solving process that includes (but is not limited to) the following characteristics:

- *Formulating problems* in a way that enables us to use a computer and other tools to help solve them;
- *Logically organizing and analysing data*;
- Representing data through *abstractions* such as models and simulations;
- *Automating* solutions through algorithmic thinking (a series of ordered steps);
- Identifying, analysing, and implementing possible solutions with the goal of achieving the *most efficient and effective* combination of steps and resources;
- *Generalizing and transferring* this problem-solving process to a wide variety of problems". (ISTE & CSTA, 2011).

According to Early Code Consortium (Early Code Consortium, November 2022) Computational Thinking represents a set of four components as described below:

Problem Decomposition is a method for breaking down a complicated problem or system into smaller, more manageable parts. It is also known as the "Divide and Conquer" method. Problem decomposition enables children to evaluate the problem at hand and identify all the steps that are required to complete the task.

Pattern Recognition as the second component of computational thinking is a way to look for similarities or patterns within problems. It allows children to analyse similar objects or experiences and identify commonalities.

Abstraction is a method used to focus only on the essential information and to dismiss unnecessary details. In this way, it leads children to more understandable and straightforward solutions.

Algorithmic Thinking is a method used to develop an ordered steps solution to the problem, or the rules to follow in order to provide solutions.

On the other hand, regarding *socio-emotional learning* (SEL), *The Collaborative for Academic, Social, and Emotional Learning* (CASEL, 2022) defines it as an integral part of education and human development. SEL is the process through which all-young people and adults acquire and apply the knowledge, skills, and attitudes to develop healthy identities, manage emotions and achieve personal and collective goals, feel and show empathy for others, establish and maintain supportive relationships, and make responsible and caring decisions.

Each of the five socio-emotional learning components, once mastered, serve as cornerstones for success in both academic and personal life:

Self-awareness refers to being aware of one's own emotions and feelings and one's impact on others. This component includes the process of learning to stop, observe and articulate your own feelings, moods and energy levels.

Managing one's own resources is the ability to successfully regulate one's emotions, thoughts and behaviours in different situations. This competence is cultivated by looking for patterns and strategies that increase the level of self-control in stressful or difficult situations.

Social awareness is the recognition that each of us is different and that we need to empathize with others even if they come from different backgrounds and cultures.

Relationship skills represent the ability to establish and maintain healthy relationships with others, regardless of their background. Key aspects of managing and maintaining relationships are the ability to listen carefully and communicate clearly with others.

The process of making responsible decisions represents the ability to make constructive choices regarding personal behaviour and social interactions based on social norms and ethical standards.

Cultivating these SEL components helps children become balanced and wise members of their classroom and community. Ultimately, learning to know yourself and manage your emotional life leads to improved academic success and the development of positive relationships with other community members.

The challenge will be to apply the principles of SEL and at the same time use computational thinking.

2. From Theory to Practice: The Relationship Between Computational Thinking and Socio-Emotional Learning

In the previous chapter, we highlighted some essential aspects regarding the two concepts (CT and SEL). Although it may seem that CT has a lot to do with computers and informatics, in reality, we use computational thinking in our current activities, but we do not call it such. If we think of a simple action of buying some pharmaceutical products and food products, in order to accomplish the task we will have to take into account several variables and analyse them: the best route, list of products, necessary time, finding the best-stocked store, the budget, method of payment and so on.

The ability to transform a complex problem into a simple one is an ability that many of us have already developed. In the presented context, computational thinking is present in the planning part and following the plan is similar to a programming activity.

If computational thinking is one of the key skills throughout life that we develop unconsciously then the socio-emotional development of children is a skill that is better to be taught. We must prepare children and young people to become wise, responsible and empathetic adults, although children learn to understand and

manage their own emotions, unconsciously, in the family environment. Later, once school starts, we cannot expect all this emotional baggage to be left at the entrance. Teachers have an important role in identifying each vulnerable situation and have to be aware of the implications of socio-emotional realities on the learning process.

2.1. SEL in Romanian Educational System

Romania has placed a strong emphasis on children's social-emotional development in the past ten years, especially on issues regarding better emotion management in the sense of achieving a much-desired wellness or wellbeing state. The results of these efforts can be seen in the nationwide school curricula for the second grade (ages 8-9) where the subject of *Personal Development* is taught and the one for the fifth grade (ages 11-12) where the subject of *Counselling and Personal Development* is taught.

The interest for SEL is increasing in the Romanian educational system as the number of initiatives promoting SEL, at macro and micro level. Most of these are projects that raise awareness on socio-emotional learning and offer training to teachers while other initiatives are organised at national level and generate more deep change in adopting SEL in a policy framework at national level. In the past years, socio-emotional learning and student well-being have become priorities, especially due to the pandemic context. One relevant action was the publication of a guide for school counsellors on "*Programs and counselling activities for the development of students; socio-emotional competencies*", with three components (for primary, secondary and tertiary education) and specific examples of activities, programs for developing SE competencies. More than 70 examples and activities are organised on five dimensions of social and emotional learning.

The values promoted in the Romanian educational system are an integral part of the response that education offers to the challenges of the contemporary world. These values equally reflect the culture and spirituality of the Romanian people and are meant to guide the management of personal life (health, fulfilment and personal development), to promote a sustainable lifestyle, oriented towards success, active citizenship, social inclusion, entrepreneurship and integration into the labour market.

2.2. SEL and CT through Future Teachers' Eyes

In the Romanian Educational Law 68th Article, the eight domains for the key competencies that determine the students' training profile are mentioned. The 3rd and 4th paragraphs refer to primary education, ICT and the preparatory class:

(3) ICT is an optional subject for students from 1st to 4th grades and is a compulsory subject in middle and high school education.

(4) The curriculum for the preparatory class (before 1st grade) aims at physical, socio-emotional development, cognitive development of language and communication, as well as the development of skills and attitudes in learning,

while ensuring the bridges to the development of the 8 key competences (LEN 1/2011).

In order to establish a baseline in students' degree of familiarity with the concepts of CT and SEL, we wanted to create an overview of the way in which the two concepts are defined from their perspective, and of the way in which they establish the connection between the two concepts.

The target group consists of students enrolled in the first year at Pedagogy of Pre - School and Primary Education - bachelor programme, at the University of Bucharest, Faculty of Psychology and Educational Sciences. The survey took place during the first month of the first semester of the academic year 2022-2023, during the *Information and Communication Technology* course. A number of 71 students took part in the survey and 67 of them do not currently work in the educational system.

The results showed a decreased level of knowledge on CT and SEL concepts: 41 respondents were not familiar with the CT concept and 57 respondents never have heard of SEL. Their responses were surprisingly taking into account that the values promoted in the Romanian educational system are an integral part of the response that education offers to the challenges of the contemporary world. These values equally reflect the culture and spirituality of the Romanian people and are meant to guide the management of personal life (health, fulfilment and personal development), to promote a sustainable lifestyle, oriented towards success, active citizenship, social inclusion, entrepreneurship and integration into the labour market.

In the previously mentioned survey, students were also asked to describe the concepts, in order to see their understanding on the terms. Most of the descriptions were incomplete or irrelevant. Only to mention a few for SEL - *"For me this concept represents a learning related to the social environment and emotions."; "Learning by empathizing with various social cases.";* and CT - *"I perceive the concept of computational thinking as an innovative source of technological learning."; "A set of skills based on computer science concepts to which is added a range of mental tools.".*

Other answers were more specific and proved a better knowledge on the field, but the number of such answers was very small.

As a result, the teachers were asked to apply the new methods developed during projects aimed at developing both computational thinking and socio-emotional learning skills.

3. European Initiatives in Introducing CT and SEL at the University of Bucharest

Within the University of Bucharest, the Faculty of Psychology and Educational Sciences, starting from 2018, projects aimed at both computational thinking and socio-emotional learning took place.

EARLYCODE - Developing Teaching Materials for Preschool Teaching Undergraduates on Computational Thinking and Introduction to Coding (2018-1-TRO1-KA203-058832) is an European project, having the main aim of up-skilling preschool teaching undergraduates on Computational Thinking and Coding Education and equipping them to inspire and teach children computational thinking principals utilizing effective, innovative and engaging methods.

The project intended to improve capacity within the education sector to provide high quality computational thinking teaching at preschool level in the partner countries. The project specifically targeted higher education students studying to become preschool teachers.

EARLYCODE project focused on developing teaching materials for Preschool Education undergraduates, lecturers and preschool teachers on computational thinking and introduction to coding.

The project's consortium consisted of public and private organizations from five countries: Turkey, Romania, UK, Italy and Latvia. The intellectual outputs are available in all partner countries' languages, including Romanian.

COMPUSEL - "Computational Thinking in Enhancing Primary Students' Social and Emotional Learning Skills" (2021-1-TR01-KA220-SCH-000031609) is a new project, framed at KA220 School Education – Collaboration Partnerships that aims to improve the SEL Skills of primary students and training primary school teachers for this purpose. It will develop a curriculum and digital stories including examples of different social and emotional challenges that will be discussed and seek solutions together with primary school teachers to foster self-awareness, self-management, social awareness, relationship or responsible decision-making.

The first main target group of the project practice will be a total of 100 primary school teachers in the partner countries. These teachers will be involved in the project practice actively through seminars, workshops and training activities (piloting). The second main target group of the project consists of 100 primary school students attending public schools (associated partners) in the partner countries and will be trained during the piloting. 17 teacher educators (lecturers/trainers) are another target group of the project.

4. Conclusions

Social-emotional learning is an important asset for the harmonious development of children, and interest in the subject is constantly growing at the macro level. There are many ongoing development initiatives, projects and courses that address the topic by emphasizing the need to use appropriate teaching methods to develop social-emotional learning.

Combining social-emotional learning and computational thinking can be an innovative way to teach children how to handle different life situations from a different perspective, which includes analysing problems, identifying similarities

with other experiences and identifying commonalities, retaining essential information and developing rules to follow to find solutions.

Teachers need to be familiar with these concepts and have access not only to literature, but also to practice, receive support and appropriate materials to be able to organize lessons that include social-emotional learning and computational thinking. With proper training, teachers can identify common problem situations in their classrooms and discuss with children using computational thinking components that allow children to find their own solutions to specific problems.

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