

Bringing emotions into the picture: the CambiaColore technology for socio-emotional learning in children

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Abstract

Recognizing our and other people's emotions and being able to express them are key abilities that need to be nurtured and cherished. Technologies can provide teachers and educators with tools that help them engage children in didactic activities, which can foster the development of their emotional abilities. These technologies can also help children find outlets for their emotions, for instance through drawing or expressing emotions with their bodies. This work presents CambiaColore, a novel technology for emotional expression in children. The technology is grounded in the link between drawing and emotion, which is particularly powerful in children and aims to provide teachers with a novel engaging tool for educational, socio-emotional learning activities. Moreover, the technology aims to help children better grasp the interplay between individual and group emotions. The system was co-designed with teachers and educators, who provided incredibly valuable insight regarding its usability and target users. Here, we describe the theoretical premises of our system and its set-up and game-play and present future work directions.

CCS Concepts

• **Applied computing** → *Interactive learning environments; Collaborative learning; Media arts;*

1. Extended abstract

In this work, we summarize the design of *CambiaColore*, a novel technology for emotional expression in children. The technology is grounded in the link between drawing and emotion, which is particularly powerful in children and aims to provide teachers with a novel engaging tool for educational, socio-emotional learning activities. The system was co-designed with teachers and educators, who provided incredibly valuable insight regarding its usability and target users.

Socio-emotional learning (here, SEL) can be considered an umbrella term that refers to several different abilities, both individual (e.g., recognizing one's own emotions) and social (e.g., establishing meaningful social relationships with peers) [AKJSB07, EDL06, WN11]. Socio-emotional skills are essential to personal growth, as they enable individuals to develop the capacity for self-regulation, empathy, and effective interpersonal communication, which promote personal well-being and successful social integration. Strictly related to SEL is Emotional Intelligence (here, EI), which can be defined as *the capacity individuals have for monitoring their feelings and those of others, discriminating between various types of emotions, and using this information to channel thoughts and actions* [SM90]. Moreover, EI includes the perception of emotions, and the ability to handle them [Sal97]. A thorough description of EI goes beyond the scope of this work. The book by Goleman [Gol05] and a more

recent review on the measurement of EI [BLMVMSCS21] can provide further information about the topic. To enhance children's ability to name, recognize, regulate, and share emotions, curricula targeting SEL and EI have entered the classroom (even in pre-school [GP18]). Given the complexity of SEL and EI and their multifaceted nature, bringing them into the classroom is not trivial: research has reported a lack of confidence in teachers when considering the possibility of tackling SEL in their programs [FP08]. In this respect, we believe technology could help provide teachers with engaging activities to foster SEL. For this reason, we proposed a system, *CambiaColore*, to help teachers bring EI into the classroom. The system specifically targets emotional reflection and expression, which are considered key EI competencies [Moo99] as these abilities underpin all other emotion skills [BOME07]. Being able to recognize and express emotions can be a protective factor against later psychological and interpersonal issues [Zin04]. In addition to this, the system also engages children in group activities, thus tackling group EI, which has been underexplored in research [Ghu11]. The system is designed for primary school children (aged 4 to 11) and was developed through a participative design approach that involved teachers and educators.

The core idea of the system is that drawing can be a way to express emotions [Dra23] and that drawings made in a group, where every member expresses their emotions, can help visualize and then grasp how individual emotions all contribute to the overall emotional atmosphere. In the literature, many drawing-based activities

for EI have been proposed. Raccanello and colleagues [RB24] have outlined a set of drawing-based tools to assess children's emotional state. In this respect, the novelty of CambiaColore lies in bringing movement into the picture: the emotional expression activity requires children to interact with the technology by moving, thus also leading them to reflect on the link between movement and emotions [SJ99]. The idea of linking drawing, movement, and emotional expression has been recently explored by Lin and colleagues [LYZ*24]. Their research, however, targeted adults and focused on emotional expression in individuals, rather than in groups.

The CambiaColore system consists of a glass table with a projector underneath and a canvas in front of it. Users are given a paint roller covered in a retroreflective fabric that allows a Kinect V2 RGB-D camera, also positioned under the table, to track their movement. The glass table is divided into areas (not visible to the users) corresponding to different colors. Users select the corresponding color by moving the roller to a specific area and then use it to draw. What they "paint" through their movement is projected onto the canvas and, therefore, made visible to them and other users. Figure 1 can help better understand the system set-up. It is worth mentioning how the system was designed, with the help of teachers and educators, to be as adaptive and inclusive as possible. For instance, the roller can be replaced by a bigger or different tool, as long as it is covered in retroreflective material, to adapt to different user needs. In our emotional expression activity, each color



Figure 1: *The CambiaColore system set-up. The picture shows the table, the projector, the Kinect camera, and the paint roller used to interact with the system. The drawings created through CambiaColore are projected onto the white canvas facing the table.*

represents a distinct emotion, allowing users to use the system to

communicate their feelings by drawing through their movement. The activity is designed to be used in the classroom, i.e., in a group setting. After all users have provided their drawings, the system will show a group canvas that is a pictorial representation of all the different emotions of the classroom at a specific time. The drawings can be saved in a folder to be later retrieved and used to foster further classroom activities.

To further refine the technology and the gameplay, we presented a prototype of the system during a local science festival. Figure 2 shows a group of students interacting with our system. Roughly



Figure 2: *Future users interacting with CambiaColore. Children can play with CambiaColore alone or in groups. The system tracks their movement and provides a visual feedback.*

150 children aged 4 to 11 interacted with the system and played the game expressing their emotions through drawing. All participants understood the activity and enjoyed playing the game. This step was crucial in defining the activity and fine-tuning the system. An experimental study is currently being carried out to validate the system through questionnaires, EI scales (see [CSC*15] for a review of EI assessment tools), and semi-structured interviews.

In terms of educational purposes, the aim of the activity is manifold: first and foremost naming and expressing feelings is an ability that needs to be trained and acquired (see: [BRRS12], [BBHS19] and [HBBW20]); moreover, the activity is meant to allow the expression of all kinds of emotional states, even the negative ones, therefore helping users understand that any feeling is worth being recognized and negative emotions should not be punished or repressed. Research has shown how incorporating emotional expression activities in the classroom can trigger a positive domino effect that starts with building self-awareness and ends with being able to regulate one's own emotions and those of others. These

activities have the additional benefit of reinforcing the importance of monitoring and expressing emotions [NRFB16]. In addition to this, our activity and our technology suggest the use of drawing as a tool to express emotions; research has demonstrated how children appreciate the emotional nuances of drawings and how drawing is, for most children, a natural outlet for their emotional state [JFJ04]. What is more, users will have to move to draw: this might foster a reflection on how movements and emotions are linked, both their own and those of other users participating in the activity.

In terms of research purposes, CambiaColore aims to explore further the link between drawing, movement, and emotional intelligence [LYZ*24] at the individual and group levels. To do so, we plan to create a data set of drawings collected with the help of groups of children participating in our activity. The data set will contain, along with images representing both individual and group drawings, annotations of individual and group feelings collected through a grid designed specifically for children, named Emojigrid [TKU*18], allowing them to place their affective state in a 2-dimensional space. The data set will also include movements recorded through the system (i.e., tracked by the Kinect camera). The data collection will allow us to investigate several aspects of emotional drawings. First and foremost, we will be able to link emotional states with the colors selected by the children to express them. This was one of the core suggestions we received during the co-design step: children should choose their color-emotion mapping due to the diversity in the affective perception of color across individuals. Moreover, further analysis could shed more light on how different emotional states lead to different drawings, e.g., in terms of shapes and lines. These research results might, in turn, improve the design of the system by allowing us to add feedback functionalities, helping the teachers analyze the emotional states of individuals and the group as a whole.

This work is part of the RAISE (Robotics and AI for Socio-Economic Empowerment) Liguria project, which aims to enhance citizens' well-being through technological innovations in areas such as mobility, cultural community spaces, and education. Our system is specifically designed for school settings, prioritizing accessibility and affordability.

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