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Students' Emotions in Socio-constructivist Approaches: Comparing Experiences at Different Italian School Levels

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Abstract
Emotions are becoming increasingly central in education research. The research shows a deep gap concerning emotions triggered by socio-constructivist approaches where learning occurs through social interaction, peer-work, group work, and learning activities based on building ideas or concrete objects. The specific emotions emerging in such contexts are still under-researched. To address this gap, this study first reviews how emotions are currently conceptualized and studied. We then present excerpts from several of our studies to analyze the specific emotional processes that emerge in relation to socio-constructivist educational activities. The main objective is to understand what emotions are elicited in students when participating in educational socio-constructivist activities. Several school levels are involved—middle school, high school, and university—to find common emotion. Five "socio-constructivist emotions" were singled out: emotion fluidity, discovering new parts of the self, pleasure of learning, value of the group, and crossing space–time boundaries. The paper discusses each of them with a qualitative analysis of excerpts extracted from the data available. The paper ends by discussing the theoretical and practical implications of this analysis.

Keywords Social constructivism · Emotions · Learning · Educational context · Trialogical learning

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Introduction

Emotions are considered important for students due to their impact on every aspect of learning. Exams, homework, peer relations, and interaction with the teachers all involve emotions (Kepanen et al., 2020). While learning, various emotions can emerge that may vary from boredom to excitement, from worry to gratification, and from aggravation to satisfaction (Richards, 2022). The current literature examined emotions as rather related to individual learning and their effects on the cognitive and/or physiological processes, whether by interfering with them (Gross, 2002) or enhancing them (Moreno, 2022; Pekrun, 1992). However, there is insufficient research into the emotions triggered by social interaction, peer-work, group work, and learning activities based on building ideas or concrete objects. As Zembylas (2005) notes, "in spite of the recent recognition of the role of emotions in science learning, the focus still remains primarily on cognitive aspects of learning e.g., cognitive processes of thinking or measurable cognitive outcomes" (p. 92). Only more recently, researchers (Bembich & Gasperdo, 2022; Mirza, 2016) have attempted to understand the emotional processes accompanying learning when a socio-constructivist approach is implemented. Even with this growing attention, mainly focusing on the socio-cultural dimensions, there remains the need to understand what specific emotions are triggered by the socio-constructivist approach. The approach adopted in this article is innovative because it does not attempt at discussing only the role that emotions might bear for learning, but shows how the socio-cultural processes activated by constructivist approaches to learning might promote the emergence of complex arrays of emotional experience, which are still poorly understood. By emotional experience, we do not refer to a neurological model (Heilman, 1997; Heilman & Nadeau, 2021) but rather to a conscious experience that includes awareness of what and how emotions are felt in real contexts (Lambie & Marcel, 2002). In this paper, we seek to demonstrate how socio-constructivist teaching strategies can elicit specific emotions, which has not yet been adequately investigated. To do so, the next section provides a brief discussion of the literature on emotion and learning. We then report on the findings from several projects. Finally, based on these, we outline the emotional dimension of socio-constructivist approaches.

Reviewing the Connection Between Emotion and Learning

The importance of the relationship between learning and emotion has long been noted, for example, by ancient Greek philosophers like Aristotle, influential psychologists like Wilhelm Wundt, and innovative educators like Maria Montessori (Hascher, 2010). However, systematic assessment of emotions in educational contexts was not introduced until the 1930s, when the first questionnaire measuring anxiety was developed (Brown, 1938). During the last two decades, there has been considerable growth in the empirical investigation of the role of emotions in learning and education (Camacho-Morles et al., 2021; Loderer et al., 2020; Pekrun & Linnenbrink-Garcia, 2014), leading to a wide variety of research approaches. According to Tyng et al. (2017), there are three main approaches: (a) the subjective approach, which focuses on the subjective experience of emotions during the learning process; (b) the behavioral approach, which investigates facial expressions, gestures, and vocal expression of emotions; and (c) objective approaches that are usually highly influenced by neuroscience and focus on physiological measures and neuroimaging

of emotional experiences. Meanwhile, other researchers have developed strategies for using various methods and approaches simultaneously, such as qualitative and quantitative self-report, central nervous activation of brain areas, neurohormonal processes, behavioral classroom observation (Pekrun, 2016), and critical performative analysis of emotions (CPAE), inspired by sociocultural, narrative, and post-structural theories (Kuby, 2016).

The variety of approaches reflects not only different methods and analytical foci but also various theoretical perspectives and definitions of emotions. Although many scholars agree that an emotional episode consists of at least cognitive, affective, physiological, and behavioral components (Schutz, 2014), the nature and definition of emotion itself are still debated (Barrett, 2006; Izard, 2007). Indeed, a range of alternative definitions of emotions is available, for example in terms of social constructions, discourses, social practices, and skills (Kuby, 2016). This diversity of conceptualizations is connected with the fact that research on emotions draws theoretically on a wide range of disciplines, including psychology, philosophy, sociology, and cultural studies.

There have been only sporadic attempts to systematically review the literature on the relationship between learning and emotion (Zembylas & Schutz, 2016), with few traditions conceptualizing emotions in the context of learning. For example, studies of emotion stemming from the Vygotskian tradition often adopt the concept of *perezhivanie*, which is usually translated from Russian as lived emotional experience (Byman et al., 2022; Clarà, 2015; Ng & Renshaw, 2019). As a theoretical concept, *perezhivanie* captures the dynamic relations between the intra- and inter-psychological dimensions, between individual and social, and between emotion and intellect. This is a way for a "representation of me in the environment," focusing on the influence of the environment on the subject (Vygotsky et al., 1994). All personal and environmental characteristics are represented in one emotional experience (Li et al., 2017). Perezhivanie offers a conceptualization of emotion as a process of the reflective transformation of experience rather than as a temporary state; therefore, emotional experiences are formative for the learner's selves across time (Ramos & Renshaw, 2017).

In contrast, the post-structuralist perspective conceptualizes emotions as discursive practices, thereby emphasizing their performative nature (Zembylas, 2007). Accordingly, this line of research focuses on how specific emotional experiences emerge and produce specific discourses while also considering the impact of power relations (Lanas, 2016). Another approach is to adopt actor-network theory to investigate how emotions function as actions through the use of language, bodies, and movements in relation to social actors and objects of learning (Lewis & Crampton, 2016). Lewis and Crampton (2016) provide an account of how emotions circulate and mobilize across multiple space–time configurations—the so-called chronotope, a term taken up by Bakhtin (1981)—thereby demonstrating their relevance for learning processes (Ritella & Loperfido, 2021; Ritella & Sansone, 2020a, b). Finally, while many researchers examine discrete emotions like boredom, anxiety, or enjoyment (e.g., Goetz et al., 2014), other authors have proposed a dimensional conceptualization of emotions. To clarify our position, we are not interested in discrete emotions, but rather, we like to understand the complex emotional experiences elicited by socio-constructivist educational contexts, where social interactions and building processes are at least as relevant as the individual learning processes.

Regardless of the wide range of methodological and analytical lenses, the research findings generally show that emotional experience is important for learning and can have complex implications for cognitive, motivational, and behavioral processes in any educational situation (Artino et al., 2012; Jung et al., 2014), including technology-enhanced learning (D'Mello, 2013; Loderer et al., 2020). In particular, emotions are a significant

factor associated directly or indirectly with many different educationally relevant variables, including satisfaction, physical and mental health, motivation, learning strategies, cognitive sources, self-directed learning, quality of teacher-learner interactions, class education, concentration, information processing, and consequently academic achievement (Hayat et al., 2020; Mega et al., 2014; Pekrun et al., 2011). Regarding studies on the impact of emotions on learning outcomes, some focus on activity achievement emotions, that is, emotions specifically linked to success and failure (Camacho-Morles et al., 2021); others examine "academic emotions." While partially overlapping with the previous one, the scope of this concept is wider because it covers four types of emotions (Pekrun, 2006; Pekrun et al., 2011): positive (enjoyment, pride, hope), negative (boredom, anger, anxiety), activating (joy, pride, anger), and deactivating (shame).

Evidence is contradictory regarding the specific impact of positive and negative emotions on learning. For example, some studies have reported a positive correlation between learning achievement and positive emotions (Baek & Touati, 2017), whereas others have reported negative or non-significant relations (Trevors et al., 2016). For negative emotions, the results are also mixed. For example, a considerable body of research has shown that boredom can undermine attention, motivation, and engagement (Camacho-Morles et al., 2019; Putwain et al., 2018). However, boredom may benefit academic performance by triggering creative processes (Mann & Cadman, 2014) and creating the urge to change (Bench & Lench, 2013). Emotions may also indirectly impact learning processes and outcomes via mediating factors. For example, both positive and negative emotions can facilitate learning processes when mediated by self-motivation and satisfaction (Zimmerman, 2008), while negative emotional states can either enhance or hinder learning, depending on intensity and duration (Vogel & Schwabe, 2016).

In an educational context, emotions do not only affect individuals; rather, they can be shared among participants during a learning activity or even emerge through social interaction within the cultures or communities that people have been socialized into throughout their lives (Lasky & Moore, 2000). Based on this line of thought, some authors argue that collective emotions are important components of the social-emotional climate and can contribute to both students' and teachers' emotional development (Pekrun, 2016), with some research indicating the role that empathy can play as a "connecting factor" between emotions and education (Demetriou, 2018).

The importance of the social dimension of emotions is also stressed by the social-emotional learning (SEL) approach, emerging from the constructivist tradition where new educational approaches are meant to improve personal and social development through learning. The Collaborative for Academic, Social, and Emotional Learning (CASEL, 2015) has identified five interrelated competencies that are required for social-emotional learning; those are self-awareness, self-management, social awareness, relationship skills, and responsible decision-making. Those skills are essential for students to be successful in schools as well as when they become adults. Therefore, SEL is conceptualized in a way that educational issues are not only related with school achievements today but also real-world problem as such that individuals will function effectively in a society and become responsible and caring citizens when they grow up. Shonert-Reichl (2017) describes three main components of the SEL framework: learning context, student, and teachers. Those factors reciprocally affect each other and function together. SEL has been used to develop positive interactions and behaviors in students (Khazanchi et al., 2021). For instance, it has been effectively used in peer bullying prevention and intervention programs through increasing students' understanding and social skills (Smith & Low, 2013).

Some authors considered social-emotional learning as a cure for public health problems as such that SEL programs can improve student self-esteem and confidence, increase students class engagement and grades, and reduce antisocial problems and have significant and everlasting potential in the long term in a way that they can be psychologically healthy and socially desirable and fit and would have successful and stable carriers (Greenberg et al., 2017). Therefore, in the future, there would be low costs and less problems for the governments. Thus, it is imperative that today's students experience SEL in schools and be more effective in their future life.

Studies in the USA (Jones et al., 2015) have shown that social-emotional learning can promote students' academic achievement and career success. Therefore, the idea of supporting social-emotional learning in a variety of settings has received attention at local, state, and federal levels as well as regarding educational policy in general. The social dimension of the connection between emotions and learning is particularly stressed by sociocultural scholars inspired by Vygotsky (1981; e.g., Holodynski, 2013), who claim that this field of research should consider social and historical aspects. Indeed, Vygotsky argued that complex emotions appear only historically as a combination of relationships that arise from historical life. These historically developing emotions are often labeled "secondary emotions" as opposed to "primary emotions," which are considered to be genetically programmed through evolution. While a great deal of research on emotions and learning focuses on the impact that primary emotions, such as joy or anxiety, have on learning, the interest within the sociocultural approach to learning is not only on the role played by these primary emotions but especially also on secondary emotions that develop during socialization into the cultural environment.

Various studies have confirmed that emotions, cognition, language, and the historical-cultural reality are closely interconnected (Rubin, 1998; Ratner, 2000; Swain, 2013). For example, studies with children who have not been in contact with symbols, values, and cultural meanings indicate that these children have a limited visible repertoire of emotions. This confirms that part of our emotional experience develops through sociocultural processes (Rubin, 1998; Grusec, 2011; Roth & Walshaw, 2019). Accordingly, when people socialize with new types of cultural practices (e.g., a new type of learning activity), they may experience new configurations of complex emotional trajectories. Following this line of thought, a sociocultural understanding of emotional experience requires a focus on these complex configurations of emotional experience rather than exclusively on the expression of the basic universal emotions that are usually addressed in the psychological literature. The literature outlined above includes many conceptualizations of educationally relevant emotions, with varying degrees of exhaustiveness. However, although a few studies indicate that students in different academic settings and environments experience different emotions (Hayat et al., 2020), most of the literature does not consider the specific emotions emerging when students familiarize themselves with novel teaching strategies, such as collaborative learning and socio-constructivism activities. Little is known, for example, of the emotional trajectories that emerge when the learning effort occurs in groups designing and building a shared object or planning and conducting experiments in a laboratory, which are typical learning situations within the socio-constructivist approach.

In this article, we wonder what emotions are arise when students are required to work in groups using techniques like jigsaw (Aronson, 1978), reciprocal teaching (Rosenshine & Meister, 1994), progressive inquiry (Hakkarainen, 1998), or role taking (Blatner, 2009; Turner, 1956), both in face-to-face situations or at a distance, performing activities aimed at building innovative products, objects, or ideas intended for users

other than those who made them. In the following sections, we use empirical examples extrapolated from several learning experiences having in common the implementation of socio-constructivist techniques.

Emotions Rising from Socio-constructivist Educational Experiences

In this section, we will report extracts from the field, considering learning situations organized around one specific socio-constructivist approach, namely TLA (Paavola et al., 2011; Sansone et al., 2016). This approach is called *trialogical* because it integrates two approaches, monological (i.e., individual knowledge and conceptual processes) and dialogical (i.e., distributed cognition and social/material interactions), with a third element: the intentional processes involved in collaboratively producing knowledge artifacts that are shared and used by an extended community. TLA provides solid, well-grounded guidelines, indicating (i) the features of the objects to be built—in particular, the idea that the object should address a larger community than the one actually building it; (ii) the relevance of creativity and reflection, not only to the work done but also to the nature of knowledge and its evolution over time; (iii) the centrality of collaboration; and (iv) the widespread use of any type of technology both for communication and as tools for building the objects (Paavola & Hakkarainen, 2014). These guidelines support the planning of technology-based teaching and learning activities, thereby facilitating shared efforts of working with knowledge artifacts. This highlights the socio-constructivist nature of TLA, that is, by encompassing any collaborative and creative practices—such as mentioned jigsaw, reciprocal teaching, and progressive and inquiry role taking—finalized at the construction of meaningful objects activating individual and collaborative strategies, reflective processes, and the effective use of educational technologies.

Indeed, all the examples discussed in this paper are extrapolated from our research group's experiences of implementing TLA into educational contexts. The excerpts presented have been selected not because they are exceptional but because they are representative of the emotions expressed by the majority of students participating in the learning activities from which the excerpts are extracted. The contents expressed in the excerpts selected are also found in all cases examined. The analysis accompanying the excerpts is based on the interpretative content analysis (Drisko & Maschi, 2016) which focuses on the narrative description of the meaning of communication considering the context within which that communication occurred. All the excerpts have been selected jointly by the research teams (the authors of this paper) during several cycles of reading and re-reading all the material available. The selection process was based on the following criteria: expression of emotions clearly linked to socio-constructive activities. Different school levels—and consequently students with different ages ranging from 13 to 24 in average—are considered in order to single out age independent emotions. In other words, we do not consider, in this paper, age as a variable, but rather, we like to focalize on those socio-constructive emotions that emerge cross-age and regardless of the school level. Under the methodological point of view, this choice does not represent a problem since the analytic method used—the interpretative content analysis—does not pose constraints or limitations in terms of age subjects.

Emotion Fluidity

One specific aspect we found in our socio-constructivist educational settings is the extreme variability of emotion across time. Socio-constructivist approaches are usually characterized by several steps, where different types of activities alternate. For instance, the day can start with a teacher-centered lesson, followed by a discussion activity, which precedes a laboratory or practical activity, with or without the support of educational technology. All these activities are meant to integrate individual learning with collaborative learning within a community that shares aims and practices (Darnis & Lafont, 2015). Our intention here is not to go into the specific emotions connected to each step; rather, we want to capture the emotions elicited when a variety of activities is proposed, which engages students in different ways of interacting, both with the teacher and their peers.

We gathered this information by looking at the case of a university course on e-learning for work psychologists, held at the University of Bari (Italy). During this course, lasting 12 weeks with three weekly in presence encounters, students (about 60; half of them female; age 24 in average) were required to collaboratively build digital objects commissioned by e-learning companies. Through these concrete tasks, students could implement the theoretical notions about educational technology that they learned in lectures delivered by the professor and from the course reading material. This course is perfectly aligned with TLA principles because the object built is meant for a community of users defined by the companies. At the end of the course, students were asked to complete a self-report, purposely made, in which two open questions (This course offers innovative teaching. How did you feel? Which emotions did you feel?) were meant to investigate the emotions they felt during the course. In excerpt 1 below, extracted by one of the self-report above mentioned, one of the students clearly describes how her emotions changed during the process.

Excerpt 1. Changing emotions (Abbey[1]; female, age 23)

> [original transcript] Inizialmente non avevo ben chiaro cosa aspettarmi da questo corso, poi man mano che il tempo è passato, ho attraversato diversi stati emotivi: dall'incertezza iniziale, sono poi passata alla sorpresa quando, ho visto realizzarsi il nostro progetto che pensavo rimanesse solo un'idea, lì ho iniziato a prendere consapevolezza delle mie potenzialità in questo corso, ho capito che non era qualcosa di irraggiungibile ma che, con la giusta volontà e mentalità, poteva essere portato a termine in modo positivo. Dopo di che, ad essere sincera, è subentrata un po' di ansia: sì,sin dal primo giorno osservare il calendario con le scadenze, mi ha sempre fatto venire un po' di agitazione, forse perché lo vedevo come qualcosa di irraggiungibile e che mai sarei riuscita a realizzare [....]. Dopo la presentazione del nostro oggetto aziendale, poi, si è fatta spazio la felicità mista ad una sensazione strana di leggerezza: più o meno la stessa provata il giorno della laurea. Dopo 3 mesi pieni di gruppi, email, progetti, mi sembra quasi "strano" non dover entrare in un altro gruppo o ricoprire un altro ruolo.
> [translation] Initially, it wasn't clear to me what to expect from this course. Then as time went by, I went through various emotional states: from the initial uncertainty, I then moved on to surprise when I saw our ideas come to fruition, which I initially thought would only remain an idea. At that point, I began to become aware of my potential. I understood that it wasn't something unattainable but that, with the right

[1] All names are fictitious to protect participants' privacy.

> will and mentality, it could be completed in a positive way. After that, to be honest, a bit of anxiety took over: yes, from day one as I looked at the deadlines signed in the calendar, it always made me feel a little nervous, perhaps because I saw it as something unattainable and that I would never be able to achieve [....]. After the presentation of the object made for the company, happiness mixed with a strange feeling of lightness made room: more or less the same feeling experienced on the graduation day. After three months filled with groups, emails, projects, it almost seems to me "weird" not having to join another group or fill another role.

It is easy to recognize the emotional trajectory in this excerpt. Initially, the student experienced confusion and a feeling of being lost, attributable to the novelty of the learning approach. Students are not used to being asked to enter collaborative groups to produce objects or ideas. They still have a very strong representation of learning as reproducing content, especially in the context of a traditional, public university like the one where this course is implemented. However, the student then notes her surprise. Previous research has demonstrated the role that this emotion can play in learning. Pezzo (2003), for example, describes a two-stage model that includes an initial surprise when one's expectations are violated and a resultant surprise, arising from a failure to make sense of an event. In our case, surprise is attached to a good result, to the first-hand experience of being able to achieve a result considered initially as too demanding, beyond the student's self-attributed capabilities.

This student also mentions anxiety, which is one of the most studied emotions in learning (Mandler & Sarason, 1952). Anxiety mostly interferes with learning, especially when the student judges the content to be particularly difficult (Everson et al., 1993) or related to traumatic or complex events, such as during the recent COVID-19 pandemic (Chirico et al., 2022; Pressley, et al., 2021; Ritella & Sansone, 2020a, b). From excerpt n. 1, we can infer that anxiety is just one step within a multifaceted process. Abbey talks about this emotion when referring to the deadlines. Setting intermediate deadlines is typical for socio-constructivist approaches. Indeed, to build objects or ideas, several steps are required and deadlines need to be fixed to give students an overview of the process and, given that the work is shared, enable everyone to organize themselves appropriately. The participants can then gain a clear picture of the whole process and feel being part of it. Abbey feels anxious because she is uncertain whether the deadlines are adequate to accomplish the whole task. We can assume that this feeling is generated due to her intention to actually meet the deadlines, although some degree of flexibility from the teacher helps in diluting anxiety. In any case, it does not seem to interfere with the learning process despite impacting the general perception of the time and effort needed to build the object.

Abbey then talks about happiness. As a positive emotion, this seems to compensate for the stress, anxiety, and preoccupation that may have underpinned the course, especially regarding deadlines. Finally, a sense of lightness appears: the commitment is over, but she already misses it. That is, socio-constructivist approaches are surely demanding but, at the same time, fulfilling.

Discovering New Parts of the Self

Another interesting emotion we found in our projects is closely connected to the discovery of something new about oneself. When experiencing a socio-constructivist style in learning, students seem to find out aspects about themselves they did not know they had or, perhaps, they actually did not have at the outset of the course but developed along the

way. This happens because, in socio-constructivist contexts, students are required to build knowledge. While involved in such a task, they also build new parts of themselves (Ligorio, 2009). The builder is raised alongside the knowledge being built. Specific techniques, such as role taking, offer students the possibilities to try out new ways of doing things (Sansone et al., 2016). By performing different roles, students can try out new positions in a safe social context, such as the educational one. These roles usually look similar to those they will take up later in their social or professional life. This is also a way to strongly connect in-school and out-of-school learning since what is learned in both contexts enters the learners' identity (Ligorio, 2010).

Students can be leaders, researchers, or observers—indeed, the list of possible roles is quite long. Once a role has been assigned, they can act in ways legitimized by the specific features of the role. This is evident already in the literature comparing students covering a role to non-role takers (Cesareni et al., 2016) and studies on the long-term effects on those covering roles (Ritella et al., 2020).

The comments reported in the next excerpt, from the self-report of one the students enrolled in the same e-learning course mentioned in the previous section, describe the emotion connected to the discovery of new parts of the self.

Excerpt 2. Discovering new capabilities (Richard, male; age 23)

> [original transcript] L'esperienza nei gruppi mi ha dato modo, innanzitutto, di conoscere meglio me stesso ed esplorare alcuni aspetti su cui non avevo mai riflettuto come le capacità di leadership e il parlare pubblicamente [....]. Ho provato un po' di paura nell'approcciarmi la prima volta alle presentazioni o nello scontrarmi con l'utilizzo di nuovi software di cui non sapevo nulla, ma dopo l'impatto iniziale sconvolgente della novità tutto si è risolto dandomi un nuovo senso di fiducia nelle mie capacità.
> [translation] The experience in groups gave me the opportunity, first of all, to get to know myself better and explore some aspects I had never thought about, such as leadership skills and public speaking [...]. I felt a little scared when approaching presentations for the first time or having to deal with the use of new software I knew nothing about, but after the initial shocking impact of the novelty, everything resolved itself, giving me a new sense of confidence in my abilities.

In this excerpt, the student clearly refers to developing a better knowledge of himself through exploring new aspects of the self. Students acquire new competencies and skills, which contributes to the evolution of how they think of themselves. This also leads to new emotions: in the example here, initially fear of novelty, then shock at the impact of finding himself doing things that he would have never thought of doing, and finally, a sense of growing self-confidence.

Again, we record an evolution of emotion, but this time attached to the perspective of himself. Socio-constructivist activities impact how students perceive their capabilities and knowledge, and ultimately this impacts the idea of who they are and who they can be. This awareness can cause a specific emotion, which students seem to be aware of by the end of the course, even if it is hard to establish exactly when this happens.

The Pleasure of Learning

Learning can be a pleasant experience, especially when connected to curiosity and motivation (Litman, 2005; Perlovsky et al., 2010). Socio-constructivist courses can trigger both

motivation and curiosity for many reasons. First, in many cases, novelty is important. Students are positively surprised when teachers ask them to actively create something new, whether an abstract idea or a real object.

The following excerpt from a group of high school students well describes this emotion. In this case, a class (about 25 students; 15 male; average age 17) from a Vocational Educational Training attended by future cooks decided to create, together with their physics teacher, a video guide for a steam-convection oven. This class was known as one of the most problematic in terms of behavior (although they would describe themselves rather as "exuberant") and had low average learning outcomes. Therefore, the manifestation of this type of emotion was even more striking.

Excerpt 3. Overcoming the fear to learn (Collective class text written at the end of the school year)

> [original transcript] Ma ci piaceva l'idea di creare un oggetto, qualcosa che finalmente dimostrasse in modo tangibile che eravamo capaci di impegnarci.
> Ci siamo sentiti coinvolti e protagonisti di un'attività, siamo riusciti a trasformare idee spesso vaghe e confuse in un prodotto concreto e funzionale. Questo oggetto è il risultato di un lavoro di collaborazione di tutta la classe. Abbiamo imparato ad utilizzare diverse tecnologie per fare qualcosa di utile e interessante; abbiamo condiviso con tutti i compagni della classe informazioni, esperienze, capacità; abbiamo sorriso molto durante gli incontri; con questo progetto abbiamo imparato a guardare oltre; durante le attività i professori erano accanto a noi e con noi; costruendo il video abbiamo dimostrato che si può volare alto; non abbiamo avuto paura d'imparare.
> We liked the idea of creating an object, something that finally demonstrated in a tangible way that we were capable of committing ourselves.
> We felt involved and felt being protagonists of an activity; we managed to transform often vague and confused ideas into a concrete and functional product. This object is the result of the collaborative work of the whole class. We have learned to use different technologies to do something useful and interesting; we shared information, experiences, skills with all classmates; we smiled a lot during the meetings; with this project, we have learned to look beyond ourselves; during the activities, the teachers were next to us and with us; by building creating the video[2] we have shown that we can fly high; we were not afraid to learn.

This excerpt condenses the various reasons why these students discovered the joy of learning. They felt they had a chance to demonstrate what they could do, probably overcoming the implicit labels they feel as students who are supposedly not interested in learning. In Italy, vocational schools are considered being for those who are not interested in an academic career, since their diploma does not allow students to enroll at university. Furthermore, they either propose professions not overlapping with what is actually required by the labor market or train students for new jobs that are not always clearly defined. We believe the reason behind the happiness to learn felt by these students is the TLA introduced by the teacher. The students felt empowered: they were required to test an innovative approach and to build a challenging object in collaboration with the company that produces the oven. They probably interpreted this as an opportunity to experiment in a new setting, very different from the traditional teacher-student transmission, as well as to delegitimize

[2] This is the trialogical object that they built: a demo about how to use the oven.

the labels that others gave them. Teachers were perceived more as partners ("teachers were next to us and with us") and they could use "different technologies to do something useful and interesting." This allowed them to consider learning as an opportunity to put their abilities into practice.

Students felt like "protagonists" in that their ideas and active contributions were essential and appreciated. The feeling of transforming ideas that were initially "vague and confused" into something concrete meant that their contributions were being taken seriously and that what they think and do really matters. The group is described as the place to share both positive and negative aspects of the learning experience, to comfort and support each other, and to find resources to empower themselves as learners. The availability of many tools—including but not limited to technology—made the students feel they were doing something "useful and interesting" for a wider audience than just their own classroom. They felt trusted by their teachers, who acted as members of a team where each one contributes according to their own abilities and competencies. All these factors make learning exciting, so much so as to reconsider their own representation as "turbulent." Now, they feel brave and have overcome their fear of learning. Indeed, the pleasure of learning becomes the pivotal mechanism empowering these students, who seem to have moved from "learned helplessness" to "learned hopefulness" (Seligman, 1980).

This empowering mechanism is clear even in the university students from the course we mentioned earlier. They express a similar feeling, as seen in the following excerpt.

Excerpt 4. Feeling "in power" (Clarissa, female, age 23)

> [original transcript] Dal corso e-learning: Mi sono sentita sempre coinvolta nel senso proprio di POWER, cioè dovevo stare dentro al ritmo, dentro alle cose, ed è stato molto positivo, cioè io… ero felice di venire a lezione, ero entusiasta di avere una sfida da eh… da affrontare! Mi sono sentita motivata durante ogni fase, ogni momento.
> I always felt involved in the proper sense of POWER., That that is, I had to stay within the rhythm, inside things, and it was very positive, that is, I... I was happy to come to class, I was enthusiastic about having a challenge to eh... to face it! I felt motivated during every stage, every moment.

Here, we find a mix of intrinsic motivation, happiness, sense of feeling challenged, and being in the flow, as Csikszentmihalyi et al. (2005) defines it.

Clarissa clearly talks about feeling "power" despite challenging requirements, tight deadlines, and complex and novel tasks. She can succeed and she enjoys being aware of this. Clarissa clearly talks about feeling "empowered," underlining how her emotional state develops from positive to motivated, involved, enthusiastic, and happy. This allows her to become a proactive and empowered learner who takes the initiative and copes with different situations.

The Value of the Group

Even though a large part of the specialized literature highlights the impact of the social dimension on emotional reactions, the specific way in which social aspects influence learning is quite articulated, particularly when the focus is on collaborative learning (Järvenoja et al., 2018). In technology-based collaborative groups, adaptive social dynamics can improve students' skills, such as their social effectiveness (Annese et al., 2022). Positive socio-emotional interactions within groups have been linked to positive outcomes in

engagement because they can enhance both individual learning and group development (Bakhtiar et al., 2018). There are different ways to implement collaborative activities: with or without technology, using a specific method such as jigsaw or reciprocal teaching, or by just forming groups and assigning a discussion task. Although it would be interesting to explore what emotions are triggered by each specific group setting, this is beyond the scope of this article. Here, we want to stress that when groups have a shared task and adopt strategies to make sure everyone is actively participating, there are positive effects on emotional awareness (Warsah et al., 2021).

In the following excerpt, Luana comments on the group activity she volunteered to participate in within the course Experimental Pedagogy (about 50 students; most of them female; average age 23) as part of her 3-month undergraduate psychology degree program at the University of Rome, Sapienza. TLA was adopted for this course, with groups required to create a pedagogical scenario to be implemented at one school level of the students' choice (primary, middle, or high school). This task involved the participation of school teachers as experts, while the students were responsible for proposing a tool for the teachers to use in their contexts. In the excerpt, extracted by her self-report proposed by the teacher, Luana compares how she felt about working in a group at the start of the activity, and how this feeling changed.

Excerpt 5. (Luana, female, age 21)

> [original transcript] A dire la verità ero molto scettica quando ci è stata proposta la parte di lavoro di gruppo. Non pensavo potesse "funzionare" ma mi sono dovuta ricredere. Pian piano cresceva l'interesse nei confronti del "compito" collaborativo, in generale, e delle opinioni dei miei colleghi, in particolare. Quindi, sì, è cambiato il mio modo di pensare all'attività e paradossalmente ciò che ha permesso questo cambiamento è stata l'attività stessa nel suo svolgimento e nel suo procedere collaborativamente.
> [translation] Honestly, I was very skeptical when the group work part was proposed to us. I didn't think it could "work," but I had to change my mind. Gradually, my interest in the collaborative "task" and in the opinions of my colleagues grew. So, yes, my way of thinking about the activity changed, and paradoxically what allowed this change was the activity itself in its development and in its collaborative progress.

Again, we can observe an emotional trajectory during the development of the activities, confirming that emotions fluctuate throughout the learning situation in relation to social interactions (Linnenbrink-Garcia & Pekrun, 2011). Luana is initially "very skeptical" about the idea of working in a group, but changes her mind during the work and clearly attributes this change to the activity itself, carried out in a collaborative way. Luana, like many of her colleagues, has never worked in a group before, and this novelty is accepted with some concern. Gradually, her interest in the collaborative "task" grows alongside her interest in the task itself. This change leads her to modify her emotional experience, thereby making her interpretation of such a peculiar learning situation more positive (Boekaerts & Pekrun, 2015) and increasing her overall engagement with the content (Roseth et al., 2008).

In other words, for Luana, the change of emotion toward the group is intertwined with the cognitive level ("My way of thinking about the activity has changed"). This change can also occur purely on an emotional level, as in the case of Rossana, who attended the same course.

Excerpt 6. (Rossana, female, age 21)

> [original transcript] mi sono resa conto che lavorare insieme ad altre persone sia

> un'esperienza divertente, stimolante e che arricchisce sicuramente dal punto di vista delle relazioni. Quindi più che "cambiare il mio modo di pensare" direi che ho riscoperto un piacere, da tanto tempo accantonato. E tutto questo soprattutto grazie alle discussioni online.
> [translation] I realized that working together with other people is a fun, stimulating and certainly enriching experience from a relationship point of view. So more than "changing my way of thinking" I would say that I have rediscovered a pleasure that has been set aside for a long time. And all this thanks to, above all, online discussions.

Initially, this student seems to acknowledge the benefits of group work in terms of fun, engagement, and relationships. She then clarifies that this is not based on a change in her "way of thinking," but rather on her re-discovering a pleasure that she has long shelved. Here, group work impacts the way in which she relates to others (Turner, 2014). Awareness comes through participation in joint activities, including the guided online discussions that these students participated in. In technology-mediated social-constructivist educational contexts, there is typically a strong and fruitful interweaving of the different settings, methodologies, processes, and products required of students (Ligorio & Sansone, 2009). This complexity is meant to support collaboration by offering a wide range of opportunities. Collaboration is not just something students can learn by themselves; it needs to be directly experienced (Sansone et al., 2019). The possibilities of real collaborative learning reside in highly structured intra-group interactions that are strictly designated around well-defined scripts assigned to students and anchored to specific pedagogical models (Ligorio & Sansone, 2009). Webforum discussions, in particular, can become mediators of collaborative processes so long as they are guided by specific techniques, such as jigsaw, progressive inquiry, and role taking. As students discuss in these forums, reflections are nurtured, and diversity is appreciated until group work becomes a meta-object of discussion and simultaneously the cause and consequence of the emotions of enjoyment.

Crossing Space–Time Boundaries: a Wider Empathy

TLA is also meant to provide an opportunity to create connections between school and other contexts. Cross-contamination between different contexts allows one to acquire modes of interaction, ways of thinking and talking typical of the counterpart contexts (Akkerman & Bakker, 2012; Amenduni et al., 2021; Paavola & Hakkarainen, 2014; Ritella et al., 2016). Following this approach, the ImparaLoop project was designed and implemented in a middle school located in Northern Italy. The project involved three middle classrooms (about 15 students each; equally male and female; average age 13) and their teachers that were first adequately trained to implement the TLA. The project aimed to reinforce the relationship between territory, families, and schools, around certain "places of memory" that are crucial for the community, in this case a small mountain town, called Paraloup, where several crucial episodes of the Italian resistance occurred during the Second World War. The village of Paraloup is now totally renewed and hosts a digital museum with a cafeteria and a rest area. During the project, students carried out various trialogical activities that drew on the involvement of witnesses to deepen their understanding of the socio-historical issues related to the Italian resistance. The final trialogical object was a students' website meant for students from all over the country in preparation for a visit to Paraloup. Before ending the visit to the village, students were asked to take a minute and individually write down their thoughts about their emotions during this experience. These

notes were collected by the teacher and later analyzed by the researchers. Excerpt 7 reports on parts of Jacob's writing.

Excerpt 7. (Jacob, male, age 13)

> [original transcript] Sono salito pensando ai partigiani, che da Cuneo partivano a piedi per arrivare fin qua, e mi guardavo intorno, pensando a una compagnia di persone che sembravano una grande famiglia. Quando siamo saliti per raggiungere le croci, tirava un forte vento e faceva molto freddo. In quell'istante mi sono sentito Nuto Revelli nella campagna di Russia.
> [translation] I climbed the mountain thinking of the partisans who left Cuneo on foot to get here, and I looked around, thinking of a group of people who looked like a big family. When we went up to reach the crosses, a strong wind was blowing, and it was very cold. In that instant, I felt like Nuto Revelli[3] in the Russian countryside.

Jacob reflects on his experience of the visit by highlighting the implicit physical sensory aspects—the climb, the wind, the cold—as well as by showing how he overcame space–time boundaries. In both cases, the emotional component is relevant. The effort and time taken up by the climb offer a space to think about the partisans making that same climb and to imagine them as a "big family." Once he reaches the top, a new form of identification allows Jacob to move, this time to Russia, in the guise of a remembered partisan hero. Outdoor learning is known to trigger positive social and emotional skills (Eaton, 2000). Such an unusual and rich learning experience enables an intense emotional journey, made possible by going outside the classroom to have physical involvement with nature.

Crossing borders, which is one of the most crucial features of socio-constructivist approaches like TLA, triggers specific emotions. Moving from one context to another implies also moving from one space–time configuration or chronotope to another. Indeed, the excerpt just discussed is a good example of how chronotopes trigger not only empathy between people but also the feeling of actually "being there" (even without digital technology). This extends the empathic process to events, people, and places from a different time and place, thereby activating a cross-chronotope emotional fluidity.

Discussion

The main aim of this paper was to contribute to the discussion about learning and emotion in socio-constructivist educational contexts. To do so, we drew on excerpts from participants' reflections on activities in a range of contexts, from middle school to university courses, designed using a TLA approach, which is considered quite representative of socio-constructivism.

TLA has already proved to be a very powerful tool across many different education situations (Paavola & Hakkarainen, 2014; Sansone et al., 2016; Van der Veen et al., 2016). Nevertheless, research on TLA, to the best of our knowledge, has not explored the emotional dimensions. Our experience with TLA suggests that, by stimulating significant innovation, it causes a complex array of emotional reactions that have not yet been properly explored.

[3] A famous Italian Second World War partisan.

The excerpts we selected are meant to define the emotional configuration within which students move once traditional teaching styles have been abandoned. We first detected extreme variability in the students' emotional states. When involved with educational strategies that require a large array of techniques—from traditional teachers' lecturing to collaborative building of objects—a kind of mirroring in the range of emotions appears. This does not necessarily mean that each type of educational strategy arouses specific emotions; rather, it suggests that offering a panorama of different learning strategies evokes a mix of emotions ranging from the more traditional ones—such as anxiety and happiness—to specific emotions, such as discovery of new parts of the self and experiencing different chronotropes.

Emotional variability has been studied in relation to self-regulated learning (SRL) (Zimmerman & Schunk, 2011). The results have been mixed (Ben-Eliyahu & Linnenbrink-Garcia, 2013). For instance, Li et al. (2021) found that students with high SRL had smaller emotional variability than low SRL students, although these differences were not statistically significant. The students in the present study experienced a diversified set of emotions that evolve over time, where each emotion seems to both counterbalance and better specify the others.

Education has traditionally been considered a tool for self-discovery, whereas a lack of knowledge obscures the ability to know oneself. While this may be true, it seems limited because, in socio-constructivist contexts, students not only discover themselves but also "build" new parts of themselves (Ligorio, 2010). Finding out something new about themselves explains the students' astonishment recorded in the excerpts. They understand that they are capable of developing skills and knowledge that they had never considered part of their repertoire, or perhaps not even desired. Finding themselves in solving challenging tasks and facing unforeseen situations allows students to live in new and original positions. This result is perfectly in line with a large part of the literature demonstrating that education plays a clear role in forming identity (Verhoeven, et al., 2019). Further identity positions can stem from the processes of adopting educational strategies where making and discussing, building and reflecting, are continuously combined.

Although it is not a new claim to say that learning can be fun, traditional educational strategies still often seem to forget it. Socio-constructivist approaches are also meant to motivate students through challenging and creative tasks. Learning, in these cases, is less connected to assessment and judgment from teachers or even peers. Given that the fear of assessment can interfere with learning (Adler, 2004), socio-constructivist approaches call for self- or reciprocal assessment (Brown & Harris, 2013). While the cases we report here include these types of activities, we wanted to emphasize how TLA shifts the focus toward the object to be built, which of course reflects the knowledge and competencies acquired by the builders. This decreases the emphasis on how much a single student "weighs" and lets the students concentrate on the fun of seeing their ideas and proposals be implemented.

This concentration on objects produces another type of fun as students see an object emerging while being aware that they are the builders. Indeed, students are often not even aware that they are actually learning something; this is what experts call "inert knowledge" (Renkl, et al., 1996).

Having an object that embodies what they learned helps students activate inert knowledge. Knowledge and competencies are not only acquired through reading and rereading books or listening to the teacher. Rather, they are often activated through group activities and discussion, object ideations and manipulation, and sharing and negotiating. What they learn is immediately put into practice, which likely improves the fun of learning.

Socio-constructivist emotions—at least a part of them—are needed for breaking the more or less implicit representation of teachers as experts and holders of knowledge to be passed on to the learners and of students as simply information receivers and task executors. Once socio-constructivist approaches have been introduced, teachers become partners with whom students can try out ideas and activities. Students no longer sit and listen passively; now, they are active and can propose, produce, invent, experiment, and even go beyond the boundaries of what is already known; they become empowered members of their groups, almost like their teachers or tutors. As a result of changing students' and teachers' representations, even knowledge representation changes. It now becomes something buildable and modifiable with boundaries that are no longer dictated by authorities (teacher, textbook, authors, experts, etc.) but instead has blurred outlines that can be modified and superseded.

This explains also the emergence of a new type of empathy accompanying the cross-chronotope experience. Students enter into contact with places and people distributed in space–time configurations, different from the here and now. Consequently, students feel strongly connected to people and places from the past; they feel part of a "flow" that allows them to look toward the future while knowing where it comes from. This increases their intention to impact, contribute to, and modify this future, as clearly demonstrated in another of our TLA research projects (Barzanò et al., 2020).

Finally, an intriguing emotion accompanies the raising of a new organism that is capable of learning: the group. The discomfort our students report when asked to participate in structured group activities reveals how, even today, at least in Italian public schools, group work is rarely used or proposed only in a superficial way—with the appropriate differences between the various school levels—without really triggering the dynamics of collaborative learning. Instead, collaborative learning is often reduced to simplified and trivialized group work lacking the techniques that really activate collaborative learning. Becoming part of collaborative groups guided by jigsaw or role taking, for instance, is new for students. The groups develop specific cognitive and emotional learning dynamics that go beyond the individuals, while still including them.

While many factors have been shown to trigger real collaborative learning (Mattessich & Monsey, 1992), there has not yet been adequate research regarding the specific emotion of feeling part of a sort of superorganism, i.e., the group that transcends yet simultaneously includes its individual members. Our data suggest that it is an experience densely characterized by an emotional point of view. Realizing that you can learn more in a group and in a different way than through individual study results not only in the discovery of a new source of learning but also in the appreciation of the fact that an enterprise such as constructing a complex object becomes possible when performed collectively although it was impossible in solo mode. Realizing that greater achievements are possible only as a group is precisely the emotional connotation that accompanies collaborative learning.

Conclusions

Through an ethnographic-discursive approach, this paper contributes to research on the relationship between emotions and learning in a doubly original way: first, it addresses the issue from the perspective of the theoretical-methodological approaches used in various school and university educational contexts; second, it looks at emotions as complex

configurations, emerging from specific learning situations, which we can label "socio-constructivist emotions."

Scholars have previously concentrated more on defining discrete emotions, evaluating their impacts in terms of positive/negative opposites, and identifying correspondent methods of observation.

The analysis presented in this paper clearly shows how socio-constructivist methodological approaches (e.g., TLA) favor the emergence of an articulated constellation of different kinds of emotions, often opposite, which change during a course, and whose value goes beyond their impact on academic achievement (Linnenbrink-Garcia et al., 2018). That is, these are emotional processes that unfold over the medium term (Vygotsky, 1981). They function as empowerment mediators and identity changes, or, at the very least, stimuli for restructuring and strengthening students' overall emotional competence, with inevitable effects, directly or indirectly, on their participation in the learning context.

These effects are clearly linked to the specific characteristics of the approach used and, therefore, to the teaching methods each teacher adopts: structured group work, flexible mediation of the tools, requests to create meaningful objects, solicitation of discursive and reflective processes, repeated cycles of activities and product review, and self- and peer-assessment. These techniques make it possible to create an educational context that is challenging, demanding, fun, engaging, anxious, and exciting and that ultimately triggers inert knowledge (Renkl et al., 1996). This multifaceted environment generates both group and self-empowerment and ultimately a repositioning of identity, in the sense of learners' developing new ways of being, and the opening of operational horizons and practical responses to contingent reality. In this way, education can fulfill its true mission of supporting students' identity building (Verhoeven et al., 2019).

We therefore consider our results relevant for both teachers and researchers. The most important implication for teachers is to pay attention to designing learning contexts that diversify techniques, assignments, actions, tools, and actors. Regarding research, studies of in-depth methods are needed to grasp the complexity of the relationship between emotions and learning, beyond single emotions and their short-term impacts on the learning process.

This paper was not intended to provide an exhaustive and conclusive answer to the question of targeting emotions in socio-constructivist environments. Indeed, more research is needed in this direction to overcome various limitations of our work. Future studies can consider the possible role of local culture, employ a systematic analytic tool to enable comparison of data from different sources, and focus on developing a deeper understanding of the impact of emotions on students' developmental path. A more sophisticated analytic tool may enable further emotions to be tracked. By addressing these limitations, in-depth studies can be planned to better grasp the interaction between specific features of socio-constructivist learning experiences and their effects on the individuals and the group through the mediating role of emotions. Finally, it could be interesting to investigate teachers' emotions since it is reasonable to imagine that a socio-constructivist didactic also impacts the emotions experienced by teachers. These could perhaps in turn create a constant flow of mutual influence.

Understanding emotions within a socio-constructivist approach can have positive consequences. In particular, students may experience a wider range of emotions that support a type of learning that is closely connected to the understanding of others and themselves. In the long run, this can enhance positive development, contribute to eliminating problematic behaviors, improve students' academic achievement and performance in specific tasks, improve citizenship capacity, and promote healthy behaviors (Durlak et al., 2015; Eynde & Turner, 2006).

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Data Availability The datasets generated during the current study are available from the corresponding authors on reasonable request.

Declarations

Ethical Approval Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Competing Interests The authors declare no competing interests.

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