Socio-emotional Regulation in Collaborative Hybrid Learning Spaces of Formal–Informal Learning

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Abstract. It has been suggested that a group's regulation in hybrid learnng contexts is correlated to their social and emotional interactions (Isohätälä et al. 2020). How these socio-emotional interactions influence collaboration has primarily been studied in formal learning contexts. However, the influence of these factors is potentially more challenging in outside-of-school activities, which may happen synchronously or asynchronously and without teacher supervision. The chapter explores the role of emotions in co-regulation and socially shared regulation during collaboration in hybrid contexts that mix formal and informal learning. This chapter provides an overview of the literature and the research tools related to socio-emotional regulation in computer-supported collaborative learning (CSCL) and problematizes the need for a better understanding of how socio-emotional factors unfold and operate in hybrid contexts where formal and informal learning are mixed. This problematization is illustrated with examples observed during a well-established physically sited (math) gymkhana.[1] The discussion opens the question to further investigate and design

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[1]   In our context, a gymkhana is an outdoor game where (15-year-old) students must use clues and riddles to find and solve (math) problems that are located throughout the streets of one of the city's neighbourhoods.

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how to support students in improving their socio-emotional regulatory skills through CSCL for hybrid learning contexts.

Keywords: Social-emotional Regulation, Hybrid Learning Spaces (HLS), Collaborative Learning.

1   Introduction

This chapter explores hybrid learning spaces (HLS) in the sense of spaces outside school where students collaborate in groups without teacher intervention. These learning opportunities may have been designed by teachers but they are actually enacted informally. This kind of hybridity –that mixes formal and informal learning– (Ellis & Goodyear, 2016) is the main focus of this study.

Two of the five trends in HLS (Ellis & Goodyear, 2016), imply two key challenges: (a) giving more agency to students, and (b) that agency needs/implies the students' regulation. Agency is one of the most important capacities to be developed in education and collaborative learning because it has to do with student motivations and interests (Ahn & Clegg, 2017; (Ingold 2008; Goodyear et al. 2018); Scardamalia & Bereiter, 1991; Tchounikine, 2019). The regulation of learning is needed when, for example, students are outside of school and there is no teacher orchestrating the situation. If we add collaboration to that mix — another key skill for the twenty-first century (OECD, 2017)— we place this chapter in the field of co-regulation and socially shared regulation (Hadwin et al., 2018; Järvelä & Hadwin, 2013).

In the case of the gymkhana that we present, three groups of students are observed collaborating during an outdoor activity (solving math problems). At that age, more experience collaborating for school purposes is a skill that should be promoted. But if emotional issues arise, they can have a strong impact on the students' performance. As we will show, in this kind of context, socio-emotional factors seem to emerge more freely than in more formal settings.

These socio-emotional processes requiring some kind of control are invisible to members and do not activate automatically; being aware of them requires learning and experience (Järvelä et al., 2020). According to Järvelä and colleagues (2016), groups do not necessarily recognize nor react to challenging collaborative situations. Thus, they need to be alerted to and learn to regulate, those processes.

The gap that we try to describe and address is that among all these regulatory processes, the least studied are emotion and motivation (Järvenoja et al., 2019). Feelings of wasted time, discouragement and socio-emotional challenges can make a group fail (Barron, 2003). Thus, regulation of social and emotional issues during collaboration is a key factor in a group's performance (Järvelä et al., 2015) and is under-researched in HLS (and adjacent areas of research such as computer-supported collaborative learning, CSCL) in contexts outside school without teacher intervention.

Our main research question is: how has socio-emotional regulation been tested with the use of technology. In the chapter we explore existing research and tools for emotional regulation.We identify the need to design tools that support socio-emotional regulation *during* collaborative activities in HLS (not only *at the beginning*). In order to support the need for further knowledge to understand this gap, we studied social interactions and socio-emotional regulation in groups that were not supported by any technology. Our goal for future research is to gather insights for how to support students' needs with asynchronous tools that afford their collaboration in HLS where the digital and physical merge. This is another dimension of hybridity that we plan to develop in our future work.

This chapter is structured as follows: The first section is an overview of previous research about social and emotional regulation in CSCL from a situational perspective in order to set a common background of core concepts. Then, the chapter presents a review of the tools designed by researchers in order to learn about socio-emotional regulation during collaboration. Finally, we present an analysis of the observations of students collaborating in a hybrid learning context that illustrates the gap described earlier.

2   Theoretical Background

2.1   Social Interactions: Cognitive and Socio-emotional Effects

Learning in collaboration involves social interactions that affect cognitive and socio-emotional processes (Isohätälä et al., 2020; Kreijns et al., 2003, 2013; Kreijns & Kirschner, 2018). For example, cognitive processes comprise thinking, shared knowledge building and shared understanding. Socio-emotional processes refer, for example, to forming groups or establishing a group climate (Kreijns et al., 2003). Some of these processes are internal; they take place inside individual learners' minds and emotions. However, they also unfold when members interact with each other (Goffman, 1983). These social aspects of CSCL were studied and modelled by Kreijns et al. (2003).
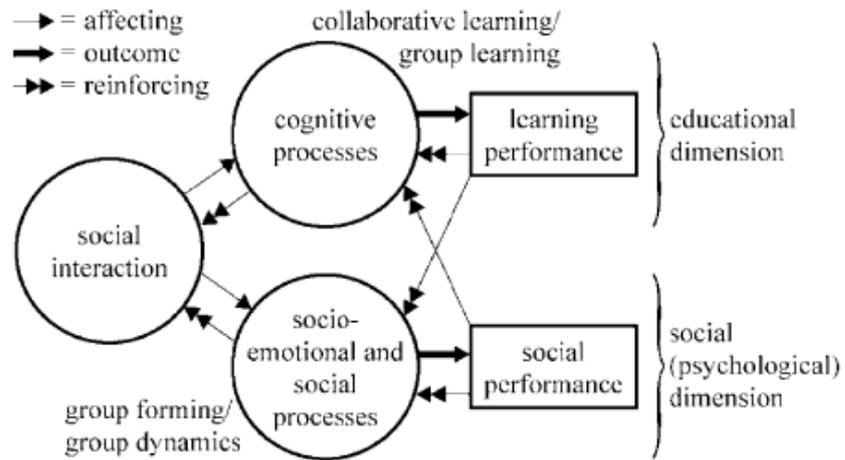
Fig. 1: Kreijns et al. model, 2003

The model was extended 10 years later through the addition of an 'educability' attribute (Kreijns et al., 2013). This refers to the educational affordances that support collaborative learning. A few years later, Kreijns and Kirschner (2018) proposed a second extension; the hedonicity attribute. This concept expresses the degree of enjoyment and positive experience that (online) collaborative learning tools provide. With this concept, they posit that the influence of the games and putting a fun spin on interaction will result in learning that is not only effective but also something to be enjoyed.
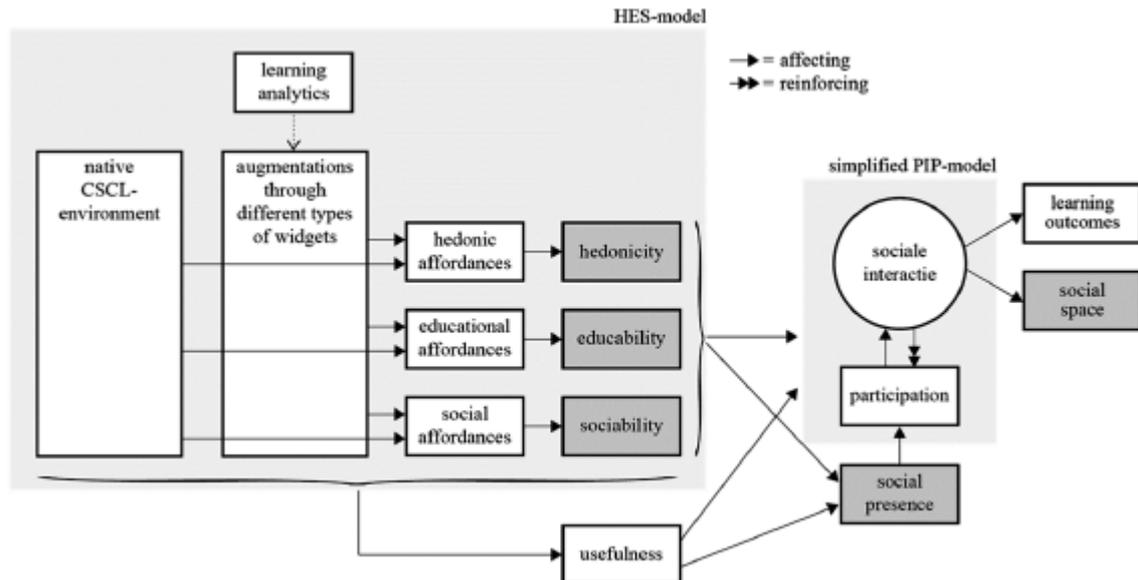
Fig. 2: Kreijns & Kirschner model, 2018

The Kreijns & Kirschner model (2018), a mix of formal and informal learning, is especially relevant in HLS because the above-mentioned 'hedonicity' attribute makes the model more complete, up-to-date, and appropriate for young collaborators.

We now focus the scope of our study on a particular type of social interaction during collaboration: regulation.

2.2 Regulation in Collaborative Learning

Regulation of learning is a key strategy for cyclically planning for, monitoring and reflecting on the cognitive, behavioural and emotional (including motivational) conditions of learning whenever needed (Isohätälä et al., 2020; Pintrich, 2000; Zimmerman & Martinez-Pons, 1988).

A recent review of self-regulation learning models (Panadero, 2017) describes their history and evolution and compares them according to different aspects, including their conceptualization of motivation, emotion and context. The model

proposed by Järvelä and Hadwin (2013) is based on situated perspectives of learning (Greeno et al., 1996) and proposes three modes of regulation in collaborative settings: self-regulation, co-regulation (one member helps regulate another member) and socially shared regulation (regulation of the group as such).

All models of regulation refer to three phases: planning, monitoring and reflection. Some also mention the influence of personal history and previous experiences of collaborating.

In this chapter, we are focusing on social interactions but more specifically on interactions that lead to co-regulation and socially shared regulation. We are focusing on the monitoring phase of regulation because, as we will show, the monitoring phase is the least researched.

Now we will zoom in a bit to focus more on a kind of regulation: socio-emotional regulation. This, above all, is manifested when students encounter social challenges during collaboration. These challenges have been described (Hadwin et al., 2018) and refer to communication, unmotivated group member(s), unequal participation or distribution of work, unsupportive group climate, different styles of interacting and difficulty communicating due to language barriers.

Several tools have been developed by researchers to support different modes of regulation in collaboration. Below, we present some categories that previous researchers have suggested.

From the point of view of how CSCL tools can be leveraged to support groups in regulating collaboration, Miller and Hadwin (2015) proposed two types: (a) scripting tools that structure and guide collaboration by specifying, sequencing and distributing activities and roles to be enacted (Dillenbourg, 2002; Fischer et al., 2013), and (b) group awareness tools that help group members access information about behaviour, knowledge or social aspects so that they can use this information to coordinate collaboration by themselves (Janssen & Bodemer, 2013).

Regulation in scripting tools is usually performed by teachers, who flexibly orchestrate and modify the structured sequences of activities (Amarashinge et al., in press). Conversely, HLS contexts (outside school, no teacher supervision) require self-regulation support approaches that promote students' agency.

Järvelä and her colleagues (2015) used the concept of affordances (Gibson, 1977) to categorize many of the research tools that have been designed for CSCL.

They observed that most of them have focused on the educational and/or technological affordances, and too often have overlooked the *social affordances* proposed in our chosen model of social aspects of CSCL (Kreijns et al., 2003, 2013; Kreijns & Kirschner, 2018). We have found no research tools exploring hedonistic affordances in CSCL (Kreijns & Kirschner, 2018).

3   Review of Socio-emotional Regulation Tools in CSCL

We have reviewed (see Table 1) a set of scripting and awareness tools designed to support different aspects of socio-emotional regulation according to the model of regulation presented by Järvelä and Hadwin (2013). The table provides the name of the tool, the authors, a description and an indication of the regulation studied.

None of the prior research have studied regulation in hybrid contexts without teacher supervision, in the way that we propose in this chapter. All of the tools are tested in formal contexts and address higher education or university students (except the EmATool, that was used by primary school students).

Most of the tools deal with the planning or reflecting phase of regulation. Only three are specific to socio-emotional regulation: SEST, S-Reg and EmAtool. From these three, only the last two are awareness tools.

Table 1 Socio-emotional Regulation Research Tools

Tool	Description	Regulation
Reflector (originally part of VCRI and tailored by Phielix et al., (2010) and (Järvenoja et al. 2013)	Stimulate group members to **reflect** and/or co-reflect on their individual behaviour and the overall group performance.	Social aspects of groups in CSCL
Radar (originally part of VCRI, then tailored) Phielix 2012?; Järvenoja & Järvelä, (2009); Järvenoja et al., (2013)	The radar tool was tailored (from VCRI) to promote awareness of individual SRL and SSRL. The students completed the tool individually. After that, they could see each others' Radars on the screen	Self and socially shared regulation
SEST: Socio- emotional sampling tool (scripting tool) Webster & Hadwin, (2013)	SEST supports learner regulation by scripting and prompting learners to monitor and evaluate their current emotions before, during and after the task. SEST requires learners to fill in the blanks and choose items from drop-down menus.	Self and socially shared regulation: emotions
IPT & SPT: Individual & shared planning tool (scripting tool) Hadwin et al., 2013; Miller et al., 2013; Miller & Hadwin, 2015	IPT and SPT help learners define tasks, set goals, make plans and reflect on the challenges encountered individually (IPT) or collaboratively (SPT) using a series of questions asking them to fill in blank text boxes before each task.	Self and socially shared regulation: planning
OurPlanner Järvelä et al. (2015)	OurPlanner and OurEvaluator facilitate shared planning and evaluation based on SPT. OurPlanner promotes aspects of SSRL such as task understanding, planning, goal setting and strategy use.	Socially shared regulation: planning
OurEvaluator Järvelä et al. (2015)	The focus is on evaluating what the group has been doing. OurEvaluator provides an opportunity for the group to evaluate their joint efforts and to reflect on which aspects of their regulation might need to be changed for future performance.	Socially shared regulation: evaluation
S-REG tool Järvenoja et al. (2017)	This tool aims to support group members' awareness of the motivational, emotional, and cognitive states of the collaborative learning and prompts groups to activate appropriate group-level regulation to respond to the group's situational needs.	Co-regulation and socially shared regulation
EmAtool Järvenoja et al. (2018)	This tool aims to increase awareness of motivation and emotions in a given situation. The tool also helps the student become more aware of motivation and emotions, which may in turn aid the student in self-regulation	Self-regulated learning Monitoring

4 Discussion of Two Socio-emotional Regulation CSCL Tools

Because our point of interest is the agency of students in contexts outside of school without supervision, we chose to analyse in more detail the two tools that are awareness tools, provide social affordances and deal with socio-emotional regulation: *S-REG* and *EmATool*.

4.1 S-REG Tool

This tool was designed to explore how and when students enacted co-regulation and socially shared emotion and motivation regulation in collaborative learning activities. The S-REG tool prompted the group to find the most appropriate regulation strategy for a given situation. After the tool was introduced, students were instructed to use it at the beginning of each collaborative session.
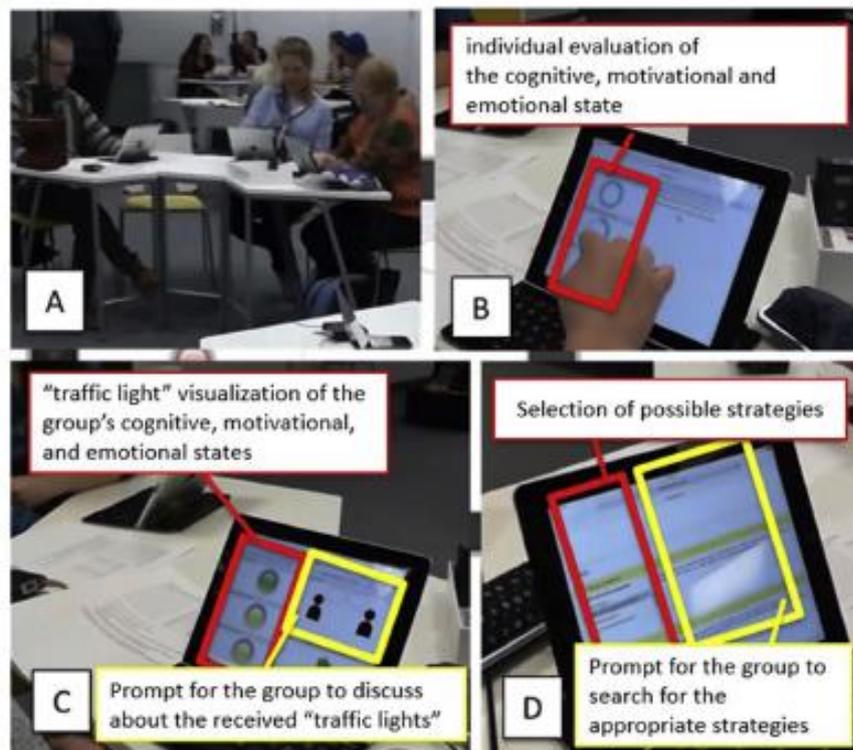

Fig. 3: The S-Reg Tool

We describe some characteristics of the tool and the experiment that we think needs further discussion:

- The tool was tested and used in phases and in a quite rigid structure that could become an obstacle to a natural, fluid collaboration among members. As we said before, students were instructed to use the tool at the beginning of each session. We think that testing the tool this way could make it become an obstacle; it was not designed to be available *when needed* by students. Thus, it does not support the process of emergent co-regulation and shared regulation.

- The tool does not fit the context of collaboration because it requires *changing attention* from face-to-face collaboration to using a screen.

- There is a traffic light indicator that represents the emotional and cognitive state of the group. If it is either red or yellow, the tool prompts the members to explain why from a list of "pre-stocked options, namely challenges." We wonder if a list of predefined options is a good way to check the emotional state of a member.

The authors imply that because the tool was used at the beginning of each collaboration session, it influenced the observed increase in co-regulation moments. The discussion of the utility of the tool concluded that the tool was "useful for creating a balanced condition for collaborative learning", but we are concerned about the limitations presented above, especially those referring to testing the tool only at the beginning of each session.

4.2   EmATool

This tool was designed for trying to raise students' awareness of their perceived emotional state and motivational goals. More precisely, the tool did that through three components: (1) an evaluation of the student's emotional states in terms of valence (negative–positive), (2) an explanation for their emotional state, and (3) the selection of their motivational goals.
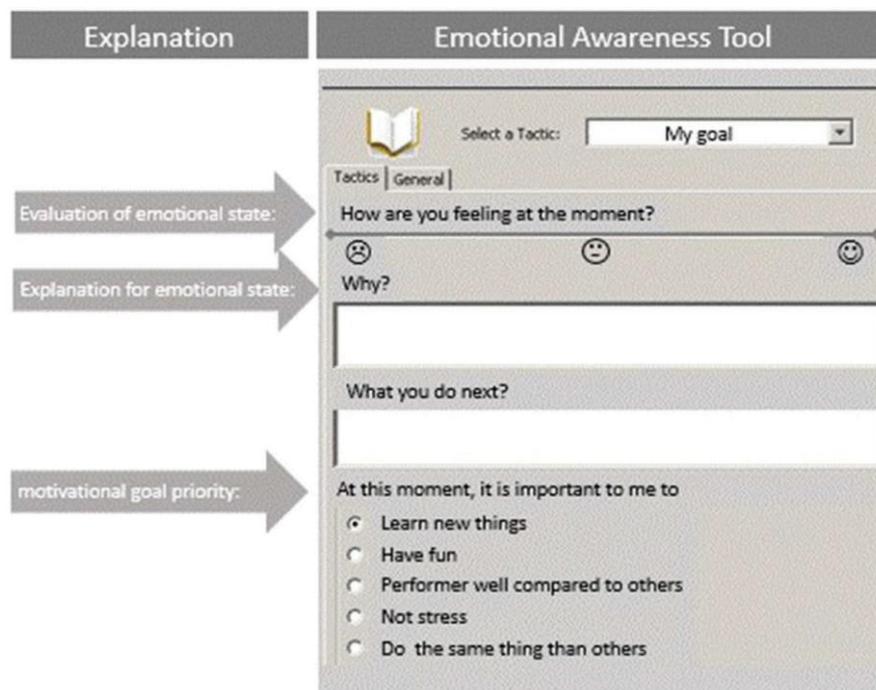

Figure 4: part of the interface of the EmATool

The emotional state of the student (1) was input on a slider from negative to positive using smiley emoticons. The explanation for that emotional state (2) was introduced by answering an open question: "Why?" The motivational goal of the moment (3) was chosen from five options: "learn new things", "have fun", "perform well compared to others", "not stress" and "do the same thing as others".

The authors considered that these three EmAtool components were enough to capture a students' situational emotion and motivation.

From the analysis offered by the authors, we hypothesize some pitfalls that could be further investigated:

- From the paper, it seems that the EmATool was also used only at the beginning of each session.

- Situational motivation was operationalized to include students' evaluations of emotional state and motivational goals at that time, but "that time" meant only the beginning of that session. From our observations (see our Illustrative Case Study section below) it appears that emotions and motivation fluctuate during collaboration as well.

- It seems to us that the tool does not cover the complexity of goals, emotions and challenges that students may encounter during collaboration. The five options to set the motivational goals seem inadequate.

- We find it difficult to report the emotional states and their fluctuation during collaboration because it requires a shift from face to face collaboration to the digital, disconnected use of the tool.

5   Conclusions of the Literature and Existing Tools Review

As we have shown in the theoretical background and in the review of socio-emotional regulation tools, there is a lack of research about social interactions and emotional regulation in spaces outside school without teacher supervision. As we will show in the following section, hybrid learning contexts are rich in socio-emotional challenges.

We have shown that the tools do not test important research (reviewed above) about regulation in collaboration. For example, they include a very small set of emotions, very few options about strategies and the integration of the tool within the flow of collaboration is very cumbersome. In general, the two selected tools have tested emotional and motivational "states" before collaboration (or at the beginning of it) in order to increase awareness. Only one of them was integrated in a CSCL tool. Furthermore, no hedonicity affordances (Kreijns & Kirschner, 2018) have been tested.

6   Observations from an HLS Activity

In this section, we observe an innovative formal–informal hybrid learning activity to explore the extent to which previous work missed tackling some socio-emotional regulation issues present in this kind of scenario.

6. 1 Context: Description of the Gymkhana Activity

This particular gymkhana has been taking place for 20 years, with around 20 high schools participating each year. It gathers approximately one thousand fourth-grade secondary school regular students (15-year-old) in groups of four. The

groups disperse around base points that have Math word problems located in the open streets of the old Jewish quarters in Seville. Students must first find these base points and locate the object of the problem in order to solve it and move forward. Students get points for the problems they solve. During the gymkhana, the groups of students work on their own, with no teacher supervision, and are free to use any resource they have in solving the problems.

6.2 Instrument, Participants and Data Analysis

Our research instrument was observations. Our aim was to obtain insights from the "life" context as it unfolded without any control over it (Baškarada 2014); Zelkowitz & Wallace, 1998). The main criteria for the observations was to document interactions and conversations about socio-emotional regulation. The data collection instruments included field notes and still pictures that were analysed concurrent with data collection (Twining et al., 2017). The field notes summarized dialogues, conversations and processes. The (58) photographs analysed recorded data about personal interactions and the context. The role of the researcher (first author) was observer-as-participant. Due to the context of the activity (being outdoors on the move) the data was analysed concurrently to collecting them (Twining et al., 2017). This real time analysis consisted on choosing to annotate just the data related to our research question.

The participants were three groups observed (A, B and C) had four members of secondary school students. Data collection took place during two rounds of the activity (the years 2018 –groups A and B– and 2019, group C). Data collection took 2.5 hours for each group A and B and 4 hours for group C. In all cases, the groups were formed on the basis of previous friendships; teachers were not involved in group formation.

In order to analyse the data, a *thematic analysis* approach (Braun & Clarke, 2006) was used to identify, analyse and report on patterns (themes) in the collected data. The observation notes were reviewed, looking for examples of socio-emotional regulation. We chose two examples based on how roles emerge in the context of our study.

7 Illustrative Examples of Socio-emotional Issues in HLS

As we noted in the Introduction, we will now show that the hybrid learning context of these examples (students collaborating on their own, outside school, mixing formal and informal learning) demands regulatory awareness and skills anywhere, anytime during collaboration. To begin with, we introduce an example of how emergent roles determine social interactions (and performance) during group work. The second case describes unresolved socio-emotional issues within a group due to a lack of awareness and a lack of an emotional regulation strategy or solution.

7.1 Example 1: Emotional Implications of Roles

The roles that emerged were tightly connected to the tasks they had to perform. In spite of that, in all three groups, we observed the casual emergence of leaders whose opinion counted more than the others (according to the comments of the other members, based on their better grades). This had a clear effect on the social

interactions of the group, and previous research about self-regulation has not explicitly tackled this issue. Based on the analysis of what students did and said during our observations we can briefly describe the role of the leaders of each group and how this affected the emotional dynamics of that group. The leader of one of the groups (A) was also a listening person, who was open to hearing her friends' opinions. The members of the group were very active and engaged; they kept attention and were focused. This contributed to better group dynamics; more proposals were generated, resulting in more constructive feedback and a better learning experience for the group's members. The leader of the other group (B) was somewhat reserved and did not promote much conversation. The dynamic of the group was very static, and no real collaboration was observed. The members had a positive climate and no issues, but they worked on their own and basically accepted the leader's opinions. The third leader (group C) was quite authoritarian and nothing could be done or decided without her approval.

We observed that if roles change among members of the group (like in group A), the interactions were more productive. If the roles were clearly established and fixed, the members tended to accept the opinions of the leaders and/or students who usually had better grades (groups B and C). These groups also had more trouble making decisions and had a tendency to remain blocked when the leader did not know what to do. We observed members of group C wasting a lot of time because they were all waiting for the leader to make up her mind about what to do. If they had been in class with the teacher, the teacher could have taken the initiative to unblock the group, but without her presence, the group remained passive. Could the design of a digital tool provide affordances to foster role changing?

7.2 Example 2: Roles Determine Unresolved Challenges in Emotional Regulation

Building a shared understanding of the problem was also a source of personal friction. Verbalizing how to model or approach a problem was difficult and led to misunderstandings and lost opportunities. For example, a problem about the area of a "star of David" made out of ceramics and embedded in a wall led one student to draw a model on her notebook. They all agreed about the drawing but were not able to *see* how to use it to calculate the area of the star given the area of one of the external triangles. One of the girls started to verbally explain her proposal (which was actually correct) but the others did not understand it. There were several reasons for the refusal of her proposal. First, her explanations were not entirely clear; she seemed shy, and although she tried several times, she never managed to communicate her idea. Second, she was not very self-confident, and the rest of the group had a slightly diminishing opinion of her so that they did not pay much attention to her. After a few trials, she had begun rejecting her own proposal as "nonsense". Nevertheless, a few minutes later, when the girl who played the role of the leader of the group went somewhere else and the shy girl was alone with another girl, they started to complain about the "leader" not listening and just keeping to her own proposals and opinions. Could the design of a new digital tool avoid these situations?

8   Discussion and Further Research

As we have shown from our observations, we detected that identity and emotional issues outside school without teacher supervision are inherited, at least partly, from formal class culture. Moreover, these aspects unfold more freely and openly in hybrid contexts that mix formal and informal learning outside school and there is no teacher supervision. Considering the examples of observations we just presented, we believe this situation would be very different if teachers had been present, but we have no way to assure this apart from our impressions of what we have seen in other situations when the same students were in front of the teacher.

There were few socio-emotional challenges, but they appeared *during* collaboration. When students are in an informal context (outside school without teacher supervision), we doubt that having an awareness tool at the *beginning* of the collaboration, such as those proposed by the analysed related work, would be efficient enough to help them regulate later, when they need it. Our observations suggest that future work in this vein should consider a focus on tools for integrating emotional awareness affordances that are available in the monitoring phase, *during* collaboration. Research questions would include: How important are these affordances for students? How can emotional regulation be organically integrated in an asynchronous collaboration tool so that it does not become an obstacle for usability or cognitive load? What happens if socio-emotional issues remain unresolved? What information (if any) should be made available to teachers?

We have chosen examples that show socio-emotional challenges, but during the observations, we also saw that students enjoyed the activity and had real fun. This connects with the concept of *hedonicity* (Kreijns & Kirschner, 2018) that we introduced earlier and that we did not see supported in the previous studies or with the tools.

It is our understanding that the challenges described by previous researchers (Hadwin et al., 2018) in the theoretical background do not pay enough attention to the importance during collaboration of roles that are inherited from class culture. We have shown with our examples that these are very important when students are young and are outside school without teacher supervision. This issue has been addressed in CSCL through macro scripts that assign fixed roles to students. Nevertheless, we think more effort could be put into understanding how to design for (socially) regulating emergent roles. This way, as we stated in the introduction, we are promoting students' agency, which is key in HLS (Carvalho et al. 2016; Goodyear et al. 2018).

Concerning HLS, the case observed and described in this chapter is based on an activity where digital technology was not used. However, based on our observations during the activity, we wonder how this kind of activity could be digitized. For example, how could we design technology that afforded to avoid the *failure* described in *Example 2*? Could it be allowing the possibility to send anonymous messages (text, photos or drawings) to the chat?

9   Limitations

Our data collection was limited in the number of groups observed. Although we found a few clarifying examples from three groups, more observations are needed to understand more different behaviours and reactions and shared patterns across groups. It could also be argued that being the gymkhana presented here such a specific activity, the observations and conclusions of this chapter are difficult to generalize.

Another limitation is the lack of recorded audio/video material. The decision to not record audio/video was made because the students being observed preferred not to be recorded. In order to keep the researcher in a more invisible and unobtrusive position within the group work, field notes were selected as the method of collecting data. However, we know this decision has a price in terms of the amount of data gathered, particularly related to body language and non verbal interactions.

10   Conclusion

We think we have described an area where more (designed-based) research is needed. The HLS case described in this chapter contributed to giving students freedom to open more socio-emotional issues, a sense of agency and a change in their understanding of some previously unknown *spaces* into appropriated *learning places* (Ellis & Goodyear, 2016). Not only did they discover and enjoy parts of the city previously unknown to many of them but we could say that because of the nature of the gymkhana and the problems, ordinary spaces become places as teachers and students appropriated them through the activity. This results in students acquiring a broader sense of the subject matter because they did not know math could be embedded in those things or places. We were positively impressed by their surprise ("I didn't know this could be math") and thus, by their change of perception of the topic. We think there is room for a deeper understanding and appreciation of formal school if we provide scaffolds and opportunities for students to connect it with their personal interests and motivations (Carvalho et al. 2016).

Looking into the future, our plan is to design and develop a mobile collaboration application that would include affordances for socio-emotional regulation on top of usual knowledge-building features. This app would be developed following a design based research methodology and tested to check if students improve their regulatory skills *during* collaboration (especially the monitoring and reflecting phases).

11   Acknowledgements

12   Open data, ethics and conflicts of interest

The ethics procedure followed the principles, tools and procedures for high-quality research (e.g. privacy, confidentiality, clear information, security, anonymity; Santiago-Delefosse et al., 2016; Twining et al., 2017). Consent was obtained from all participants. Anonymized data excerpts were taken from the observation notes. There are no potential conflicts of interest in the work.

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