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Co-regulations of learning in small groups of chef apprentices: when do they appear and what influences them?

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Abstract

Background: The debate around the regulation of learning has recently penetrated the domain of collaborative learning, introducing a social dimension to what was earlier seen, essentially, as a personal initiative. The present study aims at understanding the development of co-regulation episodes in the specific context of vocational education and training (VET), an under investigated domain.

Methods: This study involves 22 apprentice chefs who were asked to work in small groups on various learning activities related to their professional learning. Each group was videotaped while performing the activities; videos were then coded and analysed, through the nVivo software, on the basis of a coding scheme focussing on regulation and interaction. More specifically, we analysed the nature of the content discussed within the groups, the socio-regulatory processes and the types of interaction observed.

Results: Results showed that inquiries formulated as 'how' questions, efforts to give others explanations, as well as attempts to monitor the group's work found in high-level content co-regulation episodes significantly more often than in the other types of episodes. None of the indicators of positive or negative socio-emotional interactions could be linked to the quality of group regulation, neither in terms of level of content nor with respected to the socio-regulatory processes engaged in.

Conclusions: Possible explanations for the results are provided in line with the specificity of the context in which this study was run (initial VET). Implications for further research on these issues are discussed.

Background

The concepts of metacognition, regulation of learning and self-regulated learning (SRL) are increasingly at the centre of the scientific debate regarding learning and its effectiveness and are sometimes used interchangeably. Although initially proposed to describe individual processes (Flavell 1976; Schunk 2008; Winne 1997; Zimmerman 1989), these concepts are increasingly used in studies focussing on social, co- or shared constructions of knowledge (Boekaerts and Corno 2005; Hadwin and Oshige 2011; Meyer and Turner 2002; Puustinen and Pulkkinen 2001; Volet et al. 2009a).

In line with this trend, the present exploratory study investigates the process of regulation of learning in the context of collaborative group activities aiming at the development

of specific professional skills. In particular, we explore under which conditions collaborative learning activities can support interactions in content processing (Volet et al. 2009b). To this aim, we considered the level and quality of content processing and the quality of interaction functioning of the groups from a socioemotional perspective (Rogat and Linnenbrink-Garcia 2011). The present study is nested in the under-researched field of Initial Vocational Education and Training (VET) and is focused on adolescents working in professional situations, while other scholars have focused on university students (Volet et al. 2009b; Khosa and Volet 2014) or pupils at school (Rogat and Linnenbrink-Garcia 2011). Being embedded both at the company—where the learners work as apprentices—and at school—where they are expected to enhance their theoretical knowledge—represents a rich and inspiring challenge to reinforce their collaborative strengths in both learning locations. Thus, the processes of regulation of learning assume a challenging role in such a VET context: it represents a foundation in the collaborative locations in which the apprentices are embedded. Collaboration skills are central in VET (Lee et al. 2015); being able to work with others and to learn with and from others is inescapable, whether in an office, in a plant or in the kitchen of a restaurant. Chefs, for instance, despite being often under stress and time pressure need to co-regulate each member's contribution, to ultimately ensure the group's performance.

From self-regulated learning to social regulation of learning

The construct of *regulation* is of primary importance in the discussion of social dynamics and relationality. It has been used to explain 'individual and social processes of adaptation, engagement, participation, learning and development' (Volet et al. 2009b, p. 216).

In the early years, the studies dealing with regulation of learning focused on individual processes such as setting goals, planning steps, monitoring and controlling cognition, motivation, emotion and behaviour (Pintrich 2000; Winne and Hadwin 1998; Zimmerman 1986). Progressively, the *social* context in which the regulatory processes are embedded has acquired increasing interest. Nevertheless, it remained conceptualised for a while as an additional input to individual regulation before becoming a process that is intrinsically socially shared (Hadwin and Oshige 2011; Volet et al. 2009b). Currently, both self and social regulations are considered necessary 'to understand regulation of actual collaborative learning processes' (Iiskala et al. 2011, p. 380).

When adopting a social perspective, the concept of co-regulation must be proposed and specified. It is a multiple process in collaborative contexts where cognitive, motivational, and emotional aspects of regulation coexist (Salonen et al. 2005; Volet et al. 2009a, b). These authors suggest the existence of a continuum from individual regulation within groups to *co-regulation* as a group dynamic: the regulatory process may occur anywhere 'between situations where one individual temporarily leads by providing information or taking an informal instructional role' and 'co-regulatory metacognitive activity that involves several group members' (Volet et al. 2009b, p. 130). From a sociocultural point of view (Greeno 2006; Hickey 2003; McCaslin 2004), *co-regulation* refers to the process by which social context supports or scaffolds individual participation and learning. From a socio-cognitive perspective (Salonen et al. 2005; Vauras et al. 2003; Volet et al. 2009b), it concerns how groups of individuals as multiple self-regulating agents socially regulate each other's learning. In the recent literature, Schoor et al. (2015) suggest using the

term co-regulation to refer to a 'non-equal relationship with the purpose to scaffold for the appropriation of self-regulation, but not for cooperative and collaborative learning among peers where peer has a predominant role all the time' (p. 110).

Among the studies addressing the issue of regulation of learning within groups, a proliferation of terms regarding metacognitive and regulatory processes is present: *shared regulation* (Volet et al. 2009a), *socially shared regulation* and *socially shared metacognitive regulation* (Volet 2001; Khosa and Volet 2014; Iiskala et al. 2011; Volet et al. 2009b; De Backer et al. 2015); *socially shared metacognition* (Iiskala et al. 2004); and *social regulation* (Rogat and Linnenbrink-Garcia 2011). *Social regulation* can range from other-regulation to *socially shared regulation.* The term other-regulation is applied to situations in which a 'momentary unequal situation' arises (Volet et al. 2009b): one student temporarily predominates the group's interactions and takes the guiding role in the joint activity, in a directive or facilitative way (Vauras et al. 2003; Volet et al. 2009b; Rogat and Adams-Wiggins 2014; Khosa and Volet 2013, 2014; Schoor et al. 2015; Rogat and Adams-Wiggins 2015). The term *socially shared regulation*—it has been used interchangeably with the term *socially shared metacognition,* although the latter is more focused on the regulation of cognition—refers to those 'individuals' metacognitive processes that operate as a genuine social entity, aimed at a single objective, that is, the fully shared goal of the activity' (Iiskala 2011, p. 379). In other words, it regards all the social processes that groups use to regulate their joint work on a task (Volet et al. 2009b), independently of the level and the quality of the regulated object.

In sum, considering the proliferation and the overlapping of various terms, we chose to use: (a) the term *social regulation of learning* to refer to all the social modes of regulation—although Schoor et al. (2015) suggested using it only for non-equal relationships—and (b) the term *co-regulation* to explicitly refer to regulatory processes during cooperative or collaborative learning, in line with Volet et al. (2009b), especially to enlighten the variations and content-processing level of these processes.

Social regulation of learning in small groups

To investigate social regulation processes in learning contexts, the research on social interactions in small groups represents a precious point of reflection. In fact, literature on group work and collaborative learning has convincingly demonstrated that the quality of social interactions is a determinant factor for good performance and learning (Perret-Clermont et al. 1991; Dillenbourg 1999; Roschelle and Teasley 1995; Salomon 1993). Positive social interactions also lead to better reflection in a metacognitive sense, both on participants' own work and on the work of the group (Lin and Sullivan 2008; Rogat and Adams-Wiggins 2014). In small groups, members can live out experiences with socio-cultural elements of the activity, such as group climate, peer engagement, roles and degree of social support. Several factors can moderate and mark out the situation of the small group: individuals' dispositions, experiential backgrounds and appraisals of the situation in which the group members are involved. In this context, peers have the chance to coordinate their individual behaviours, taking into account the peculiarity of the group they belong to, and to consider 'not only cognitive but also motivational, affective and social dimensions, with an underlying assumption that each dimension may play out differently in relation to other variables of study' (Kimmel and Volet 2010, p. 451).

During collaborative learning, group members can build on each other's knowledge and provide feedback on each other's activities as well as on each others' metacognitive activities (Lin and Sullivan 2008). The role of metacognition in small groups seems to be quite clear: 'it is to structure the cognitive processes and the co-construction of knowledge in the activity between individuals and to monitor and control the learning processes of the individual group members' (Molenaar et al. 2010, p. 1727).

Collaborative work groups are recognized as important contexts of regulation development: they do not represent contexts of occurrence of individual regulation only but also social regulatory processes (Grau and Whitebread 2012; Goos et al. 2012; Iiskala et al. 2004). In line with this, De Backer et al. (2015) showed how reciprocal peer tutoring interventions positively influenced the evolution of tutee-prompted co-regulation and socially shared metacognitive regulation.

Social regulation of learning and socioemotional interactions

As the present study investigates the challenging combination of individual and social processes in dynamic and interactive contexts, we combine (1) the framework proposed by Volet et al. (2009a), focussing on the identification of socially regulated episodes and the recognition of content interaction level, and (2) the framework proposed by Rogat and Linnenbrink-Garcia (2011), to analyse socioemotional interactions among peers within group and regulatory processes.

The reasons to combine these two frameworks are different. Specifically, we want to explore whether the model proposed by Volet and colleagues—which has been developed within the higher education context—can also be useful and usable in VET and among adolescents interacting in professional conditions. Furthermore, we consider that (a) in most professions teamwork is important, but can be influenced by social interaction factors and especially socioemotional aspects raised when having to cooperate in a common problem solving task; this is especially true with adolescents, who may be more "spontaneous" than adults in their reactions; (b) personal engagement of the members of a group in a joint effort may also be very different around adolescence. Taken together, these two arguments brought us to look for a model that takes into account these socioemotional aspects of group work: we found that the Rogat model is the more relevant to evoke here.

We claim that the integration of these frameworks can support an integrative perspective aimed at examining social regulation of learning not only at the content level of verbal regulation among group members but also at the processes regulating the group's engagement and the emotional aspects of interactions. In other words, the importance of examining variations in the quality of the social regulation content—supported by Volet and colleagues—among the members of the same group engaged in a learning context is nicely complemented by the examination of the use of specific cognitive processes (such as planning and monitoring), as well as with the consideration of specific socioemotional components of any social interaction, which have been shown by Rogat and Linnenbrick-Garcia as potential promoters or hinderers of regulation between members of the same group.

Concretely, the first framework combines two continuous dimensions: social regulation of learning and content processing. In that framework, social regulation suggests a

continuum from individual regulation (within group), which can occur where only one person is speaking with only minor, non-verbal, inclusion from others, to co-regulation (as a group), which corresponds to episodes where more than one person contributes to the discussion and its regulation. The content-processing continuum concerns the mental activities invested to develop content knowledge; this goes from low-level content up to high-level content processing. Low-level content consists of acquiring information and sharing personal ideas, experiences or details related to the task or the management of the procedure, without any particular mental effort. High-level content refers to the concrete co-construction of meaningful knowledge and learning. As a result of these intersections, four dominant types of regulation processes can be distinguished: (1) high-level content individual regulation; (2) low-level content individual regulation; (3) high-level content *co-regulation*; and (4) low-level content *co-regulation*. The discussion of high-level content *co-regulation* episodes, displayed in small-group activities, is at the centre of the present study. Additionally, Volet et al. (2009a) identify those factors that sustain group engagement in high-level co-regulation and contribute to improve the quality of regulation, such as asking questions or giving explanations. In their view, these factors possibly contribute to initiating or to maintaining high-level content co-regulation episodes in real-time dynamics. Questions aimed at stimulating constructive reactions of the peers within the group, as well as attempts to introduce explanations for what the group is experiencing, seem to facilitate the co-construction of knowledge and to allow the peers to reflect and verbally explain in concrete terms what they think.

The second framework, borrowed from Rogat and Linnenbrink-Garcia (2011), suggests investigating social regulation of learning within a group through (1) the processes regularly used to regulate one's cognition, underlying interventions aimed at monitoring and planning or behavioural engagement to regulate the group's conceptual understanding, and (2) the identification of socioemotional interactions. The authors identify both positive socioemotional interactions, such as active listening and respect, as well as attempts to include other members in the discussion and stimulating group cohesion, which are supposed to support group functioning, and negative socioemotional interactions, such as discouraging participation in the discussion of one of the group members, as well as indicators of disrespect or of low group cohesion, which supposedly undermine harmonious group functioning. In general, exploring the role of positive and negative socioemotional interactions within a group could be interesting to see how they can support and encourage—or not—the whole group's functioning. On the one hand, positive socioemotional interactions can also support help-seeking in group contexts; on the other hand, negative consequences for the overall quality of co-regulation process—and learning opportunities—could arise when students do not respect one another or present obstacles to others' contributions to discussion (Kempler and Linnenbrink 2006).

Research questions of the present study

The focus of this study is the analysis of *co-regulation* by apprentices, solving in small groups of three or four members specific problems directly related to situations they'll have to face in their profession. As we are not interested in measuring any learning outcomes, nor in individual or group professional content acquisition, but rather in the analysis of the regulatory processes and their link with socioemotional interactions

among group members, we have decided to analyze co-regulation episodes independently from groups. According to Iiskala et al. (2011) and to Volet et al. (2009a), social interactions within small groups can be understood in episodes. Co-regulation episodes are delimited periods of joint engagement in a socially regulated cognitive process aiming towards a common goal, result or some specific learning. Each co-regulation episode supposes the interaction of at least two members of the groups and regards a specific topic on which they are working and discussing. Such episodes can be used as first units to describe small group work. Therefore, to address the following research questions, we chose to collect and analyse utterances independently by groups to underline the strengths of co-regulation episodes.

Specifically, the current study investigated.

1. How frequently monitoring or planning issues (Rogat and Linnenbrink-Garcia 2011) can be noticed in high-level content and low-level content *co-regulation* episodes (Volet et al. 2009a);
2. Whether how questions and tentativeness of explanation could be interpreted as factors contributing to sustaining group engagement in high-level content *co-regulation* episodes;
3. Whether the socioemotional tone of interactions within a group (Rogat and Linnenbrink-Garcia 2011) affects the regulation of learning within a group. More specifically, we wanted to determine if positive socioemotional interactions triggered, more often than negative socioemotional interactions, group engagement in a high-content *co-regulation* episode.

The research questions are answered in explicit detail "Discussion" section.

Method

We chose to run the present study in an authentic VET learning setting: this brings the advantages of the explorative role towards better understanding the social dynamics of co-regulation and—of course—some inevitable limitations due to the naturalistic learning context.

Participants

The present study is framed within the Swiss dual vocational and educational training system, a context in which apprentices alternate on a weekly basis between a real workplace (where they spend up to 4 days a week) and the vocational school (about 1 day a week). This context particularity makes it possible to invoke and use at school the professional experiences lived at the workplace. Moreover, given the heterogeneity of workplaces in which apprentices do their training, having apprentices confront their experiences represents a good opportunity for teachers to engage them at school in reflecting together on professional skills and specific procedures conducted in different professional contexts.

The study involved a class of 22 apprentice chefs (4 females and 18 males, aged 17–35 years (M 19.96; SD 4.71), attending the third year of training) from a vocational centre in Switzerland. As apprentice chefs may accomplish the practical part of their

training in restaurants of very different types and levels (from top-level restaurants to simple canteens), they indeed experience very different work conditions and learn different techniques and products, as well as different ways to handle these products. While some of them are trained to work with only a few other chefs around them, others usually work within large brigades of up to 15 persons.

Learning activities in class

On various occasions over a semester, the teacher presented apprentices with learning activities of a special type. For these activities, the class was split into seven groups, mainly composed of three apprentices; all group members came from different workplaces to avoid pre-operating organizations of work. The composition of the groups was left to the teacher, with the idea of balancing types of workplaces and skills in professional procedures; the composition of the groups remained the same for all the activities.

The activities were prepared by the teacher on the same scenario. As a preparation for each of them, all the apprentices were asked to experiment individually with a specific cooking method, a special dish or a given procedure at their workplace or at home and to document it in their recipe book and their learning journal. Apprentices were given 2 weeks to work on this. When this step was completed, apprentices were presented with the central task of the activities and asked to work with the members of their group during a day at school on this task; the goal of each group, to be completed together, consisted of the production of a document containing the group's solution and comments to a problem to be solved. A description of the specific problems for each activity is presented below. The work of each group was recorded on video. Depending on the tasks and the groups, the time needed to solve the problem lasted between 1 and 2 h (per activity). Once the task was solved by all the groups, the teacher orchestrated a debriefing of each group's solution in front of the whole class (approx. 30 min).

The present study focused on two activities, structured for promoting the sharing of reflection and interactions among the peers within each group and closely based on problem-solving tasks at a certain difficult level (Iiskala et al. 2004; Vauras et al. 2003). The activities were developed as follows:

Activity 1 was a timing, organizational and management problem. Apprentices had to work on recipes regarding three different cooking methods for fish and to set up together a common timeline to have all three dishes ready to be served at the same time. To do so, group members had to (1) decide on the specific steps requested for each recipe based on the pictures they had collected during the first step of the activity, (2) write a caption for each picture they wanted to use to illustrate the various steps of each recipe, (3) make sure everybody agreed on the duration of each step and (4) place each picture with its caption along a common timeline so that all recipes would be finished at the same time. To ensure that the steps of each recipe remained clearly identifiable, the captions were written on papers of a different colour. In case of doubts regarding the exact timing of a specific step or the order to be followed, the teacher could be called upon and brought to discuss with each group their propositions.

Activity 2 was a calculation problem. Apprentices had to calculate together the cost of a whole menu; each group was left free to compose it as they wanted, choosing elements from a list prepared by the teacher and to set up a correct price for it. Throughout their

work, the groups were asked to answer different types of prompts regarding their solution. During the debriefing phase, the whole class was invited to discuss the calculation made by each group before the teacher finally presented a general formula for the calculation of a menu's price.

Data collection and coding-scheme

A video camera was placed close to each group in the classroom. The visualization of the videos, combined with the transcription of all the verbal interactions, represented a real added value for the analysis: we had the chance to fully understand and better interpret the exchanges and the interactions among the group members, making sure who the speakers were (the deliverer and the receiver members in the discussion) and the contents about which they were talking. Videos were also useful in reading group members' labial movements, helping in the comprehension of unclear discussion within the climate of a real class, where small groups were working in parallel in the same room, with a high amount of surrounding noise. All the transcriptions related to the videotapes were coded using nVivo software. Due to technical problems, one group for each task could not be analysed. Our sample thus includes 12 transcriptions (6 groups involved in each of the two activities) for a total of 18 h of group-work activities. The coding of the transcriptions covered all the portions of the text concerning the task itself; the out-of-task discussions (interchanges not related to the task or past experiences in workplaces), the information delivered by the teacher, the interactions with the teacher and/or the researchers were not included in the coding scheme.

Borrowed and adapted from Volet et al. (2009a) and from Rogat and Linnenbrink-Garcia (2011), a specific coding scheme (see Table 1) was developed for both the regulation and the interaction dimensions of the group activities.

The coding process was conducted in three consecutive steps.

First step

With the goal to identify group engagement in the social regulation of learning, the coding started at the episodic level to identify all episodes of co-regulation. As already mentioned, co-regulation episodes were defined as delimited periods of joint engagement towards a common goal. Co-regulation episodes could range from a minimum of two turns of conversation to several consecutive turns and involved at least two members of a group, most often however all of them.

Altogether, the socio-regulatory episodes coded represent a large proportion of the text transcribed: they cover 75.53% in activity 1 and 67.87% in activity 2.

Each co-regulatory episode was also coded as either high- or low-content episode on the following basis. In high-level content co-regulation episodes, several group members contribute to a concrete co-construction of knowledge regarding the activity content. Such episodes involve utterances contributing to elaborating, reasoning, building on, linking ideas, explaining in one's own words, or seeking help for understanding (see two examples of high-level content co-regulation episodes in Additional file 1: Appendix S1). In contrast, in low-level content co-regulation episodes, members of the group contribute verbally to the discussion directed to address the task outcome, but only for sharing ideas about the way the task should be accomplished, or informing their partners on what they are currently

Table 1 Adapted coding scheme, inspired by Volet et al. (2009a) and Rogat and Linnenbrink-Garcia (2011)

Regulation of learning	
Types of episodes (Volet et al. 2009a)	
Low-level content co-regulation	Content-processing episodes represented clarification of basic facts
	Multiple group members made verbal contributions. Sharing ideas, only; verbal interaction related to the 'logistic' accomplishment of the task
High-level content co-regulation	Content-processing episodes referred to engagement in elaborating, reasoning, building on or linking ideas, explaining in one's own words, or help seeking for understanding
	Multiple group members made verbal contributions. Real co-construction of the knowledge
Factors contributing in sustaining group engagement in high-level co-regulation episodes (Volet et al. 2009a)	
Tentativeness of explanation	Direct and indirect tentativeness to explain what they are thinking, motivating the choices;
Questions	Sub-categories: Confirmation (request of confirmation and/or approval), Clarification (request of details), Task question (related to the concrete and logistic organization and accomplishment of the task), How question (request of explanations to better understand, ways to solve a problem, sharing ideas to solve)
Group efforts to regulate their conceptual understanding, task work, and engagement (Rogat and Linnenbrink-Garcia 2011)	
Planning	Reading and interpreting task directions, designating task assignments, discussing how to go about solving the problems; role division; something related to the future
Monitoring	Evaluating content understanding, the shared product, assessing progress, or evaluating the missing part to complete the task. Considerations on the task they are accomplishing; tentativeness to elaborate a state of the art of the situation
Interaction	
Positive socioemotional interactions (Rogat and Linnenbrink-Garcia 2011)	Group interactions that support and encourage harmonious group functioning
Inclusion	Attempting to encourage the sustained involvement and contributions of group members through positive feedback and asking for everyone's ideas; asking peers to *remain in the task;* asking the peers to be included
Group cohesion	Conveying that the group functions as a team (rather than as individuals) by working together, referring to the group as 'we'
Negative socioemotional interactions (Rogat and Linnenbrink-Garcia 2011)	Group interactions that undermine harmonious group functioning
Discouraging participation	Undermining a group member's task contributions by criticizing her/his work, not assigning him/her a portion of the task, ignoring their feedback or questions, ignoring a group member completely
Disrespect	Putting down a member of the group, grabbing papers away without permission, swearword addressed to a member of the group

doing. Although they can be oriented towards all possible aspects of the assigned task, low-level content episodes do not contribute to the learning of a specific topic; they simply include sentences and expressions discussing a given step within the procedure (see two examples of low-level content co-regulation episodes in Additional file 1: Appendix S1).

Second step

Once all the episodes of *co-regulation* were identified and coded, the attention moved to the occurrence of the different types of processes. More specifically, we identified: (1) 'tentativeness of explanation', (2) various types of 'questions' (such as confirmation questions, clarification questions, task questions, how questions), (3) 'planning' and (4) 'monitoring'. The process of 'behavioural engagement' showed so infrequently in our data that we decided not to keep it in our analysis.

We also distinguished both positive and negative 'socioemotional interactions'. The positive interactions implemented in the current study were 'inclusion' and 'group cohesion'; the 'active listening' was difficult to prove, as explicit messages of active listening are not clearly readable or visible during the productive group work.

Concerning the negative socioemotional interactions, we considered categories named 'discouraging participation' and 'disrespect'. The original 'low group cohesion' category was not consistently identifiable, in contrast with the positive group cohesion. Other proposed categories (collaborative interactions and non-collaborative interactions) were not used so as not to overlap with the previous distinction (see "First step"). For socioemotional indicators, the coding procedure was not limited to mere verbatim transcript and was extended to the behaviours visible on the video.

Examples of the coding scheme application are presented in Additional file 1: Appendix S1.

Third step

Having identified all these types of processes ("Second step"), we tried to see whether their distributions differed in the various types of episodes identified in the first step, especially in the high-level content *co-regulation* and in the low-level content *co-regulation* episodes. The SPSS statistical package was used to test for the presence of differences between the various types of episodes.

Inter-judge reliability

An interrater reliability analysis concerning the coding scheme was performed by two interdependent researchers (the first and the second author) to determine consistency among raters and to secure its quality. A double coding of 20% of the corpus was conducted, randomly extracted from the videotapes (all the groups, in both activities). The boundaries of the *episodes* to be double-checked were previously set based on the proposition made by the first rater. The inter-rater agreement statistic showed an excellent level of agreement between the two raters (Cohen's $\kappa = 0.972$). Both judges then engaged together in the refinement of the coding scheme to clarify ambiguities in a way that both coders could agree upon.

Results

Analysis of co-regulation episodes

Due to our interest in conditions for the occurrence of *co-regulation* (and not in the functioning of each single group), as well as in co-occurrences of processes mentioned (and not in group performances), we considered the whole corpus of utterances globally, and we analysed the content of verbal interactions without distinguishing it by group.

Table 2 Distribution of categorical variables over co-regulation episodes, both high-level and low-level

	Tentativeness of explanation (%)	Questions (%)	Type of questions				Planning (%)	Monitoring (%)
			Clarification questions (%)	Confirmation questions (%)	Task questions (%)	How questions (%)		
High-level content co-regulation	32.2	67.8	26.8	14.6	18.7	39.9	50.6	49.4
Low-level content co-regulation	9.2	90.8	34.9	14.7	26.6	23.9	67.0	33.0

The distributions were calculated considering the categories as follows: the contributing factors (tentativeness of explanation and questions), for a total number of 292 in high-level content episodes and 120 in low-level content episodes; the distributions were also calculated within the questions, considering the subcategories, for a total number of 198 in high-level content episodes and 109 in low-level content episodes. Planning and monitoring, for a total number of 156 in high-level content episodes and 91 in low-level content episodes

In other words, the unit of analysis was set at the level of the *episodes* of co-regulation in searching for the relative frequencies of different types of processes in high- and low-level co-regulation episodes.

The first step of our analysis revealed a total of 305 *co-regulation* episodes; 175 of them were high-level content, for a total number of 3661 turns of interaction, while the remaining 130 were low-level content episodes, for an overall 2069 turns of interaction. Step two of our analysis showed that the distribution of processes was far from being normally distributed. We therefore recoded the real variables into categorical variables, so the data would show the mere presence or absence of a given code in each specific episode, no matter how many times they appeared in a same episode.

Distribution of all the variables over high-level and low-level co-regulation episodes

A preliminary Chi square test revealed significant associations between types of episodes (high- and low-level content co-regulations) and such processes as monitoring ($\chi^2 =$ (1) 14.34, $p < .001$), tentativeness of explanation ($\chi^2 =$ (1) 67.66, $p < .001$) and how questions ($\chi^2 =$ (1) 20.88, $p < .001$). Thus, tentativeness of explanation, how questions, planning and monitoring, as shown in Table 2, were differently distributed across the two types of co-regulation.

In high-level co-regulation episodes, questions (68%) and tentativeness of explanation (32%) were frequent; in low-level content episodes, questions were very frequent (91%) while tentativeness of explanations were rather infrequent (9%). With respect to the types of questions, how questions were the most frequent (40%) in high-level co-regulation episodes, followed by clarification questions (27%), task questions and confirmation questions (18 and 15%, respectively), whereas in low-level co-regulation the clarification questions were the most frequent (34%), followed by task and how questions (27 and 24%, respectively), with confirmation questions again closing the ranking (15%). Although confirmation questions were found in equivalent proportions in the two types of episodes, the other three processes clearly differed from type to type. Finally,

planning and monitoring codes turned out to be equally frequent (50% each) in the high-level content episodes; within the low-level content episodes, on the contrary, monitoring codes were only half as frequent as the planning codes.

Table 3 illustrates the distribution of socioemotional interaction indicators. The Chi square test did not reveal any significant association with types of episodes, thus revealing that socioemotional indicators were evenly distributed across high-level and low-level content co-regulation episodes.

Differences and relationship between high-level and low-level co-regulation episodes

To examine any differences between the two types of episodes, a Mann–Whitney test was run. The test revealed, however, that the two types of episodes only statistically differ with respect to the frequency of tentativeness of explanation, how questions and monitoring (see Table 4). One of the two negative socioemotional indicators, named disrespect, was more frequently related to low-level than to high-level content episodes, but the difference was not significant ($p = 0.067$).

Several relationships appeared between the nature of socioemotional interaction processes and forms of regulations. A Spearman's non-parametric correlation analysis showed that positive and significant correlations were more frequently attached to positive socioemotional interactions than to negative ones, both in high- and low-level content *co-regulation* episodes. However, only three correlations for positive socioemotional interactions and two for negative socioemotional interactions were significant.

Table 3 Distribution of socioemotional indicators (categorical variables) in both types of co-regulation episodes

	Positive		Negative	
	Inclusion (%)	Group cohesion (%)	Discouraging participation (%)	Disrespect (%)
High-level content co-regulation	22.0	58.5	11.6	7.9
Low-level content co-regulation	21.4	53.0	10.3	15.4

Table 4 Mann–Whitney test between high- and low-level content co-regulation episodes

	U	Z	*p value*	Effective size
Tentativeness of explanation	6227.5	−8.212	0.000	−.47
Questions				
Clarification questions	11,255.0	−0.199	0.842	−.01
Confirmation questions	10,890.0	−1.037	0.300	−.06
Task questions	11,242.5	−0.244	0.807	−.01
How questions	8515.0	−4.563	0.000	−.26
Planning	11,172.0	−0.308	0.758	−.02
Monitoring	8995.0	−3.780	0.000	−.22
Positive socioemotional inclusion	11,222.5	−0.289	0.773	−.02
Positive socioemotional group cohesion	10,560.0	−1.236	0.216	−.07
Negative socioemotional discouraging participation	11,190.0	−0.464	0.643	−.03
Negative socioemotional disrespect	10,645.0	−1.831	0.067	−.10

Specifically, within high-level content *co-regulation* episodes (see Table 5), group cohesion was significantly correlated with tentativeness of explanations ($r_s = 0.194$, $p = 0.010$), planning ($r_s = 0.154$, $p = 0.042$) and monitoring ($r_s = 0.203$, $p = 0.007$). The other positive socioemotional indicator, *inclusion,* was significantly correlated with clarification questions ($r_s = 0.157$, $p = 0.038$) and task questions ($r_s = 0.325$, $p = 0.000$). No significant correlations with negative socioemotional variables appeared, whether negative or positive.

In contrast, in low-level content *co-regulation* episodes, significant correlations appeared with respect to negative socioemotional indicators: discouraging participation was significantly correlated with planning ($r_s = 0.233$, $p = 0.008$), and disrespect was correlated with monitoring ($r_s = 0.256$, $p = 0.003$). Such correlations between negative socioemotional variables and planning and monitoring need to be more deeply examined in further research to understand their real meaning. A possible explanation of such a link could be found in the nature of low-level content episodes: apprentices, deep in their teens, tend to exchange turns of talk without much verbal care for others, intensifying the slang normally used by adolescents (Deppermann and Schmidt 2000). Significant correlations were also seen with respect to positive socioemotional indicators: group cohesion was significantly correlated with task questions ($r_s = 0.228$, $p = 0.009$) and planning ($r_s = 0.306$, $p = 0.000$); inclusion was significantly correlated with task questions ($r_s = 0.207$, $p = 0.018$), in that apprentices attempted to involve the group members, especially regarding the accomplishment of the task.

Identifying predictors of high-level co-regulation episodes

Finally, a logistic regression was conducted to predict high-level *co-regulation* episodes. The results showed that how questioning and explaining interventions, as well as monitoring, were predictors of high-level *co-regulation* episodes ($R^2 = 0.282$. Model $\chi^2 = (1)$ 100.84; see details in Table 6). Looking at the odds ratio, tentativeness of explanation, how questions and monitoring had a significant and strong effect on the type of *co-regulation* generated, being, respectively, 11.483, 2.515, and 3.168 times higher, in high-level content *co-regulation* episodes than in low-level ones.

Globally, the logistic regression identified predictors of high-content *co-regulation* episodes in how questions, tentativeness of explanations and monitoring, which also emerged through the Mann–Whitney test, Chi square tests and Spearman's non-parametric correlations.

However, the existence of links between patterns of interaction and the type of *co-regulation* cannot be excluded; indeed, non-parametric correlations showed associations between interaction and regulation variables, even if only two correlations for negative and three correlations for positive socioemotional interactions for the low-level episodes are shown. The only marginal, but not significant, difference for one of the two negative interactions was disrespect.

Discussion

The current study aimed to investigate the *co-regulation* of learning in small-group contexts, where collaborative cognitive activities based on group problem-solving cases are foreseen. It contributes to extend to the VET context, prior research focussing on social

Table 5 Spearman's non-parametric correlations between regulation and interaction in the two types of episodes

	High-level co-regulation episodes							Low-level co-regulation episodes						
	Tentat. explanation	Clarification. question	Confirmation question	Task question	How question	Planning	Monitoring	Tentat. Explanation	Clarification question	Confirmation question	Task question	How question	Planning	Monitoring
Group cohesion	0.194*	0.048	0.126	0.020	0.131	0.154*	0.203**	0.042	−0.140	0.017	0.228**	−0.015	0.306**	0.025
Inclusion	0.047	0.157*	0.114	0.325**	0.078	0.021	0.005	0.062	0.116	0.114	0.207*	0.146	−0.029	0.150
Discouraging participation	−0.008	−0.070	0.091	−0.046	0.016	0.126	0.098	−0.097	−0.088	−0.039	0.021	0.106	0.233**	0.141
Disrespect	−0.087	0.050	0.108	0.067	0.093	0.050	0.144	−0.122	−0.013	0.53	−0.001	0.022	0.159	0.256**

* $p < 0.05$, ** $p < 0.01$

Table 6 Results of logistic regression of questions, explanations, planning, monitoring and socioemotional dimensions of high-level *co-regulation* episodes

	B (SE)	Odds ratio	Lower confidential interval 95%	Upper confidential interval 95%
Tentativeness of explanation	2.441 (0.437)	11.483**	1.796	3.485
Question				
Clarification question	−0.297 (0.349)	0.743	−1.063	0.334
Confirmation question	−0.458 (0.501)	0.633	−1.473	0.522
Task question	0.198 (0.416)	1.218	−0.642	1.010
How questions	0.922 (0.345)	2.515**	0.296	1.678
Planning	−0.360 (0.333)	0.697	−1.056	0.225
Monitoring	1.153 (0.340)	3.168**	0.579	1.937
Positive socioemotional inclusion	−0.221 (0.430)	0.802	−1.112	0.633
Positive socioemotional group cohesion	−0.053 (0.325)	0.949	−0.709	0.582
Negative socioemotional discouraging participation	0.303 (0.509)	1.354	−0.615	1.361
Negative socioemotional disrespect	−0.765 (0.486)	0.453	−1.893	0.077

** $p < 0.01$

regulation episodes (Järvelä and Järvenojä 2011; Vauras et al. 2003; Volet et al. 2009a) and analysing the relationship between regulation and interaction variables. Combining the use of two frameworks (Volet et al. 2009b; Rogat and Linnenbrink-Garcia 2011) to analyse group functioning in authentic settings allows for a more thorough understanding of how the quality of regulation processes can be shaped by the socioemotional aspects necessarily at play when humans interact in (as close as possible to) natural conditions. Several interesting observations can be made on the basis of our data and in line with the research questions which guided the study.

The first research question was related to the occurrence of monitoring and planning issues in high-level content and low-level content co-regulation episodes. We found that monitoring (Rogat and Linnenbrink-Garcia 2011) was well related to high-level content *co-regulation* episodes (Volet et al. 2009a), as shown by (1) the distributions of the codes, (2) the comparison with low-level content *co-regulation* episodes (Mann–Whitney test), and (3) a logistic regression, which identified monitoring as one significant predictor of high-level content *co-regulation* episodes. Clearly, apprentices monitored each other not only to check propositions and suggestions made by their peers but also to evaluate their quality and reliability. In our protocols, we found evidence that they (1) verified the feasibility of the propositions offered by the peers ('*my friend, if you calculate in grams, you cannot get results in kilos*'), so that the peers became aware of their potential mistakes ('*Ah damn!!! It's true!*'); (2) checked what they had already produced ('*Oh no! I have to butter the timbale before!*') or what was still missing ('*Here, what is still missing to do?*'); (3) suggested alternatives ('*You should put this picture here …*'); and (4) confirmed and supported members' suggestions ('*The cabbage, the onions and the tagliatelle … yes it could be ok!*'). Planning was frequent within both high-level and low-level content *co-regulation* episodes, so it does not make a difference to our interpretation. Our protocols show that planning was used to suggest task assignments, discuss how to proceed or

suggest ways to continue the task or solve the problem ('*You have to leave it in grams*'; '*However, you have to calculate in grams: you have to*').

The second research question concerned the role of how questions and tentativeness of explanation in sustaining group engagement towards high-level content co-regulation episodes. Data showed that tentativeness of explanation and how questions were significant contributing factors (Volet et al. 2009a) to high-level content *co-regulation* episodes. Wherever high-level content *co-regulation* episodes were observed, such codes were highly frequent, while they rarely appeared in the low-level content episodes. We found them primarily when group members debated to find a better solution or to co-construct knowledge and meanings, argued about their own certainty or questioned a peer's interpretation to understand better how to continue on a specific problem. In particular, how questions seemed to play a crucial role: they served as requests for a better understanding of the coherence or the relevance of the group's solution or as triggers for a thorough discussion on how to proceed towards the solution of the problem. In other words, they were not simply requests for clarification or confirmation, but requests for explanations or opinions about important strategic decisions to be made by the group ('*What do you think about the beets?*'). With *tentativeness of explanation,* apprentices tried to furnish a theoretical support to their own idea ('*Yeah, but also with gnocchi, it's ok. The vegetables are ok with rice and cornmeal mush, too*') or to give an explanation about the next step to do ('*We have to divide by 10 because this dish is for 10 persons*').

The third research question aimed to explore the relationship between the socioemotional tone of interactions and the regulation of learning within a group, paying particular attention to positive or negative socioemotional interactions and their possible effect on group engagement in high-content co-regulation episode. Non-parametric correlations identified interesting associations between the variables considered, while the logistic regression did not: no socioemotional indicator came out among the predictors of high-level content *co-regulation* episodes. Positive interactions, in particular, did not seem to be a condition for the emergence of high-level content *co-regulation* episodes. In several cases, we found evidence of good collaboration (high-level content), despite the presence of negative socioemotional expressions involving discouraging participation ('*He ignores what he reads; listen to me, beautiful guy, you know you come and say…*') or disrespect ('*Go back to your hibernation so that we can hurry on*'). It is likely that because they are used to working under time pressure and in stressful situations, apprentice chefs no longer react negatively to disrespect or impolitely formulated requests. But adolescence may also be an explanation for such apparent insensitivity to negative comments (Martin et al. 2012); at this age, discussions and interactions often include terms that would be considered offensive by adults, not by adolescents. Particularly, using disrespectful expressions in language should not be understood as disrespect; an important distinction needs to be observed between serious and playful disputes. As Deppermann and Schmidt (2000, p. 156) note, verbal duelling represents 'only one conversational practice among various ways of speaking aggressively that are common in male juvenile peer-groups'. In contrast, the presence of positive interactions seems to be difficult to attest beyond the case of group cohesion, which was often signalled in the verbatim transcript by the use of 'we'. In fact, during productive group work, behaviours as simple as active listening might already be the result of positive interactions.

Conclusions

Studies on how groups regulate their learning in joint problem solving tasks are quite rare yet and none of them deals with VET. The present study is only a first explorative study on how learners co-operate while solving in small groups tasks related to their professional domain. We have tried to summarize the strengths and weaknesses of this explorative study in the following five points.

First, the authentic setting in which the study was conducted, i.e., a real vocational school, has both advantages and disadvantages; it implies close collaboration with teachers to elaborate and implement interesting learning scenarios and a good relationship with the apprentices involved. Logistic and real obstacles were also encountered without any possibility of controlling all of the variables; for example, the composition of the small groups during the learning activities and their position in the classroom, as well as the presence of our cameras, might well have affected the tone of their interactions. Such a close relationship with the teacher and apprentices offered the opportunity to obtain confirmation that the activities provided were interesting and challenging enough to cause them to forget the somewhat artificial and show-like situation in which they were put.

Second, the coding process deserves some consideration: according to Volet et al. (2009a), *co-regulation* episodes can be identified when at least two members are interacting/co-regulating, and this means that the involvement of the whole group is a necessary condition. A lack of participation—by one or more members—can be interpreted in a double way: on the one hand, it can have no influence on the way how the other two members interact; on the other hand, although no mention of explicit exclusion may be given, it can affect the functioning of the whole group, perhaps becoming an obstacle in co-regulation. The attempt to analyse each member's intervention deserves a particular and deeper attention in the investigation of the forms of regulation within the group.

Third, as the focus of our work was not to contrast the way specific groups function—they certainly differ in their functioning—but to identify regularities in human interactions when students are asked to work in groups, we opted to consider the data collected as a unique corpus of verbal interactions even though the utterances were produced by different groups. Of course, analysing co-regulation at the group level and contrasting the way it proceeds according to group specificities, using, for instance, multilevel analysis, is an interesting question, but it would need to be applicable with more groups than what we had at our disposal.

Fourth, incorporating in the data set, in a more detailed way, all the non-verbal behaviours of the group members might offer further possibilities for analysing the regulating dynamic. Understanding how *co-regulation* connects to interactions within a group is an intriguing but difficult task that will definitely need more empirical attention, especially in accordance with the evolution of studies and the proliferation of new ways to describe, investigate and interpret regulatory processes in social contexts.

Finally, the introduction of further coding based on socially shared regulation and *other-regulation* could represent a new key to simultaneously investigate regulatory processes and socioemotional interactions. It would be important to further investigate how the group co-regulates learning depending on the role each member plays within the group. Such specific and detailed analysis of the interactions within the group, run at the

individual level, represents a further issue to be accurately addressed for all the groups involved in the current study, per activity they attended. In this way, we could identify and analyse each single individual contribution, moving the level of the unit of analysis from the *episode* to the individual.

In short, the present paper contributes to enlarge the body of studies on co-regulation of learning to the specificity of the VET format. Up to now, studies on this issue had been conducted in elementary schools or in higher education (Volet et al. 2009b; Iiskala et al. 2004, 2011; Rogat and Linnenbrink-Garcia 2011; Rogat and Adams-Wiggins 2014; Khosa and Volet 2013). On the one hand, the present study confirms for the VET context at least two observations made in the previous studies in other contexts: the relevance of cognitive processes such as planning and monitoring in regulatory processes (Rogat and Linnenbrink-Garcia 2011; Rogat and Adams-Wiggins 2014) and the role of tentativeness of explanation and questions in initiating or maintaining high-level content co-regulation episodes (Volet et al. 2009b). On the other hand, despite our hypothesis, we found no significant influence of socioemotional factors on the regulation processes despite some positive correlations. Further research with other activities, other professions and more groups involved would allow a deeper analysis of this topic. Promoting collaborative problem-solving activities in initial VET programs can support not only the development of collaborative skills, so essential in professional daily life but they also contribute to improve the quality of apprentices' learning.

Additional file

Additional file 1: Appendix S1. Examples of co-regulations episodes and coding of regulatory and socio-emotional interactions.

Authors' contributions
EM, AC and J-LG had an active part in the final manuscript. All authors read and approved the final manuscript.

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References

Boekaerts M, Corno L (2005) Self-regulation in the classroom: a perspective on assessment and intervention. Appl Psychol Int Rev 54(2):199–231. doi:10.1111/j.1464-0597.2005.00205.x

De Backer L, Van Keer H, Valcke M (2015) Exploring evaluations in reciprocal peer tutoring groups' socially shared metacognitive regulation and identifying its metacognitive correlates. Learn Instr 38:63–78

Deppermann A, Schmidt A (2000) Disrespecting: a conversational practice for the negotiation of status in juvenile peergroups. In: Nemeth E (ed) Pragmatics in 2000: selected papers from the 7th international pragmatics conference, vol 2. International Pragmatics Association, Antwerp, pp 156–164

Dillenbourg P (1999) What do you mean by collaborative learning?.In: Collaborative-learning: cognitive and computational approaches. pp 1–19

Flavell JH (1976) Metacognitive aspects of problem solving. The nature of intelligence, Erlbaum

Goos M, Galbraith P, Renshaw P (2012) Socially mediated metacognition: creating collaborative zones of proximal development in small group problem solving. Educ Stud Math 49(2):193–223
Grau V, Whitebread D (2012) Self and social regulation of learning during collaborative activities in the classroom: The interplay of individual and group cognition. Learn Instr 22:401–412
Greeno JG (2006) Learning in activity. In: Sawyer RK (ed) The Cambridge handbook of the learning sciences. Cambridge University Press, New York, pp 79–96
Hadwin AF, Oshige M (2011) Self-regulation, co-regulation, and socially shared regulation: exploring perspectives of social in self-regulated learning theory. Teach Coll Rec 113(2):240–264
Hickey DT (2003) Engaged participation versus marginal nonparticipation: a stridently sociocultural approach to achievement motivation. Elem Sch J 103(4):402–429
Iiskala T, Vauras M, Lehtinen E (2004) Socially-shared metacognition in peer learning? Hell J Psychol 1:147–178
Iiskala T, Vauras M, Lehtinen E, Salonen P (2011) Socially shared metacognition of dyads of pupils in collaborative mathematical problem-solving process. Learn Instr 21:379–393
Järvelä S, Järvenojä H (2011) Socially constructed self-regulated learning and motivation regulation in collaborative learning groups. Teach Coll Rec 113(2):350–374
Kempler TM, Linnenbrink EA (2006) Helping behaviours in collaborative groups in math: a descriptive analysis. In: Karabenick SA, Newman RS (eds) Help seeking in academic settings: goals, groups and contexts. Lawrence Erlbaum Associates, Mahwah, pp 89–115
Khosa DK, Volet S (2013) Promoting effective collaborative case-based learning at university: a metacognitive intervention. Stud High Edu 38(6):870–889
Khosa DK, Volet S (2014) Productive group engagement in cognitive activity and metacognitive regulation during collaborative learning: can it explain differences in students' conceptual understanding? Metacognition Learn 9:287–307
Kimmel K, Volet S (2010) Significance of context in university students' (meta) cognitions related to group work: a multilayered, multi-dimensional and cultural approach. Learn Instr 20:449–464
Lee D, Huh Y, Reigeluth CM (2015) Collaboration, intragroup conflict, and social skills in project-based learning. Instr Sci 43(5):561–590
Lin XD, Sullivan FR (2008) Computer contexts for supporting metacognitive learning. In: Voogt J, Knezek G (eds) The international handbook of information technology in primary and secondary education. Springer, New York, pp 281–298
Martin CE, Houston AM, Mmari KN, Decker MR (2012) Urban teens and young adults describe drama, disrespect, dating violence and help-seeking preferences. Matern Child Health J 16(5):957–966
McCaslin M (2004) Coregulation of opportunity, activity, and identity in student motivation. In: McInerney D, Van Etten S (eds) Big theories revisited, vol 4. CT Information Age, Greenwich, pp 249–274
Meyer DK, Turner JC (2002) Using instructional discourse analysis to study the scaffolding of student self-regulation. Edu Psychol 37:17–25
Molenaar I, van Boxtel CAM, Sleeger PJC (2010) The effects of scaffolding metacognitive activities in small groups. Comput Hum Behav 26:1727–1738
Perret-Clermont A-N, Perret J-F, Bell N (1991) The social construction of meaning and cognitive activity in elementary school children. In: Resnick L, Levine J, Teasley T (eds) Perspectives on socially shared cognition. American Psychological Association, Hyattsville, pp 41–62
Pintrich PR (2000) The role of goal orientation in self-regulated learning. In: Boekaerts M, Pintrich PR, Zeidner M (eds) Handbook of self-regulation. Academic Press, San Diego CA, pp 451–502
Puustinen M, Pulkkinen L (2001) Models of self-regulated learning: a review. Scand J Edu Res 45(3):269–286. doi:10.1080/00313830120074206
Rogat T, Adams-Wiggins KR (2014) Other-regulation in collaborative groups: implications for regulation quality. Instr Sci 42(6):879–904
Rogat T, Adams-Wiggins KR (2015) Interrelation between regulatory and socioemotional processes within collaborative groups characterized by facilitative and directive other-regulation. Comput Hum Behav 52:589–600
Rogat T, Linnenbrink-Garcia L (2011) Socially shared regulation in collaborative groups: an analysis of the interplay between quality of social regulation and group processes. Cognit Instr 29(4):375–415. doi:10.1080/07370008.2011.607930
Roschelle J, Teasley SD (1995) The construction of shared knowledge in collaborative problem solving. In: O'Malley CE (ed) Computer-supported collaborative learning. Springer, Berlin, pp 69–197
Salomon G (1993) Distributed cognitions. Psychological and educational considerations. Cambridge University Press, Cambridge, USA, pp 111–138
Salonen P, Vauras M, Efklides A (2005) Social interaction: what can it tell us about metacognition and coregulation in learning? Eur Psychol 10:199–208
Schoor C, Narciss S, Körndle H (2015) Regulation during cooperative and collaborative Learning: a theory-based review of terms and concepts. Edu Psychol 50(2):97–119
Schunk DH (2008) Metacognition, self-regulation, and self-regulated learning: research recommendations. Edu Psychol Rev 20(4):463–467
Vauras M, Iiskala T, Kajamies A, Kinnunen R, Lehtinen E (2003) Shared-regulation and motivation of collaborating peers: a case analysis. Psychologia 46:19–37
Vauras M, Salonen P, Kinnunen R (2008) Influences of group processes and interpersonal regulation on motivation, affect and achievement. In: Maehr ML, Karabenick SA, Urdan TC (eds) advances in motivation and achievement. Social psychological perspectives, vol 15. JAI Press, Bingley, pp 275–314
Volet S (2001) Understanding learning and motivation in context: A multi-dimensional and multi-level cognitive-situative approach. In: Volet S, Järvelä S (eds) Motivation in learning contexts: theoretical advances and methodological implications. Elsevier Science, Amsterdam, pp 57–82
Volet S, Summers M (2013) Interpersonal regulation in collaborative learning activities: Reflections on emerging research methodologies. In: Volet S, Vauras M (eds) Interpersonal regulation of learning and motivation: methodological Advances. Routledge, Abingdon, pp 204–220

Volet S, Summers M, Thurman J (2009a) High-level co-regulation in collaborative learning: How does it emerge and how is it sustained? Learn Instr 19:128–143
Volet S, Vauras M, Salonen P (2009b) Self- and social regulation in learning contexts: an integrative perspective. Edu Psychol 44(4):215–226
Winne PH (1997) Experimenting to bootstrap self-regulated learning. J Educ Psychol 89:379–410
Winne PH, Hadwin AF (1998) Studying as self-regulated learning. In: Hacker D, Dunlosky J, Graesser A (eds) Metacognition in educational theory and practice. Lawrence Erlbaum, Mahwah, pp 277–304
Zimmerman BJ (1986) Development of self-regulated learning: which are the key subprocesses? Contemp Educ Psychol 11:307–313
Zimmerman BJ (1989) Models of self-regulated learning and academic achievement. In: Zimmermann BJ, Schunk DH (eds) Self-regulated learning and academic achievement: theory, research and practice. Springer, New York, pp 1–25