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Group work does not necessarily equal collaborative learning: evidence from observations and self-reports

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Abstract Situative and sociocognitive analyses were combined to examine engagement in high-level collaborative learning and its relationship with individuals' cognitions. Video footage of 53 science university students' (nine groups) collaborative learning interactions as they worked through a case-based project was analysed in combination with students' appraisals and reflections on the activity. Sizeable group differences in amount of high-level discussion of learning content were revealed. Individual high-level contributions were positively correlated with overall unit performance. Motivation at task onset predicted amount but not depth of content-related group discussion. Interviews with participants suggested that groups' divergent patterns of engagement with content could be related to different perceptions of the notion of collaborative learning. Results are discussed in terms of implications for collaborative learning research and educational practice.

Resume Des perspectives situées et sociocognitives ont été associées pour mieux comprendre l'apprentissage coopératif le plus profitable aux apprenants. Les interactions de 53 étudiants en science ont été filmées pendant qu'ils travaillaient en groupes de 5 ou 6 personnes sur une étude de cas. Ces interactions ont été analysées en relation avec les perceptions et les réflexions des participants. D'importantes différences entre les groupes ont été observées en ce qui concerne leur degré d'engagement en profondeur dans les interactions. Au niveau individuel, l'engagement en profondeur était corrélé positivement avec la performance finale de l'étudiant dans le cours en question. La motivation au début de l'activité a pu prédire la fréquence avec laquelle l'étudiant a participé à des interactions du groupe centrées sur le contenu mais pas le niveau d'engagement en profondeur. Des interviews avec les étudiants ont révélé que les divergences d'engagement en profondeur pourraient être en relation avec leurs interprétations du concept d'apprentissage coopératif. Les résultats de ces analyses suggèrent de nouvelles pistes de recherche à creuser et des idées pratiques pour l'enseignement.

Keywords Collaborative learning · Co-regulation · Group work · Situative perspective · Sociocognitive perspective

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Introduction

Collaborative learning is on the increase at all levels of education. In the university context, it is assumed that participation in group learning activities leads to the development of teamwork skills but most importantly to a better understanding of the subject matter through engagement in collaborative learning processes. To date, however, few studies have examined the assumption that students do engage in productive collaborative learning. The present study addresses this gap by examining what students actually do when working together on a group assignment. More specifically, the study investigates the nature of students' content-related interactions during student-led face-to-face meetings for a group assignment. It also aims to determine the extent to which observed patterns of productive collaborative learning are related to students' self-reported experiences and academic performance. Situative and sociocognitive perspectives are combined to frame a dual focus on patterns of engagement in collaborative learning processes at the group level, as well as individuals' experiences and appraisals of their collaborative learning activity within their group.

Group work and collaborative learning are not synonymous

Alongside universities' increasing emphasis on group work, there is a growing body of theoretical and empirical literature on 'collaborative learning'. Although this term has often been conflated with group work in general, the collaborative learning literature (Dillenbourg 1999; Roschelle and Teasley 1995) suggests that group work does not necessarily entail students learning collaboratively. A basic pre-requisite for collaborative learning is that students engage with the substance of the learning task (i.e. the content to be understood or the problem to be solved) *together*. By this criterion, students working individually on different sections of a group assignment and then 'sticking' them together would not be said to have learned collaboratively. Though group members would still interact, their interactions would not focus on content but on managing the process of determining, allocating and then combining the chunks of work to be completed individually. This distinction between collaborative learning and task management (as discussed by Dillenbourg 1999) reflects the view that group assignments are not merely an opportunity for students to gain skills and experience in working with others. They also allow students to process information at a deeper level via the co-construction of knowledge with other members of the group, which can have considerable learning benefits.

In addition to content-focussed group interactions, two critical elements of productive collaborative learning have received increased attention in recent theoretical developments: *co-regulation of learning* (Allal 2007; Hickey 2003; McCaslin 2004, 2009; Salonen et al. 2005; Vauras et al. 2003; Volet et al. 2009a) and *high-level cognitive–metacognitive processing* of learning content (Barron 2003; Cohen 1994; King 2002; Vermunt 2004). 'Co-regulation' and related terms such as the 'shared' or 'social' regulation of learning (Vauras et al. 2003) all refer to learning behaviour and cognition that is enacted as and guided by multiple contributors' coordinated interactions. Thus, co-regulation is central to the 'coordinated, synchronous activity' in Roschelle and Teasley's (1995, p. 70) oft-cited definition of 'collaboration' in group learning contexts: 'coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem'. Negotiability, interactivity and dialogic interactions are viewed as key descriptors of co-regulation during group learning interactions (Barron 2003; Dillenbourg et al. 1996; King 1998; van Boxtel et al. 2000).

High-level (or 'deep') cognitive–metacognitive processing of learning content has also been noted as a critical feature of the most productive group learning interactions (Salonen et al. 2005). This is characterised by communications that contribute to the co-construction of knowledge (e.g. inferences, elaborations, exchange of explanations). In contrast, low-level (or 'shallow') content processing displays no evidence of transformation or integration with students' own mental representations (e.g. sharing information, defining terms). Thus, even when co-regulated, low-level processing lacks the co-construction of knowledge element that is central to the collaborative learning construct (Roschelle and Teasley 1995).

A situative approach to understanding group learning interactions

A major limitation of research on group work at university has been its overwhelming reliance on students' self-reports as data, with few direct observations of students' face-to-face group work interactions. In consequence, present understandings of what students actually do when working together on an assignment is fairly limited. Rather than assuming that group work interactions will equate to 'collaborative learning' and its associated benefits, it is important to identify when and to what extent groups actually engage in co-regulation and high-level processing of learning content, being the central, if not definitive, features of collaborative learning to which considerable educational benefits are attributed. For this reason, Volet et al. (2009b) developed a framework (Fig. 1) that conceptualises groups' engagement[1] with learning content as falling along two intersecting continua, social regulation and level of processing, such that any given interaction episode is viewed as evidencing high- or low-level processing and individual or co-regulation. The corresponding coding system of Volet et al. (2009b) allows episodes of these and other forms of group work behaviour to be identified within university students' observed face-to-face group work interactions. The 'high-level co-regulation' construct was proposed as representing the most desirable form of collaborative learning. High-level co-regulation is conceptualised as group interactions which evidence the two important features of collaborative learning described above: high-level processing of learning content and co-regulation. In contrast, low-level co-regulation refers to interactive, coordinated (i.e. co-regulated) participation in content-related discussions which remain at the descriptive level (e.g. basic facts and definitions) without venturing into the construction of knowledge via inferences, explanations or integration of information.

A major influence upon the framework of Volet et al. (2009b) was Greeno's (2006) argument that groups *afford* various forms of participation, regulation and engagement with learning content and, therefore, that researchers should study interactional patterns and cognition as constructed and enacted in their social context. The model is thus grounded in a *situative* (Barron 2003; Greeno 1998; Nolen and Ward 2008) approach to the study of collaborative learning, which focusses on 'intact activity systems' as the unit of analysis and avoids reducing group interactions to individual (albeit socially embedded) behaviours with individual-in-context explanations. In this sense, it departs from a *sociocognitive* (Järvelä and Salovaara 2004; Turner and Patrick 2004) concern with how individuals' learning behaviours within a group are mediated by their mental activity. According to a situative perspective, the explanatory usefulness of individual cognitions diminishes in interactive group contexts as emerging group dynamics have more of a bearing on what students do. Interacting students are simultaneously viewed as 'individuals' and 'the context', and what they do shapes and is shaped by emergent group-level properties that constrain and

[1] In this paper, we use the term 'engagement' broadly to refer to what students can be observed to do during face-to-face group work interactions.

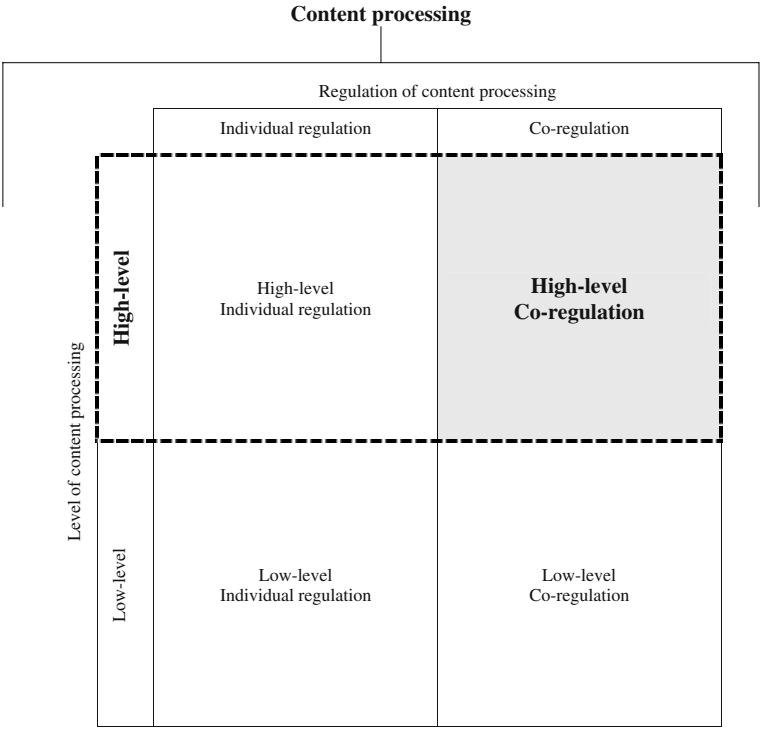

Fig. 1 Framework of Volet et al. 2009b for categorising university students' face-to-face group work interactions according to the social regulatory and level of processing dimensions of their content-related discussions. Variables subjected to statistical analysis in the present study are in *boldtype*

afford opportunities for engagement (Greeno 1998; Nolen and Ward 2008). That is, students negotiate the meanings of their words and actions, the learning content and nature of the task, members' relationships and the history and values of the group and, in so doing, shape the form and function of their interactions and the working process. Cognition itself is reconceptualised from a situative perspective as *distributed across* (Barab and Kirshner 2001) or *between* (Greeno and van de Sande 2007) individuals and their contexts (e.g. fellow interactants, the task, physical environment).

This perspective has major implications for research on collaborative learning. Firstly, it suggests that students' face-to-face collaborative learning practices are not a simple function of the cognitions, goals and emotions that members bring to the group context, and it is necessary to look to group interactions themselves for indicators of why collaborative learning interactions unfold as they do. According to Greeno (2006), a situative analysis involves direct observation of social interaction and analysis of both interactional *processes* and information structures that emerge in the verbal *content* of joint activity[2]. A situative perspective on group work behaviour thus focusses on a different level of explanation than does *appraisal theory* (Smith and Kirby 2009), which explains behaviour in a given context in terms of individuals' interpretations of the implications of that context for their personal wellbeing or more generally, sociocognitive analyses examining verbal reports as an indication

[2] In contrast, sociocognitive analyses examine verbal reports as an indication of individuals' inner, cognitive representations.

of individuals' inner, cognitive representations. Secondly, it suggests that the descriptive analysis of collaborative learning interactions should not be limited to a fine-grained focus on individual members' utterances or turns but should also take into account more broad-brush descriptions of what group members are doing together, not just as individuals.

In sum, it is argued that whilst individual cognitions are expected to play a role in mediating observable individual and (in consequence) group patterns of engagement in group learning contexts, it is also important to consider how group patterns of engagement can also be understood as emerging from the interactional activity of the group as a dynamic social system.

Integrating situative and sociocognitive analyses

Combining group and individual level analyses to understand the nature of engagement in socially regulated learning is gaining momentum (Arvaja et al. 2007; Hadwin et al. 2007; Nolen and Ward 2008). To better understand why some groups work differently to others, it is important to consider how groups' working practices emerge from group-level interactions *and* the role of individual differences members bring to the group work context. Furthermore, the educational outcomes of different collaborative learning practices must be assessed in terms of the skills, knowledge and perspectives individual students take away from the group work experience. However, only a limited number of studies (mostly in computer supported collaborative learning contexts) have combined group level analyses of students' actual engagement in a collaborative learning activity with individual level analyses of their cognitive and affective experiences. Some have revealed consistency between observed patterns of engagement and students' self-reported goals, descriptions and explanations of their work (Arvaja et al. 2007; Leinonen et al. 2003). This may be interpreted as students demonstrating a degree of awareness of their observable engagement and is consistent with the claim that metacognition (Efklides 2006), i.e. conscious monitoring and control of verbalised cognitive activities, mediates engagement. Other research has been inconclusive, showing limited relationships between observed engagement and self-reports during (Hurme et al. 2006) or after an activity (Hadwin et al. 2007).

An integrated situative and sociocognitive analysis of self-reports and observational group data poses some methodological challenges. Firstly, naturalistic studies are well-suited to addressing the question of what students actually do when working together in real-life group learning situations in their usual micro- and macro-level contexts. However, fly-on-the-wall access to naturally occurring group work data can be difficult to obtain, and controlling for task characteristics can limit sample sizes to students enrolled in the same unit, doing the same assignment. Another difficulty is that the interdependence of group members' contributions necessitates group-level analysis. Analysing data provided by large numbers of individual participants as a relatively small sample of student groups can place limitations on the types of statistical analyses that may be performed and their ability to detect significant relationships amongst variables. Whilst these hurdles may be partially responsible for the shortage of research integrating group observation and self-reports, this line of inquiry is crucial to furthering our understanding of collaborative learning. Specifically, understanding the relationships between students' actual engagement during group meetings and their (meta)cognitive appraisals and reflections regarding the group assignment is a crucial step to determining why students engage in the ways that they do during group meetings and what the consequences of this are for their learning.

To this end, this study was organised around six research questions. Two focussed on students' actual engagement in high level content processing whilst working together on a case-based learning task and the relationship of such engagement to academic performance.

Whilst the literature provides much theoretical support for this relationship, few empirical investigations have been carried out so far:

1. To what extent do students actually engage in content processing and, more specifically, high-level content processing and high-level co-regulated content processing during student-led meetings for a group assignment?
2. How do students' actual engagement in high-level content processing relate to their academic performance?

The next two questions addressed the issue of relationships between students' actual patterns of engagement during a group activity and their appraisals of that activity. Whilst a situative perspective expects patterns of engagement to emerge from interactions, a sociocognitive perspective stresses the mediating role of individuals' cognitions on their engagement. Determining whether groups' engagement in content processing is related to group members' appraisals of the group project itself and, if so, which appraisals are related to which measures of engagement is therefore important from a theoretical perspective.

3. To what extent are group members' pre-task appraisals of the forthcoming group activity related to their group's engagement in overall, high-level and high-level co-regulated content processing?
4. To what extent are group members' post-task appraisals of a just completed group learning activity related to their group's actual engagement in overall, high-level and high-level co-regulated content processing?

Finally, we sought to investigate why students engage in various degrees of content processing with each other during a group learning activity and whether students' own accounts of their learning lend support to the learning benefits of high-level, co-regulated content processing that have been claimed in the literature (Barron 2003; King 1998; van Boxtel et al. 2000).

5. To what extent did groups' accounts of what they did, how much they learned from each other and how they learned from each other reflect their actual engagement during the recorded meetings?
6. On the basis of participants' accounts, what inferences can be made about why the groups may have engaged as they did?

Method

Context

This field-based study was conducted in the naturalistic setting of a second year physiology unit, which included a group project as one of its assessment components. There was no change to regular instruction. The project required students to examine an authentic clinical case file (a different case for each group), set their own learning objectives based on the case, undertake research to learn about selected aspects and present their findings to the class at the end of semester. This involved identifying relevant physiological principles that applied to the case, integrated this with information from other pre-clinical disciplines and at an introductory level learned how to distil clinical information and identify the principles that related to the course, management and/or treatment of the diseases. Groups received no

specific instructions about how to collaborate on the task or interact during their meetings but received constructive feedback on their learning objectives in two meetings with their teachers during the project. Students received a group mark for their presentation.

Participants

Nine groups of five to six science university students participated in the study, 53 participants in total (41 female, 12 male).

Data

Four types of data were utilised: audiovisual recordings of group meetings, self-report questionnaire data, interviews and academic performance.

Audiovisual recordings of group meetings Audiovisual recordings were made of the nine groups' meetings, in which students worked together on the assignment in their own time: their first meeting after receiving their clinical case file and another meeting once they had done some background research (total 18 sessions, two per group). No restrictions were placed on the duration of meetings. The mean duration of the meetings was 44 min, 40 s (SD=10 min, 53 s) for the first round and 25 min, 4 s (SD=12 min, 50 s) for the second round.

The recordings were coded using the system of Volet et al. (2009b) based on their framework for conceptualising collaborative learning activities in terms of the constructs of social regulation and content processing. The coding system identifies episodes of students' face-to-face group work interactions that fulfil criteria for one of seven categories. Talk dealing directly with learning content is placed into one of four categories: *high-level co-regulation*, *high-level individual regulation*, *low-level co-regulation* and *low-level individual regulation*. Together, high-level co-regulation and high-level individual regulation comprise the broader category of all high-level content-related discussions, 'high-level content processing'.

High-level content-related talk includes elaborating, interpreting, reasoning, building on or linking ideas, explaining in one's own words and help seeking for understanding. Clarification of basic facts, reading verbatim from a written source and help seeking for details are categorised as low-level. Co-regulatory episodes feature verbal contributions from multiple group members, whilst episodes of individual regulation predominantly feature a single speaker, with no more than minor inclusions from others. The extract below provides an example from the data of a content processing interaction that is both high-level and co-regulated.

> Mark: So, does that means that after the, after the lamb is removed the ewe is still producing…
>
> Annie: Like I'm wondering if it almost just, so much overload…
>
> Gareth: Yeah exactly, coz it's, I read somewhere that it takes up, the foetus drains seventy percent of the glucose of the, of the ewe…
>
> Annie: So, if you…
>
> Annie: Eighty percent of the growth is within that last period, so…
>
> Gareth: Yeah, so if you take away this seventy percent drainage of your glucose suddenly, then, you know, you'll be left with heaps in the blood system, which explains these results, I guess.

Features of the above extract which contributed to its categorisation as high-level, co-regulated content processing include the following criteria from the framework of Volet et al. (2009b): multiple parties' involvement in a singular reasoning process, seamless turns combining to form a unified reasoning chain, applying past learning to a new problem, explaining in own words and deductive reasoning.

Categories of talk not dealing directly with learning content include *task* (e.g. generating learning objectives, determining the scope and structure of the assignment, selection of what information to include in the presentation), *organisation* (e.g. scheduling future group meetings, delegation of sub-tasks) and *off-task* (talk about matters unrelated to the assignment). Two judges independently coded seven of the 18 meetings. Both judges had participated in the refinement of the coding system and were blind to students' performance. The judges were in agreement for 77.3% of the total length of time across all meetings. Disagreements were resolved by discussion and refinement of the coding system to remove any ambiguity that contributed to the disagreement. In addition to inter-rater reliability, Volet et al. (2009b) reported congruence between student-estimated and observed proportion of meeting time spent discussing content in support of the coding system's concurrent validity.

Three group-level measures of students' actual engagement during group meetings, derived from the system of Volet et al. (2009b), were used (shown in boldtype in Fig. 1): *all content processing* (total percentage of meeting time spent on high-level co-regulation, high-level individual regulation, low-level co-regulation and low-level individual regulation, across both meetings), *high-level content processing* (total percentage of time spent on high-level co-regulation and high-level individual regulation, across both meetings) and *co-regulated high-level content processing* (total percentage of time spent on high-level co-regulation). In addition, a fourth, individual-level variable was computed. For each student, *individual high-level contributions* were calculated by counting the total number of turns they contributed across all high-level episodes (whether co- or individually regulated). Long turns were recounted every 10 s (e.g. a 36-s turn would be counted three times).

Self-report questionnaire data Participants completed the contextualised version of the *Students' Appraisals of Group Assignments* (SAGA) instrument (Volet 2001) at the beginning (after groups had been formed but before work on the assignment had begun) and end of the assignment. It consists of six sub-scales, each measuring a different dimension of students' appraisals of a specific group assignment they are engaged in. Respondents indicate their level of agreement with each item statement on a four-point Likert scale ('strongly disagree'=1 to 'strongly disagree'=4). Certain items are reverse-scored such that higher scores always indicate more positive appraisals.

Three SAGA sub-scales were used: *Cognitive Benefits*, *Motivating Influence* and *Affect*. Sample items from each sub-scale are 'Interacting with peers for this group assignment will enrich my knowledge and understanding', 'I'm likely to stay motivated throughout this assignment because it is completed as a group' and 'I am angry that this assignment has to be completed in a group situation'.

Each sub-scale was analysed separately according to principles of Rasch analysis (Andrich 1978; Andrich et al. 2005) to test how well the observed data fit the expectations of the measurement model. Rasch analysis places estimates of item difficulty/severity and person ability (or level of a trait such as attitude) on the same hierarchical scale. Higher person estimates (or person locations) are taken to indicate more favourable appraisals of that particular dimension of the group assignment. To maximise power, these analyses were carried out with the whole class data (N=81). In terms of the validity of the scale, the Rasch analysis showed that for each scale, all items 'fit' the same underlying psychological

construct. The overall fit statistics, item-trait chi-squares were 12.95 (p=0.23) for the Cognitive Benefits scale, 13.26 (p=0.21) for the Motivating Influence scale and 7.92 (p=0.64) for the Affect scale, indicating overall fit of the data to the model (df=10). The estimates of reliability, equivalent to Cronbach alpha, were 0.66 (Cognitive Benefits), 0.76 (Motivating Influence) and 0.83 (Affect), indicating satisfactory reliability. The analyses also revealed that the rating scales' four response categories worked consistently for all items and that the items were not biased towards a group within the sample.

Interviews Around the end of the group assignment, all participants were interviewed about their experiences of the group project. It was originally planned to recruit five groups of volunteers for the in-depth component of the study and to conduct individual interviews. When all nine groups expressed a keen interest to participate in the research, it was decided to include all of them and conduct focus group interviews with half of the groups. Most pertinent to the concerns of this study was the interview question, 'did you *really* (with emphasis) learn from each other?' with various follow-up probes.

Academic performance Overall mark in the physiology unit (to which the group assignment contributed 15%) was used as a measure of individuals' learning and performance related to the group assignment. This was considered a better measure than mark on the group assignment for two reasons. Firstly, the group project was assessed on the basis of an oral presentation and there was little variation in marks across groups. Secondly, students received a group mark for that presentation, meaning that individual members' learning from the assignment or contribution to the final presentation could not be ascertained.

Statistical analysis

Standard procedures were used for data analysis, including chi-square tests to determine whether each group was homogenous or heterogeneous in terms of its individual members' high-level contributions and Pearson correlations to determine the relationship of observed engagement to marks and appraisals.

Results

Patterns of engagement in content processing during group meetings

Question 1 was concerned with the nature and extent of students' actual engagement in content processing (a) at the *group* level and (b) at the *individual* level.

Group level analyses Table 1 shows the percentage of time each group spent on three overlapping categories of content processing across both meetings: all, high-level and high-level co-regulated content processing.

Groups differed markedly in the proportion of meeting time they spent on content-related discussions during the two meetings. Groups' patterns of engagement ranged from a substantial emphasis on the discussion of content (group M, 64.4%) to a primary focus on other matters with minimal focus on content (group B, 14.3%). Similar intergroup variation was observed for high-level and high-level co-regulated content processing. This suggests that to a large degree, the nature and extent of groups' engagement in content processing during meetings was not constrained by the requirements of the assignment itself but

Table 1 Percentage of time spent on different categories of content processing by nine groups over two meetings

Type of content processing	Corresponding cell(s) in conceptual framework	Group									
		M	J	C	G	K	E	N	I	B	Mean of all groups
All content processing		64.4	57.4	49.3	42.8	32.8	24.8	22.4	21.1	14.3	36.6
High-level content processing		35.1	5.7	17.8	12.1	6.1	17.2	9.3	9.4	6.4	13.2
Co-regulated high-level content processing		30.8	2.9	13.9	11.2	5.8	16.7	8.9	3.5	5.5	11.0

For each category, a graphical representation of the corresponding cell(s) in the conceptual framework Volet et al. 2009b is provided

determined by the different approaches to working on it that arose from individual characteristics of group members and/or emergent group-level characteristics.

On average, high-level content processing formed only a third of groups' time spent on content-related discussions. However, groups differed considerably with respect to their ratio of total content processing to high-level co-regulated content processing. For example, nearly half of group M's considerable (64.4%) engagement with content was both high-level and co-regulated. Group J also displayed a substantial focus on content (57.4%), but little of it was high-level co-regulated content processing. Group E engaged in a relatively small proportion of content-related discussions (24.8%), but of this, a majority was high-level and co-regulated. Group B engaged in relatively small amounts of both high-level co-regulated processing and content processing more generally. This adds to the picture of great intergroup variation with respect to their patterns of engagement with content during the two group meetings.

Individual level analyses A critical issue in understanding patterns of group participation in high-level content processing concerns the distribution of high-level, content-related contributions across members of a group.

Figure 2 displays the distribution of individual high-level contributions across all group members for each of the nine groups. Chi-square tests determined that only group B (X^2= 13, $p<0.05$) could be considered homogenous in terms of its individual members' high-level contributions. Thus, with the exception of group B, which had the lowest overall engagement with content, contributions to high-level discussions were not spread evenly across members of a group. However, also noteworthy is the pattern of contributions in group M, which was the highest on all three measures of engagement with content. Only four out of 46 students across all the other groups contributed more than the lowest contributor in group M. This suggests that group engagement (at least when it is extremely low or extremely high) may influence individual members' engagement with content.

Relationship between individual engagement in high-level content processing and academic performance

Question 2 was whether individuals' high-level content-related contributions during group meetings were related to their academic performance. Individuals' engagement in high-level content processing was significantly correlated with their overall mark for the physiology unit that contained the collaborative learning task (r=0.283, N=52, $p<0.05$). This means that individuals who made more high-level content-related contributions during

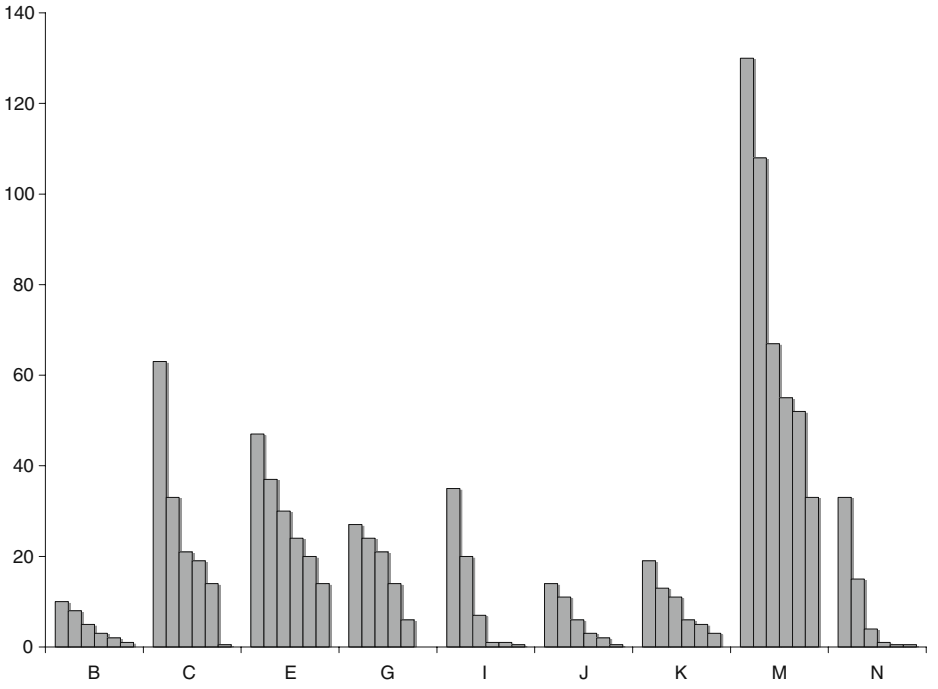

Fig. 2 Distribution of individual contributions to high-level content-related episodes within each group (note: six members' contributions are represented for each group except group G, which had only five members)

the two meetings achieved higher marks in the unit. This finding provides empirical support for the notion that students who actually engage in high-level questioning and elaborations tend to be the high achieving students. Given the group project represented only 15% of the students' overall unit mark, this relationship is noteworthy.

Relationship of pre-task appraisals to actual engagement at the group level

Question 3 was whether the proportion of meeting time groups spent on the three categories of content-based discussions could have been predicted, in part, on the basis of group members' appraisals of the group assignment prior to starting work on it. To explore this issue, group means on each pre-task appraisal variable (Cognitive Benefits, Motivating Influence, Affect) were calculated and correlations performed in order to determine their relationships with group engagement in the three categories of content processing (all, high-level and high-level co-regulated). The analyses yielded a positive correlation between pre-task Motivating Influence (group mean) and percentage of meeting time spent on content processing overall (r=0.852, p<0.01). That is, groups composed of students who gave higher ratings of the extent to which the group format would motivate them to work on the assignment spent a greater proportion of their meetings engaging with content. However, pre-task Motivating Influence did not predict engagement in high-level, or high-level co-regulated content processing, which may suggest that this was not perceived as necessary or expected, even by more motivated students. The other pre-task appraisal measures (Cognitive Benefits, Affect) were not significantly correlated with engagement in any of the aforementioned three content processing categories. This means that neither students'

affective responses to the group project prior to starting work on it nor their predictions about how much they would learn from it were linked to their subsequent engagement in content processing during group meetings.

Relationship of post-task appraisals to actual engagement at the group level

Question 4 was whether the proportion of meeting time groups spent on the four categories of content-based discussions was related to their members' appraisals of the assignment once it had been completed. Post-task group means on Cognitive Benefits, Motivating Influence and Affect were not significantly correlated with any of the three measures of engagement with content. That is, students' self-reports on how much they learned from the group project, their affective responses to it and the extent to which the group format motivated their efforts towards it were not related to their groups' actual engagement in the different categories of content processing during the two group meetings.

Qualitative analysis of three selected groups' accounts of their learning from each other

Three groups were selected for this analysis on the basis of their extreme profiles of observed engagement in content processing. As shown in Table 1, group M was the highest on all three measures of engagement with content (64.4% all content processing, 35.1% high-level, 30.8% high-level co-regulated[3]). This indicates that of all groups, group M displayed the most desirable form of effective co-learning. In contrast, group B was the lowest in overall content processing (14.3% of total meeting time) and one of the lowest in both high-level (6.4%) and co-regulated high-level content processing (5.5%). Finally, group J was selected for its profile of opposing extremes, i.e. second highest in overall content processing (57.4%), but the lowest in high-level (5.7%) and high-level co-regulated (2.9%).

Question 5: To what extent did groups' accounts of what they did, how much they learned from each other and how they learned from each other reflect their actual engagement during the recorded meetings?

The three groups' accounts during interviews were consistent with their actual engagement, strikingly so for groups B and M. In line with the observation data, group B reported spending little time on content-related discussions. This was also reflected in their reports that they learned little from each other. For example, when group B was asked 'do you feel like you've actually learned from each other?', Leonie and Agnes (pseudonyms) respectively (and emphatically) answered 'not really' and 'no. We haven't really sat down and exchanged things like aspects of what everybody was learning, so-'.

In marked contrast to group B, group M spent a majority of their recorded meetings on content-related discussion, much of it high-level and co-regulated. Consistent with this observation, all group members affirmed during their interviews that they had learned from each other:

> Oh yeah. Definitely.
>
> There's no way that one person can do that much research. So we have learned a lot about pancreatitis from each other.

[3] We remind the reader here that the 'high-level co-regulated' category is a subset of the 'high-level' category.

Furthermore, group M members' accounts of how they learned from each other contained numerous references to content-related discussion and indicators of high-level co-regulated processing such as explanation of content and questioning and answering when something was not understood:

> Basically just sharing information and if you don't understand you just keep asking and keep asking. If they don't know they'll tell you they don't know and they'll go and check it out. They'll get back to you.

> I learnt a lot from Nelly's section, because she went through hers very thoroughly, because um hers is the most important part which explains how the disease comes about, and what kinds of diseases of this type there are and the effects it has … I learnt a lot from her explanations there.

> We have learned a lot … You have to know what's going on and everything and have to know their parts … and they also help you with your learning … and explain things to you when you don't get it.

Again, these accounts were very consistent with the observation data.

Compared to groups B and M, the correspondence between group J's accounts and the observation data was less clear cut. This could be related to group J's more complex engagement profile (high in overall content-processing, but lowest in high-level content processing). Group J members related that they had gone 'through the process of understanding the case together', which was consistent with their relatively large proportion of engagement in content processing. However, their affirmative response to a question about whether they had learned 'from each other about the case' was somewhat at odds with their very low observed engagement in *high-level* content-related discussions. But unlike group M, descriptions of the actual processes through which they learned 'from each other' were scarce and even when present were vague and poorly articulated:

> Everyone needs everyone coz everyone looks at different things.

> If you need to know something about the cell you go to Sophie.

In consequence, their accounts contained very little description of content-related interactions that would be considered high-level, which is consistent with their observed low levels of engagement in such interactions. One could speculate that they equated learning *from* each other about the case with familiarising themselves with the basic facts provided in the case summary *with* each other. This may have contributed to the discrepancy between this group's low engagement in high-level content processing and its members' claims of having learned from each other.

Question 6: On the basis of participants' accounts, what inferences can be made about why the groups may have engaged as they did?

Interviews were examined for any indicators of possible explanations of groups' observed patterns of engagement. Overall, it appeared that groups had different conceptions of the most important or pressing concerns they had to address to complete the assignment successfully. There were indications that each group focussed their meetings around what they perceived as the most important or pressing concern(s), which were very much in line with their observed patterns of engagement.

It appeared that group B's minimal engagement in content-related discussions was due to a perception that a time-efficient, division-of-labour type approach was the most effective way of coping with the time pressures of the rest of their studies. They therefore streamlined their focus to what they felt was necessary to get the assignment done, despite acknowledging that they could have learned more from each other if they had engaged in more content-related discussions. Leonie offered the following explanation of their lack of content-related discussions:

> We haven't really had time. [Agnes agrees—'no'] I mean, we've had months to do this but we've just been working from one assignment to the other until we had a gap where we could meet and discuss the project and its really just about meeting objectives to have so much work done by the next time etc. so we haven't much of an opportunity to exchange the theory of the topic.

In contrast, there was evidence that group M's large proportion of engagement in high-level, co-regulated content processing was due to their perceptions that understanding each other's 'parts' was an important step towards accomplishing the expected task outcomes and that face-to-face explanations and questioning were the best way to achieve this. This included a perception of the importance of equipping all members to field questions during their final presentation:

> During our meetings we shared with each other what we were doing, so we at least have an understanding of the whole thing, so on the day itself of the presentation if he asks us any questions anyone can handle the questions.

Another contributing factor to group M's greater (high-level) engagement with content may have been a perception that content-related discussions saved time in learning the material (e.g. 'it saves us time on having to read up on the other person's work, and we just come and they share with us and we kind of have an understanding').

Group J's observed emphasis on low-level (but very little high-level) content-related discussion appeared to be in part due to their perception that generating learning objectives remained an unresolved priority that requiring much of their attention. They felt that they were struggling with their learning objectives, so this was where they spent most of their time. This involved a great deal of low-level engagement with the facts of their case to tease out the most suitable relevant learning objectives, but little high-level content processing:

> the learning objectives. I don't know if we just put too much focus on it … but we got stuck for ages … we still haven't done them properly but for a few weeks that's all we did was learning objectives.

Therefore, it may have been that to some extent, high-level content-related discussions were rare due to a perception that the 'generating learning objectives' stage was a higher priority and had not been satisfactorily resolved in their group. Another contributor to the observed patterns of engagement for this group may have been a limited awareness or consideration of the distinction between high- and low-level content-related discussions, the importance of high-level discussions for their learning or that they engaged in little high-level discussion. This interpretation is consistent with their claims of having learned 'from each other about the case', despite the lack of clear evidence of deep content processing in their accounts.

In summary, differences in the three groups' observed patterns of engagement were very much in line with their different perceptions of what were the most important concerns for their group to address to complete the assignment successfully. This suggests that to increase groups' high-level, co-regulated engagement with content, it is necessary to find ways to ensure students consider these types of interactions as centrally important, rather than dispensable, aspects of the group work process.

Finally, there were also indications that a single member could exert a considerable influence on how their group interacts. For example, multiple group M members identified a particular group member, Mary, as engaging in persistent content-related questioning. Some noted that they had not themselves been motivated to do this to the same extent as Mary, despite appreciating the learning benefits of these interactions. Mary's content-focussed engagement and questioning seems to have been motivated, in part, by 'interest' and a drive to resolve feeling 'lost':

> I was interested when I was listening to Linda or Elisa talk about their part because I didn't really understand it so I was interested and I was listening. And then after that I was lost, as in I didn't know what was happening, as in what she was saying, so I questioned and she answered me and I felt optimistic.

The potential for discernable individual influences on group processes, therefore, highlights the importance of maintaining a sociocognitive interest in individual differences that may influence behaviour, even whilst pursuing situative understandings of collaborative learning behaviour at the group level.

Discussion

The present study revealed nine groups' divergent patterns of engagement in productive content-related discussion and provided tentative explanations for cross-group variability. Overall, groups spent only a minority of their meeting time engaging with content. High-level and high-level co-regulated content processings were particularly scarce, meaning that groups largely neglected precisely those types of discussions that were their best opportunity to reap learning benefits from the group work situation. Groups' patterns of engagement with content did range widely, however, from negligible (group B) to substantial (group M). These findings suggest that divergent interactional practices may be adopted by different groups working on the same assignment, and it should not be assumed that group assignments will necessarily give rise to substantial engagement in productive content-related discussions. This highlights the need for universities to do more to promote collaborative learning than simply assigning group projects.

Consistent with prior evidence of high-level content processing's cognitive benefits (van Boxtel et al. 2000), individual high-level contributions were related to higher marks. The correlation was modest but noteworthy given the assignment contributed only 15% to students' overall mark in the physiology unit. However, in the absence of an experimental design, it is not known whether high-level contributions improved academic performance, whether higher achieving students had better-developed repertoires for, or were more inclined towards, high-level discussions or whether a third factor (e.g. interest in the physiological focus of the unit) increased both academic achievement and high-level contributions via separate causal pathways. There is a need for future research to experimentally manipulate groups' engagement in content processing to evaluate its impact on performance and tease apart the relative influences of individual versus group engagement in high-level content processing upon individual achievement.

Groups whose members gave higher pre-task estimates of the motivation they would derive from the group context allocated a greater proportion of meeting time to content-related discussions. However, interpretation of this result is complicated by the fact that after the assignment, retrospective reports of motivation derived from the group context were *not* related to their engagement with content. One possibility is that an initial sense of 'motivation' lead

students to engage in more content-related discussions, but they did not associate this engagement with 'being motivated' when appraising their motivation in retrospect. Instead, they may have based such appraisals on other aspects of the project (e.g. organisational discussions that felt like they were 'getting things done'). Similarly, it could be that because content-related discussion was not a salient or important aspect of the project for these students, it barely factored into their consideration of how they felt about the project or how much they learned from it and therefore was not correlated with these appraisals. This raises the important issue of respondents' subjective interpretations of interview questions and self-report items (Karabenick et al. 2007) and their conceptualisations of constructive learning from each other (Loyens et al. 2007).

Although pre-task appraisals of motivation due to the group context were related to groups' overall engagement with content, they were not significantly correlated with high-level or high-level co-regulated content processing specifically. A possible explanation is that groups who felt more 'motivated' at the beginning of the task channelled this into a greater focus on content during meetings, but did not perceive high-level content processing to be essential to completing the task and thus did not focus their energies there. For example, group J gave no indications during their interview that they believed their lengthy but primarily low-level content-related discussions suffered from a lack of deeper analysis. This relates to the broader finding from the qualitative interview data that each group's patterns of engagement appeared to be oriented to what its members saw as the project's most pressing or important tasks. Whilst students' motivation to engage with a group project is important, the numerous and divergent *ways* of engaging that are available to them mean that additionally, it is crucial that they are motivated to engage in the ways that will be most beneficial.

It appears likely that for group J, inadequate awareness of the difference between low- and high-level content-related discussion and the relative merits of high-level discussions may have contributed to their lack of engagement with content at a high-level. On the other hand, Visschers-Pleijers et al. (2006) found that first and second year medical students were aware of key characteristics of effective discussions. In line with this, even group B, who engaged in little discussion of content, appreciated that it would have benefited their learning. Further empirical investigation of this issue is required. If student awareness of the benefits of deep content-related discussions is more widespread than is their actual engagement in this, this would suggest that providing students with information about high-level content-related discussions is a necessary but not sufficient step to promoting effective collaborative learning.

It is important to acknowledge some possible influences on groups' observed engagement linked to the naturalistic, non-interventionist nature of the study. Firstly, each group worked on a different case. Teachers in the course stressed that the case itself had little bearing on the assignment's difficulty or complexity, which was primarily determined by the learning objectives students chose for themselves. Therefore, case differences were unlikely to have had a major impact on the results. Nevertheless, it would be worthwhile for future research to examine differences in the patterns of engagement seen across groups working on the same case. Secondly, there was intergroup variability in the duration of meetings. Future research could experimentally investigate the relationship between meeting length and observed engagement. Artificially shortening or lengthening the 'natural' duration of a meeting by imposing a standardised duration might affect students' engagement as they attempt to fit their meeting to the set length. Thirdly, groups may have engaged in more high-level content-related discussions if this was clearly requested and explained in the instructions given to them. Future research should examine the effect of interventions aimed at promoting high-level co-regulated content processing on groups' actual engagement in it. However, this was a field study concerned with what students do when direction from teachers regarding their

face-to-face collaborative processes is minimal, which in our experience is the norm. Our findings suggest that in a typical instructional context, it should not be assumed that groups will spend substantial time on high-level content-related discussions.

If the enhancement of students' content learning is a genuine goal of group assignments at university, then productive engagement in collaborative learning needs to be actively promoted by universities. Despite the ubiquity of group work at university, students are generally not taught what learning collaboratively looks like in practice, how to engage in it or that it is likely to enhance their learning. These should be taught to students as important pre-skills for effective collaborative learning. However, even if students appreciate the benefits of high-level co-learning and know how to engage in it, they still might not do so if the nature of the assignment and/or its assessment does not require it. For example, group B indicated that they considered content-related discussions to be a beneficial yet dispensable aspect of the project that they 'didn't have time' for. Therefore, it is important to investigate how group assignments can be designed so as to *require* students' collaborative engagement in high-level content learning (Barron 2003; Cohen 1994; King 2002). Addressing this issue would require what Biggs (1999) has called constructive alignment between learning outcomes, learning activities and assessment. In short, to maximise students' engagement in the most beneficial forms of collaborative learning, universities can and should intervene at the instructional, task design and assessment levels, as the mere scheduling of group assignments is unlikely to achieve this.

As our results affirm, an emphasis on high-level, co-regulated content-related discussion tends not to be students' 'default' approach to working on group assignments. It is thus imperative that the skills for high-level, co-regulated content-related discussions are not taught in a cursory manner but allocated substantial time and attention from teachers, with ample opportunities for practice and teacher feedback on students' enactment of these skills. These skills must be well-established in students' repertoires so that they are less effortful and more likely to be maintained as habitual group work practices (see the fluency literature, e.g. Binder 1996). A number of training programmes have demonstrated some success in enhancing group discussion (e.g. King 1992, 1998; van Boxtel et al. 2000). Training in exploratory questioning, which often precedes cumulative reasoning episodes in students' group work interactions (Visschers-Pleijers et al. 2006), is likely to be valuable. It is also crucial that students regularly encounter group assignments that require and reinforce the use of these skills throughout their university studies.

To date, intervention studies on group work practices have focussed largely on short-term demonstrations of behaviour change and corresponding learning outcomes (e.g. van Boxtel et al. 2000). However, it is the cumulative impact of continuing to engage productively in collaborative learning, throughout their studies, that is expected to have the greatest benefit for students. There is therefore a great need for degree courses to regularly promote productive collaborative learning behaviour throughout the whole course and for empirical investigations of long-term maintenance and outcomes.

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Current themes of research:

Productive co-regulation in collaborative learning. Attitudes toward culturally mixed group work at university. Discursive psychological research on intergroup prejudice. Behavioural management of diabetes.

Most relevant publications in the field of Psychology of Education:

Volet, S.E., Summers, M., & Thurman, J. (2009) High-level co-regulation in collaborative learning: How does it emerge and how is it sustained? *Learning and Instruction*, *19*, 128–143.
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Current themes of research:

Integration of self and social regulation in learning contexts. Productive co-regulation in collaborative learning. Metacognitive instruction. Bridging the cognitive—situative divide in research on learning and motivation. Learning in cultural contexts.

Most relevant publications in the field of Psychology of Education:

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