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Structuring asynchronous discussion groups: the impact of role assignment and self-assessment on students' levels of knowledge construction through social negotiation

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Abstract

This article examines the impact of the introduction of roles and the added value of self-assessment on students' level of knowledge construction in online asynchronous discussions in a first-year university course in instructional sciences. Students' postings in 20 discussion groups were used as the research data for this study. All messages, submitted during the 12-week discussion period and comprising four discussion themes of 3 weeks each, were analysed. Repeated-measures multilevel modeling was adopted to analyse the data from the content analysis. The results point at a significant positive impact of assigning roles to students. However, this positive impact depends on the moment of the introduction of the roles. Higher levels of social knowledge construction were found in discussion groups where roles were introduced right at the start of the discussions and faded out towards the end. The results further indicate that self-assessment has no significant added value.

Keywords

collaboration, computer-supported collaborative learning (CSCL), networked learning, role assignment, scripting, self-assessment.

Introduction

In the early days of the information technology age, computers were rather positioned as personal tools and their potential to foster interpersonal communication was less well anticipated (Crook 2002). In contrast, current approaches towards computers and the Internet acknowledge this interpersonal significance. Recent online learning and instruction approaches highlight the importance of learner interaction in view of knowledge construction. This has resulted in a growing implementation of computer-supported collaborative

learning (CSCL) approaches, including asynchronous discussion groups, whose educational potential is often studied (e.g. Järvelä & Häkkinen 2002; De Laat & Lally 2004; Schellens & Valcke 2005; Schellens *et al.* 2005).

This study focuses on two instructional approaches to stimulate knowledge construction through social negotiation in asynchronous e-discussions, namely role assignment and self-assessment. The study is situated in the context of a first-year instructional sciences course, where asynchronous discussion groups of 10 students are organized in addition to weekly face-to-face working sessions. The discussion groups are organized to foster students' processing of the learning content and, by confronting them with authentic tasks, to promote discussion about the different concepts

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presented in the face-to-face sessions and in the course manual. Roles were assigned to students when collaborating in the online asynchronous discussions in order to promote knowledge construction through social negotiation. Previous research presented empirical evidence that students act in line with assigned roles (De Wever *et al.* 2008). This specific structuring approach is combined with the introduction of self-assessment in order to enhance reflection. The main aim of this study is to evaluate the impact of role assignment on students' knowledge construction and to study the surplus value of introducing self-assessment.

Roles as a structuring tool

Putting individual students together does not necessarily bring about effective interaction or collaborative learning (Weinberger *et al.* 2005). Instructional design, building on collaborative learning environments, therefore focuses on embedding a certain amount of structure, such as adding specific goals, defining task types, presenting task prescripts or pre-structuring (scripting; De Wever *et al.* 2008). The goal of introducing structure is to support interaction processes and actual collaborative learning within CSCL-environments. Some empirical evidence underscores that pre-structuring or scripting learning environments improves collaboration (Pfister & Mühlfordt 2002) and produces strong positive learning effects (Baker & Lund 1997).

In a previous article (De Wever *et al.* 2008), we examined role assignment as a specific type of scripting. Five roles were presented to students: the role of starter, moderator, theoretician, source searcher and summarizer. The study showed that students act in line with their assigned roles. As a result of this manipulation check, the present study can, in a valid way, assume that possible treatment effects can be related to differential role assignment and adoption.

Self-assessment to enhance reflection

As McLoughlin and Luca (2002) argue that CSCL environments enable students to become more self-directed and that 'the shift to student self-direction and autonomy means that students need to take more responsibility for their own learning' (p. 577), self-assessment was introduced in this study. Self-assessment requires

learners to make judgements about their own learning and is considered as a tool providing feedback to students about both learning and educational standards (Boud & Falchikov 1989; Boud 1995). It requires students to consider the characteristics of competent work in a given area or situation and to apply these criteria to their own work (Boud 1999). Self-assessment helps students to internalize academic standards (Gibbs 2006). As such, self-assessment encourages independent and self-directed learning. In collaborative contexts, this implies that self-assessment fosters reflection on the quality of personal contributions and the input of others and develops awareness of effective and qualitative contributions to the discussions (Sluijsmans *et al.* 1999; Freeman & McKenzie 2002). Students need to monitor the actual condition of their discussion, learning process and human relations to improve their learning community and to plan their upcoming study so that they can make their learning substantial (Mochizuki *et al.* 2003).

While performing their own regular and structured self-assessment, learners develop a questioning and reflective approach (Robinson & Udall 2006). Self-assessment encourages students to become critical and perceptive and stimulates reflection, thereby contributing to the learning processes and to lifelong learning (Larres *et al.* 2003). Empirical evidence stresses that self-assessment has an effect on cognition, affection and conation and can encourage deep approaches to learning (McDonald & Boud 2003). Research also reveals a considerable impact of self-assessment on students' content-related learning, quality of problem solving and self-reflection (Sluijsmans *et al.* 1999).

In this respect, self-assessment was introduced in the present study as a reflection tool and a tool for learning. It was implemented primarily as a way to help students improve their learning, as it focuses students' attention on the metacognitive aspects of their learning and teaches them to be more effective at monitoring their own performance (Longhurst & Norton 1997) and not as a substitute for the instructor's evaluation. Following the claim that self-assessment is clearly an important part of supporting students to improve their own learning (Longhurst & Norton 1997), it is hypothesized that self-assessment of the individual contributions in a CSCL environment will elicit re-adjustment of discourse in forthcoming collaborative activities. The idea is that by asking students to reflect upon and to rate the

quality of their performance, students will identify weaknesses and strengths and might amend or redirect their contributions in forthcoming discussions (Hunt *et al.* 2002).

Method

Research questions

The first research question focuses on whether students are capable of judging their own social knowledge construction processes. As self-assessment has a considerable impact on self-reflection (Sluijsmans *et al.* 1999) and reflecting on one's own knowledge construction processes might influence the quality of the knowledge construction processes of subsequent discussions, we want to check to what extent students are able to assess their own knowledge construction processes accurately. This question precedes the study of the impact of the research conditions on the knowledge construction processes.

The second research question focuses on (1) determining whether role assignment has an impact on the knowledge construction processes in the discussion groups, (2) whether the moment of introduction of the role assignment is an important factor, and (3) whether self-assessment has a surplus value to stimulate students' knowledge construction through social negotiation.

Research setting

Context

The present study was conducted in the context of a first-year course in instructional sciences in the Bachelor in Educational Sciences of Ghent University. The instructional design of this course combined face-to-face sessions with an online learning environment (Schellens & Valcke 2000). All first-year students enrolled ($N = 273$) participated in the discussion groups.

The discussion groups were organized in parallel to the weekly face-to-face sessions to promote the timely study of the theoretical concepts. It was expected that students would develop a stronger knowledge base when applying the theoretical concepts during discussions and while they were involved in social negotiations and debate. After a 1-week trial discussion, the

formal study plan required students to discuss four successive authentic tasks. Each discussion took 3 weeks. Within the 3-week periods, students collaborated online, independent of time and location. The authentic discussion tasks were identical for all groups and were related to corresponding chapters in the handbook (behaviourism, cognitivism, constructivism and evaluation). The main goal was to stimulate debate on the theoretical concepts presented in the face-to-face sessions and in the course manual. A full example of one of the discussion tasks can be found in the supporting information.

Students were divided at random into discussion groups of 10 persons. Participation in the online discussion groups was a formal component of the course and represented 25% of the course grade. Students were required to contribute at least four times per discussion theme. In line with the approach of Guldberg and Pilkington (2006), 'the tutor monitors the discussion but takes a background role unless a real need to intervene is perceived' (p. 160).

Roles

In specific research conditions, particular students of a group were assigned one of the following five roles: starter, summarizer, moderator, theoretician and source searcher. The inclusion of the starter and the summarizer was founded on the literature regarding the starter-wrapper technique (Hara *et al.* 2000), while the moderator was incorporated based on the findings of Gray (2004) indicating the role of an online moderator as critical for enhancing learning. Further, Srijbos *et al.* (2004) argue that when cooperative learning pedagogies, and more specifically roles, are used in higher education or online learning environments, they should be adapted to the specific context, as students in these settings vary considerably in prior knowledge, experience and collaboration skills. Taking into account that the discussion groups are organized to stimulate debate on the theoretical concepts presented in the face-to-face sessions and in the course manual, the starter, summarizer and moderator roles were supplemented with the roles of source searcher and theoretician.

The *starter* was required to start off the discussion, to add new points for other students to build upon, and to give new impulses when discussions slacked off. The role of the *moderator* consisted of monitoring the

discussion, asking critical questions and probing others' opinion. Students in the role of *theoretician* were required to introduce theoretical information and to ensure that all relevant theoretical concepts were used in the discussion. The role of the *source searcher* consisted of seeking external information about the discussion topics to stimulate other students to go beyond the scope of the available handbook. The *summarizer* was expected to post interim summaries during the discussion and a final synopsis at the end, focusing on identifying dissonance and harmony between the messages and drawing conclusions. In general, all students were allowed to perform all these activities. However, students with a specific role were asked to pay explicit attention to the activities related to their role on a regular basis.

Self-assessment

In the present study, self-assessment was introduced to enhance reflection and to stimulate self-directed learning (Larres *et al.* 2003). The students were asked to evaluate themselves in relation to the knowledge construction processes in their messages. They were informed by the staff members about the fact that this self-assessment would not affect the formal score for this course and about the criteria for the summative assessment. The self-assessment was based on an online questionnaire in which students had to rate their knowledge construction through social negotiation after each discussion assignment.

Data collection

The discussion transcripts of 20 discussion groups were selected for this study and the transcripts of the entire 12-week discussion period were analysed, comprising four discussion themes of 3 weeks each. This resulted in

the analysis of 4818 messages or approximately 60 453 lines.

Design

Discussion groups were assigned to one of three research conditions. In the first condition, students started discussing without role assignments in themes 1 and 2; role assignment was introduced when discussing themes 3 and 4. In the second condition, roles were assigned right from the start in themes 1 and 2 but were no longer stressed during themes 3 and 4. The third condition was equal to the second condition, except that students in the third condition were, in addition, requested to fill out a self-assessment questionnaire at the end of each discussion theme.

The specific cross-over design of the present study was helpful to answer research question 2, as it allows us to explore the differences between role-supported and non-role supported discussions. Furthermore, the comparison of the first two research conditions enables us to study whether the timing of role assignment is an important mediating factor influencing students' knowledge construction through social negotiation. Comparing the second and the third condition allows us to explore whether self-assessment has a surplus value in stimulating knowledge construction through social negotiation. Table 1 gives an overview of the different research conditions.

In each condition, roles were introduced in either the first or the last two discussion themes. In the first theme where role assignment was applied, five randomly selected students were given one of the five roles. In the second discussion theme with role assignment, the roles were assigned to the students who did not take up a role in the first discussion theme. The rotation of roles guaranteed that each student adopted a specific role at least once. Students were asked to perform their roles in

Table 1. Overview of the research conditions.

Theme	Condition 1	Condition 2	Condition 3
1	No role assignment	Role assignment	Role assignment + SA
2	No role assignment	Role assignment	Role assignment + SA
3	Role assignment	No role assignment	No role assignment + SA
4	Role assignment	No role assignment	No role assignment + SA

SA, self-assessment.

addition to submitting regular discussion inputs. Taking into account the different discussion assignments, the study was constructed according to a repeated-measures design.

Quantitative content analysis

In order to determine the level of knowledge construction through social negotiation, quantitative content analysis was applied. This quantitative approach to content analysis focuses on collecting and coding a large amount of data. This large dataset of codes allows us to perform statistical tests to compare the different conditions.

The interaction analysis model of Gunawardena *et al.* (1997) was applied to analyse the transcripts. This model examines the social construction of knowledge in computer conferencing and distinguishes five different levels of knowledge construction activities: (1) sharing and comparing information, (2) identifying areas of disagreement, (3) negotiating meaning and co-construction of knowledge, (4) evaluation and modification of new schemas that result from co-construction, and (5) reaching and stating agreement and application of co-constructed knowledge (see Table 2). A detailed discussion of this model can be found in De Wever *et al.* (2006). This model of Gunawardena *et al.* (1997) has been applied in a number of empirical studies (Marra *et al.* 2004; Schellens & Valcke 2005; Schellens *et al.* 2005; De Wever *et al.* 2006). Marra *et al.* (2004) compared this model with the model of Newman *et al.* (1995) and argued that Gunawardena's model provides 'a more holistic view of discussion flow and knowledge construction' (p. 39). Schellens and Valcke (2005) studied the validity of the instrument of Gunawardena *et al.* (1997) by simultaneously coding the discussions using the instrument of Veerman and Veldhuis-Diermanse (2001). They concluded that both models

are parallel to one another for the first three levels of knowledge construction. They furthermore concluded that the coding scheme of Gunawardena *et al.* (1997) goes beyond the scheme of Veerman and Veldhuis-Diermanse (2001) and discriminates more advanced levels of knowledge construction, such as testing and applying newly constructed mental models.

As suggested by Rourke *et al.* (2001), messages were selected as units of analysis, as complete messages are an objective unit and are considered as the unit defined by the original author of the contributions.

A discussion of the analysis scheme of Gunawardena *et al.* (1997) can be found in the supporting information, together with a discussion of coding decisions and an excerpt of student postings with the assigned codes.

By analogy with the content analysis scheme applied to analyse the transcripts of the discussion groups, the self-assessment questionnaire was founded on the instrument of Gunawardena *et al.* (1997). The questions probe into students' perceptions of their achieved levels of knowledge construction through social negotiation. More particularly, students were asked to rate how often their own contributions to the discussion fit into each of the five levels of knowledge construction. An example of the self-assessment items was, 'My contributions aimed at sharing and comparing of information'.

By presenting the self-assessment questionnaire after each discussion, students were required to step back and evaluate the levels of knowledge construction reflected in their contributions. They were encouraged to reflect on the extent to which their messages were effective contributions to the ongoing discussion. In this way, students were required to monitor their discussion behaviour. They were motivated to verify which knowledge construction processes they invoked. In case they noticed their messages did not cover the whole spectrum of knowledge construction processes, this could lead them into adjusting their future discussion behaviour to optimize future debates.

Table 2. Levels of knowledge construction in the interaction analysis scheme of Gunawardena *et al.* (1997).

Level	Description
1	Sharing and comparing of information
2	Exploration of dissonance
3	Negotiation of meaning
4	Testing synthesis
5	Agreement statements and applications

Coding strategy and reliability

Five independent coders were trained for approximately 7 h to carry out the coding activity. After working with coding examples for each level of knowledge construction in the analysis model (Gunawardena *et al.* 1997), they coded some transcripts together in order to discuss and elaborate on the coding process. Next, the tran-

scripts were coded independently. A number of transcripts were randomly selected for calculating interrater reliability coefficients. Krippendorff's α interrater reliability coefficient ($\alpha = 0.52$, $n = 198$) was situated between 0.40 and 0.80, which corresponds to 'fair to good agreement beyond chance' (Banerjee *et al.* 1999; Neuendorf 2002; De Wever *et al.* 2006).

Statistical analysis

Taking into account the hierarchical nesting of students in discussion groups and the successive nature of the four themes, repeated-measures multilevel modeling was applied to answer the research questions. In the present study, measurement occasions (the four discussion themes) are nested within subjects (Hox 1998). We refer to De Wever *et al.* (2007) for an in-depth discussion on this analysis technique.

The statistical package R 1.8.1 (R Foundation for Statistical Computing, Vienna, Australia; <http://www.r-project.org/>) was used for the calculation of the interrater reliability. MLwiN 2.01 (Centre for Multilevel Modelling, University of Bristol, Bristol, UK; <http://www.cmm.bristol.ac.uk/MLwiN/>) was used to perform the multilevel analysis. The multilevel models were estimated with the iterative generalized least squares procedure. All analyses assume a 95% confidence interval.

Results

Research question 1: students' ability to evaluate their own social knowledge construction processes

In order to explore whether students are able to assess their own level of knowledge construction, we focus on the match between students' self-assessment and the content analysis of their messages. Following Longhurst and Norton (1997), a convergence measure was computed per discussion theme by calculating the difference between the self-reported occurrence of utterances reflecting each level of knowledge construction (LKC_{SA}) and the observed occurrence of messages for each level of knowledge construction (LKC_{OBS}) as coded by the coders during the content analysis.

For each level of knowledge construction, a difference score was calculated (LKC_{DIF} 1 to 5). Negative difference scores indicate that students underestimate their level of knowledge construction, while positive difference scores point at overestimation. The multi-

level analyses indicate that students underestimate themselves at the first level of knowledge construction (LKC_{DIF} 1 = -1.103, SE = 0.128) and overestimate themselves at the four subsequent levels (LKC_{DIF} 2 = 1.314, SE = 0.086; LKC_{DIF} 3 = 1.344, SE = 0.101; LKC_{DIF} 4 = 2.280, SE = 0.084; LKC_{DIF} 5 = 1.714, SE = 0.067). A detailed discussion of these results can be found in the supporting information.

Research question 2: impact of the research conditions on levels of knowledge construction reflected in the online discussions

The second research question focuses on the impact of the three different research conditions on the levels of knowledge construction reflected in student messages (LKC_{OBS}). For this research question, a four-level model was estimated, with messages (level 1) hierarchically nested within measurement occasions (level 2) that are clustered within students (level 3) who are in turn assigned to groups (level 4). The analysis models were built following a stepwise procedure. A random intercept null model and a compound symmetry model were estimated first. Next, additional analyses were performed in which the different research conditions were included as predictors to the model. All models are presented in the supporting information.

In the final model (see Table 3), the difference in LKC between the four themes and the three research conditions is explored in detail, taking the interaction effects between the conditions and the themes into account. In this respect, the differential progress in LKC_{OBS} in the different research conditions is studied. In the first theme, students' contributions reflect significantly higher LKC_{OBS} in both condition 2 (role/no-role) and condition 3 [role/no-role + SA (self-assessment)] compared with the first condition (no-role/role; $\chi^2 = 11.725$, d.f. = 1, $P = 0.001$ and $\chi^2 = 5.767$, d.f. = 1, $P = 0.016$, respectively). No significant differences were found between conditions 2 and 3 in theme 1 ($\chi^2 = 1.128$, d.f. = 1, $P = 0.228$).

In the third theme, the LKC_{OBS} is also significantly higher in condition 2 (role/no-role) and condition 3 (role/no-role + SA) compared with the first condition (no-role/role; $\chi^2 = 29.824$, d.f. = 1, $P < 0.001$ and $\chi^2 = 7.853$, d.f. = 1, $P = 0.005$, respectively). In addition, the LKC_{OBS} is significantly higher in condition 2 compared with condition 3 ($\chi^2 = 7.954$, d.f. = 1, $P = 0.005$). The

Table 3. Multilevel parameter estimates of LKC_{OBS} (final model).

Parameter		Random	
Fixed		Level 4 – group	
Intercept	1.244 (0.065)	σ^2f0	0.013 (0.005)*
Theme 2 (cognitivism)	–0.058 (0.066)	Level 3 – student	
Theme 3 (constructivism)	0.070 (0.061)	σ^2v0	0.004 (0.004)
Theme 4 (evaluation)	0.040 (0.061)	Level 2 – theme	
Condition 2	0.297 (0.087)***	σ^2u0	0.006 (0.006)
Condition 3	0.210 (0.088)*	Level 1 – message	
Theme 2 * Condition 2	–0.150 (0.088)	σ^2e0	0.617 (0.013)***
Theme 2 * Condition 3	–0.064 (0.088)		
Theme 3 * Condition 2	0.444 (0.081)***		
Theme 3 * Condition 3	0.228 (0.081)**		
Theme 4 * Condition 2	–0.056 (0.084)		
Theme 4 * Condition 3	0.045 (0.084)		

Values in parentheses are standard errors.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

LKC_{OBS}, observed level of knowledge construction in student messages.

differences between the conditions are not significant for themes 2 and 4. As to the differences between role and no-role based discussions, the results of the final model indicate that for the initial discussion theme, the discussion groups with role assignment reach higher levels of knowledge construction, whereas the opposite is true for theme 3. In conditions 2 and 3, no role assignment was present in this third discussion theme and yet these discussion groups reach higher levels of knowledge construction.

Discussion

Research question 1

The first question focused on the ability of first-year students to evaluate their level of knowledge construction in an accurate and critical way.

The results clearly indicate that students underestimate the extent to which they engage in sharing and comparing information during the ongoing discussion. On the other hand, they overestimate the occurrence of postings reflecting the four subsequent levels of knowledge construction. This means that students post fewer contributions focusing on identifying disagreement, negotiating meaning, evaluating co-constructed meaning, and agreeing on and applying the co-constructed knowledge than they actually think they do. These results are in line with Robinson and Udall's (2006) statement that 'students are often unable to make realistic judgements about their own learning' (p. 98).

The findings that first-year students are not always capable of judging themselves accurately might be due to lack of experience. This corresponds to the findings of Larres *et al.* (2003), who studied the difference between objective and self-appraisal computer literacy tests and argued that at entry level students 'would require much more experience in self-evaluation before it to become effective' (p. 109). The findings can entail that more support should be given to the students for them to develop their self-assessment skills, for example by making students aware of the fact that their self-assessed ratings will be validated with ratings from other sources (e.g. cross-checking with other measures or verification with peer or instructor assessment) and by providing comparative information about peers as suggested by Larres *et al.* (2003) and Gibbs and Simpson (2004). In addition, students could be informed of the divergence in self-assessed ratings and independent ratings. Finally, explicit development of assessment skills can be called for, as suggested by McLoughlin and Luca (2002) and Black *et al.* (2004), who argue that students might need assistance in achieving the skills that come with more autonomy and responsibility.

Falchikov and Boud (1989) point at two other possible explanations for the lack of students' accuracy in self-assessment. First, they claim that 'studies within the broad area of science appear to produce more accurate self-assessment than do those from other areas of study' (p. 425). In addition, they claim that the level of the course of which the assessment is a part is an impor-

tant influential factor as well. It more particularly appears that students in advanced courses are better at assessing themselves accurately.

Based on the findings with respect to the first research question, it can be argued that future practice and research should aim at making students' self-assessment more accurate by exposing them to self-assessment more frequently, by offering an introductory training, by making students aware of the fact that their self-assessment will be monitored and by providing them with comparative information and feedback.

Research question 2

The second research question focused on the impact of (1) role assignment, (2) the moment of introducing the roles, and (3) the surplus value of self-assessment.

When we focus on the results with regard to the introduction of role assignment, significant differences were found in themes 1 and 3 between the *condition with roles in the two final discussion themes* and the *conditions with roles during the two initial themes*. In both themes 1 and 3, the latter conditions outperform the former one with respect to the levels of knowledge construction. As to the impact of the presence of roles, this implies that in the first theme, students in discussion groups with roles outperform students in discussion groups without role assignments. In the third theme, the opposite can be concluded. Concerning the importance of the moment of the role introduction, it can be noticed that in both the first and the third theme, groups with initial role assignment outperform groups receiving role assignment at the end even when the original role assignment had faded out.

These results lead us to the conclusion that the moment of the role introduction can have an important impact. The observation that groups with initial role assignment outperform the others in theme 3 might point at the fact that students have interiorized the role-related activities. In this respect, Weinberger *et al.* (2005) argue that 'fading of the cooperation script could improve internalization processes' (p. 34). However, as the trend is not pursued in the fourth theme, further research is needed to confirm this finding. Further research might also focus on gradually decreasing the role assignment, as Hoadley and Enyedy (1999) argue that 'we know from studies of learning technology that gradually fading of scaffolding from a tool, or tools with a gradually sloped learning curve are more effective

than sudden drops in scaffolding, or tools with a staircase shaped learning curve' (p. 250).

With regard to the impact of self-assessment on students' knowledge construction, the research condition without self-assessment significantly outperforms its equivalent including self-assessment in the third discussion theme. From these findings, the conclusion can be drawn that the introduction of recurrent self-assessment procedures does not have a significant surplus value on knowledge construction processes in the asynchronous discussions.

This may be due to the fact that the first-year students in our study were not yet able to assess their knowledge construction processes in an accurate way. In this respect, the introduction of training students in self-assessment merits particular attention in future research, as McDonald and Boud (2003) already illustrated that 'self-assessment training had a significant impact on the performance of those who had been exposed to it' (p. 217).

Moreover, further research is wanted as it can be argued that the process of incorporating self-assessment to enhance the quality of the discourse in online discussion groups is still in its infancy. Murphy and Jerome (2005) note that 'little has been written on students' self-assessment of participation in online discussion' (Introduction, ¶3). In this respect, they suggest the use of self-analysis comprising a detailed examination of the number of messages, their distribution over the modules and their length, supplemented with an analysis of the content of the contributions in relation to claims and grounds and a critical assessment to demonstrate knowledge construction by presenting quotes. Such a detailed self-analysis might have a more direct impact on knowledge construction in discussion groups. However, further research is needed to confirm this hypothesis. In addition, future studies should also focus more on the long-term effects, as students may need more time and experience in self-assessment in order to improve their participation in the discussion groups.

Limitations of this study and directions for future research

As the present research aims to study collaborative learning in CSCL environments by manipulating variables that influence collaborative activities (see O'Donnell & Dansereau 1992), we focus on the social

knowledge construction processes in the discussions. Studying processes is important, 'especially if educators want to know which learning activities and methods are contributing to collaborative knowledge building' (Dennen & Paulus 2006, p. 96). In online discussions, it is therefore necessary to look at what is actually going on during students' discourse (Schellens *et al.* 2007). Consequently, the present research studies a process-related dependent variable that is an indicator of knowledge construction in the online discussions (Dennen & Paulus 2006). Further research should focus on unravelling the specific relationship between knowledge construction processes and the actual acquisition of knowledge, for instance by presenting knowledge acquisition tests after each discussion theme.

Another limitation of this study is the sole use of quantitative content analysis. This technique allows us to focus on one aspect and explore it meticulously over a large amount of data. However, expanding this technique with a more qualitative approach to content analysis would help us to gain a deeper insight into students' discourse and to pick up nuances and details of specific social knowledge construction processes within selected student postings. Moreover, our quantitative content analysis was based on a single coding scheme from Gunawardena *et al.* (1997). Although this model has been compared with other models and we are confident that this model analyses knowledge construction in a reliable way, two drawbacks still remain. First, social knowledge construction can be operationalized in different ways. By selecting this model, we were bound to this specific operationalization. Other models may shed a different light on knowledge construction. A second drawback is that measuring knowledge construction is never completely accurate. Although we used multiple coders and paid specific attention to the coder training, a certain amount of indistinctness still remains. To overcome the abovementioned drawbacks, future research could validate our findings by applying one or more alternative content analysis scheme(s).

Furthermore, this study took place in an authentic educational setting. This implies that we could not control all variables affecting instructional processes and outcomes. This is a limitation compared with experimental studies. However, it also presents advantages, as this complex and ecologically valid setting provides a more stringent test of the successful implementation of roles and self-assessment as compared

with studies in controlled laboratory settings. In this respect, we argue that the interventions implemented in this study are feasible and that the results can be generalized to our research context, which is the study of knowledge construction processes and the related outcomes in online asynchronous discussion groups with first-year university students. However, further research, implemented in other knowledge domains and with students of different educational levels, is needed in order to make more general statements about the impact of roles and self-assessment.

Conclusion

The main aim of this study was to examine the effect of assigning roles on students' knowledge construction and to study the surplus value of introducing reflection through self-assessment on the knowledge construction processes within the discussion groups.

With respect to the introduction of roles, it can be concluded that introducing roles is a valuable structuring tool, especially if roles are introduced at the start of the discussions and faded out at a later stage. In this respect, it appears that role assignment is particularly helpful to get students started. The ultimate goal is that this structuring tool eventually can be faded out or taken away when students have interiorized the skills related to the different roles and are competent enough to discuss in a more natural way, which is without the additional support and structure of role assignment. In this respect, we agree with Brown *et al.* (1989), who state that fading of support should be an integral part of scaffolding. The findings of the present study suggest that students were already sufficiently competent to move forward without the additional structure offered by explicit role assignments after discussing for 6 weeks.

As to the implementation of self-assessment, it can be concluded that a larger investment in support for the students should be made in order to increase first-year students' ability to assess their knowledge construction processes in asynchronous discussions accurately. This can be achieved by exposing them more frequently to self-assessment experiences, by implementing a self-assessment training, by pointing at the validation of their self-assessment and providing comparative information, by providing intermediate feedback by instructors or by peers, or by introducing peer assessment. As to the impact of self-assessment, this study

failed to show a significant surplus value of self-assessment on the levels of knowledge construction reflected in students' discourse in asynchronous discussion groups. However, further research and practice is recommended as the students in this study were not experienced in assessing their knowledge construction processes, and research on incorporating self-assessment to enhance the quality of the discourse in online discussion groups is still in its infancy (Murphy & Jerome 2005).

Supporting information

Additional Supporting Information may be found in the online version of this article:

Supplementary text. A discussion of the analysis scheme of Gunawardena *et al.* (1997) together with a discussion of coding decision, an excerpt of student postings with the assigned codes, and a detail of the statistical output.

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