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Structuring asynchronous discussion groups: Comparing scripting by assigning roles with regulation by cross-age peer tutors

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Abstract

The present study focuses on comparing the impact of role assignment and cross-age peer tutors on students' level of knowledge construction in 15 asynchronous discussion groups of nine students each in a first-year university course ($N = 135$). Content analysis was applied to analyse the level of knowledge construction in students' online postings. The results indicated that students in the tutor-supported discussions reached significantly higher levels of knowledge construction as compared to students in the role-supported group. These findings underline the value of regulation by cross-age peer tutors to foster freshmen's knowledge construction processes.

Keywords: Role assignment; Peer tutoring; Content analysis; Asynchronous discussion groups; Computer-supported collaborative learning (CSCL)

1. Introduction

The present study fits in with the search for instructional approaches to stimulate knowledge construction through social negotiation in online asynchronous discussions. The study was situated in the context of a blended first-year course on Instructional Sciences, in which 27 discussion groups of nine students each were organised to foster students' processing of the learning content. Five discussion assignments were presented to the groups in order to stimulate debate on theoretical concepts presented in the face-to-face sessions and course manual. An example of a discussion assignment can be found in Appendix A. In order to promote knowledge construction through social negotiation, two structuring approaches were introduced: one assigning different roles to the students and the other assigning a fourth-year peer tutor to each discussion group. The main aim of the study was to compare the impact of both structuring approaches on students' level of knowledge construction in asynchronous discussion groups.

1.1. Learning environments

The theoretical foundations for the design, development, and implementation of computer-supported learning (CSCL) environments are often based on constructivist principles. Constructivism and electronic learning environments go hand in hand. Kirschner (2001, p. 1) even argued that "the future (and even the today) of learning is constructivist design and development of collaborative and cooperative learning situations in powerful integrated electronic environments". Social constructivism does not only assume that knowledge is actively constructed by the learner, it also emphasises the socially and culturally situated context in which learning takes place (Duffy & Cunningham, 1996). Social knowledge construction is thus seen as a collaborative process where meaning is negotiated from multiple perspectives (Merrill, 1991).

In the present study, asynchronous online discussions were introduced as a CSCL-environment. Rourke and Anderson (2002, p. 3) argue that discussion is an excellent activity for supporting the co-construction of knowledge, since explaining, elaborating, and defending one's position to others "forces

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learners to integrate and elaborate knowledge in ways that facilitate higher-order learning''. Gilbert and Dabbagh (2005, p. 6) claim that ''an important instructional benefit of asynchronous communication is its potential to support the co-construction of knowledge''. In these learning environments, students can work together, achieve shared understanding, and collaboratively solve problems (Cecez-Kecmanovic & Webb, 2000).

However, simply grouping individual students in asynchronous discussion groups does not necessarily bring about effective interaction or collaborative learning (Weinberger, Reiserer, Ertl, Fischer, & Mandl, 2005). Therefore, educational researchers and practitioners continue to explore instructional approaches in online learning environments in order to guide and improve collaboration processes and thus collaborative learning. This can, for instance, be done by scripting or by regulating the discussions (Dillenbourg, 2002), since providing structure by means of scripts or regulation can be seen as a form of scaffolding for students to get started in authentic activities. In this study, we opted for one specific type of scripting, the assignment of different roles to group members. Regulating the discussions, on the other hand, was realised by assigning a cross-age peer tutor to the discussion groups.

1.2. Role support versus peer tutor support

A script (the term is actually borrowed from the theatre world) specifies the roles and the nature and timing of the activities of the participants (O'Donnell & Dansereau, 1992). In this respect, a script can be considered as a more or less rigid scheme according to which the collaboration proceeds (Pfister & Mühlpfordt, 2002). The assignment of roles is a scripting approach that has been used and proven successful in online discussion environments (De Wever, Schellens, Van Keer, & Valcke, 2008; Schellens, Van Keer, & Valcke, 2005; Strijbos, Martens, Jochems, & Broers, 2004). Previous research (De Wever, Van Keer, Schellens, & Valcke, 2007, 2009; De Wever, Van Winckel, & Valcke, 2008; Schellens & Valcke, 2006) showed that scripting by assigning roles enhances social knowledge construction in asynchronous discussions. De Wever, Van Keer, Schellens, & Valcke (submitted for publication) found that role assignment was even favourable for students without roles in role-supported groups. The present study focuses on comparing this instructional approach with regulating by peer tutors. Although peer tutoring is not new in online discussion environments (see, e.g., McLuckie & Topping, 2004; Van Rosmalen, Sloep, Kester, et al., 2008), the impact of assigning peer tutors on the social knowledge construction in the discussion groups has not been studied.

In the present study, both structuring approaches were used to improve collaborative knowledge construction. The main difference between both approaches is that the roles are a priori assigned to the students. This type of scripting is not flexible: before the onset of the discussions, students are assigned a role and these roles do not change during the discussions, irrespective of the ongoing collaboration processes. Supporting the asynchronous discussion groups by introducing a cross-age peer tutor on the other hand is a more flexible way of structuring the learning environment, since tutors can regulate their own and indirectly also the tutees' discussion behaviour based on the collaborative processes students are engaged in. In this respect, regulation by peer tutors fits in with the recent view of Pata, Sarapuu, and Lehtinen (2005) on scaffolding, emphasising that scaffolding means providing assistance to students on an as-needed basis with fading out of assistance as competence or mastery increases.

1.3. Roles as scripting tools

Roles are assigned to participants in order to support the process of social negotiation in the asynchronous discussion groups. Roles are seen as important factors in determining the quality of knowledge construction in a community (Aviv, Erlich, & Ravid, 2003). They compel students to focus upon their responsibilities in the discussion group and on the content of their contributions. Furthermore, research revealed that roles appear to increase students' awareness of collaboration and elicit more task content statements (Strijbos et al., 2004).

Instructional collaborative learning approaches focus on assigning roles to students in order to support coordination and promote effective interaction patterns. A number of positive effects are attributed to roles. Groups are expected to work efficiently, smoothly, and productively (Cohen, 1994) and ''the practical matter of having critical roles filled in meetings has direct implications for improving task performance and satisfaction'' (Zigurs & Kozar, 1994, p. 277). Furthermore, the use of roles can alleviate problems of nonparticipation or domination of the interaction by one group member (Cohen, 1994). In the present study four roles were assigned to students, that is, the role of (a) moderator, (b) summariser, (c) theoretician, and (d) source searcher.

The role of the *moderator* consists of starting off the discussion, monitoring the discussion, asking critical questions, inquiring for others' opinions, adding new points upon which other students can build, and giving new impulses every time the discussion slacks off. This role is partially based on the starter role of the starter–wrapper technique as reported by Hara, Bonk, and Angeli (2000). In the Hara et al. (2000) study, the starter was to initiate the discussion by asking questions related to specific readings, and the wrapper summarized the discussion on the readings for the week. The moderator role is also based on the topic leader role (Tagg, 1994). The topic leader was responsible for submitting an initial introductory exercise contribution and appeared to serve a vital contextualizing function in moderating conferences (Tagg, 1994). According to Gray (2004), a moderator role is critical for enhanced learning in online contexts.

The *summariser* is expected to post interim summaries during the discussion and a final synopsis at the end. This role is based on the wrapper role (Hara et al., 2000) and the topic

reviewer role (Tagg, 1994). The topic reviewer was responsible for summarizing the topic at the end in Tagg's (1994) study.

Strijbos et al. (2004) suggest that when roles are used in online learning environments in higher education, 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 in the present study were organised to stimulate debate on theoretical concepts presented in the face-to-face sessions and course manual, the moderator and summariser roles were supplemented with those of theoretician and source searcher.

Students in the role of *theoretician* are required to introduce theoretical information and to ensure that all relevant theoretical concepts are used in the discussion. This role is closely related to the specific goal of the online discussions in the present research setting, namely becoming familiar with the different theoretical concepts through discussing and solving tasks.

The role of the *source searcher* comprises seeking external information on the discussion topics in order to stimulate other students to go beyond the scope of the course reader. It is based on the information giver described by Zigurs and Kozar (1994), on the resource person described by Cohen (1994), and on a specific activity assigned to the role of weekly participant by Zhu (1996), namely bringing related issues or newspaper articles to everyone's attention.

1.4. Peer tutors as regulators

Peer tutoring can be defined as ''people from similar social groupings who are not professional teachers, helping each other to learn, and learning themselves by teaching'' (Topping, 1996, p. 322). A more capable, knowledgeable, and experienced peer with a supportive role is called the tutor, while less experienced students receiving help from a tutor are called tutees (Topping, 1996). Research of McLoughlin and Marshall (2000) points at the legitimate nature of scaffolding offered by peers in computer conferences to support cognitive development. In this respect, Vygotsky (1978, p. 86) introduced the concept of the zone of proximal development, which is ''the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined by thorough problem solving under adult guidance or in collaboration with more capable peers''. Wong, Chan, Chou, Heh, and Tung (2003) argue that according to Vygotsky's learning theory, students interacting with a more knowledgeable peer can learn to become as knowledgeable as the peer.

The peer tutoring concept originates from face-to-face settings and has only recently been re-conceptualised in view of online collaborative learning environments. In current research, online peer tutoring is brought under more attention in higher and further education (Jones, Garralda, Li, & Lock, 2006; McLuckie & Topping, 2004). Recent studies on online peer tutoring focus on appropriate ways to select peer tutors (Van Rosmalen, Sloep, Brouns, et al., 2008; Van Rosmalen, Sloep, Kester, et al., 2008), on different cognitive tools that can be used (Wong et al., 2003), or on the effects of peer tutoring on student achievement, motivation, and attitudes (Cheng & Ku, 2009). Kester et al. (2007, p. 202) argue that ''peer tutoring may also enhance learning or knowledge construction''. However, research about the impact of online peer tutoring on social knowledge construction remains scarce.

According to Roscoe and Chi (2007), two types of peer tutoring can be distinguished based on the age and the knowledge gap between participants. In same-age tutoring, students are of a similar age or grade. This same-age variant of peer tutoring is often reciprocal and thus students take turn tutoring each other (Roscoe & Chi, 2007). In cross-age tutoring, older and more advanced students tutor the younger or more inexperienced students. Falchikov (2001) distinguishes between cross-institutional and same-institutional peer tutoring, between cross-level and same-level peer tutoring, between unequal and equal status, and between fixed-role or reciprocal peer tutoring. Following her subdivision the peer tutoring in our study can be described as ''cross-level peer tutoring involving one institution: unequal status built on exiting differences'' (Falchikov, 2001, p. 36). Since all freshmen had no prior knowledge concerning the course topics and are about evenly capable (meaning there are no ''more capable peers'' among them), we opted for the cross-age variant in the present study.

In the present study the peer tutor training was built upon the e-moderating model of Salmon (2000), which has been specifically conceived for use in constructivist e-learning collaborative contexts in higher education (Moule, 2007). Moreover, Salmon (2000) indicates that an e-moderator is not per se a qualified teacher, which allowed the use of the model in the context of peer tutoring. In addition, the taxonomical structure of the model is helpful in view of training e-moderators across many learning disciplines, contexts, and educational levels (Salmon, 2000).

Salmon's (2000) model consists of five stages. The first stage, called ''access and motivation'', focuses on welcoming the group members and encouraging everyone to participate in the discussion. In the second stage, called ''online socialization'', the tutors' task is to ''create an atmosphere where the participants feel respected and able to gain respect for their views'' (Salmon, 2000, p. 29). At the third stage, called ''information exchange'', tutors should ensure that the contributions focus on discovering or exploring the different aspects of the problems or issues (Salmon, 2000). Central at the fourth stage, called ''knowledge construction'', is a high level of interaction, taking stands, and negotiating meaning and building common understanding. In this respect, tutors ''have the role of a facilitator, not a transmission role'' (De Smet, Van Keer, & Valcke, 2008, p. 210). At the fifth stage, called ''development'', tutors should focus at promoting critical thinking, for instance by stimulating tutees to comment on each other's writing (Salmon, 2000). Earlier research studying the contributions of the peer tutors indicates that the tutors perform a blend of different tutoring activities, focusing mainly on activities related to the first four stages in

Salmon's (2000) e-moderating model (De Smet et al., 2008). However, peer tutors did only seldom focus on activities such as stimulating critical thinking or further reflection which are related to the fifth stage "development" (De Smet et al., 2008).

1.5. Research questions – hypotheses

Two research questions were posited in the present study. The first research question focused on the differences between three separate research conditions in order to (a) determine whether the level of knowledge construction of messages in the fully tutored condition (Condition 1) differed from messages in the other two mixed conditions (Conditions 2 and 3) and (b) whether the order of assigning the role or peer tutor matters. Thus, the difference between assigning first peer tutoring and then the roles (Condition 2) and assigning first the roles and then peer tutoring (Condition 3) was investigated. (See Table 1 for a detailed overview of the conditions.)

Considering the assumption that peer tutors can react in a more flexible way by providing or fading out scaffolds, triggering essential contributions of the tutees to optimise the ongoing collaborative processes, it was hypothesized that Condition 1 will result in higher level of knowledge construction than Conditions 2 and 3 (Hypothesis 1).

In addition, given the fact that roles are more valuable at the start of the discussion and can be faded out at a later stage (De Wever et al., 2009), it was hypothesized that Condition 3 will result in higher level of knowledge construction than Condition 2, since it benefits from early role assignment and more flexible peer tutor support at a later stage (Hypothesis 2).

The second research question compared role-supported groups with tutor-supported groups across conditions, focusing on determining whether differences exist in the level of knowledge construction of messages depending only on the type of support. Considering the assumption that peer tutors can react in a more flexible way, it was hypothesized that the level of knowledge construction will be higher in tutor-supported groups than in role-supported groups (Hypothesis 3).

2. Method

2.1. Participants

Participants were first-year students enrolled in the 5-credit course Instructional Sciences at the Ghent University. Fifteen groups of nine students participated in the study ($N = 135$). The average age of the students was 18.28 years (SD = 0.79) and 89% of the students were female (91% in Condition 1, 89% in Condition 2, 86% in Condition 3).

Table 1
Overview of the conditions of the study.

Theme	Condition 1	Condition 2	Condition 3
Behaviourism	Tutor support	Tutor support	Role support
Cognitivism	Tutor support	Tutor support	Role support
Constructivism	Tutor support	Tutor support	Role support
Integration theme	Tutor support	Role support	Tutor support
Instructional design	Tutor support	Role support	Tutor support

2.2. Design – procedure

The present study was conducted in a naturalistic higher education setting at Ghent University. Participating students were divided at random into 27 discussion groups of nine persons, of which 15 were randomly selected for the present study. We opted for a group size of nine, since research of Schellens and Valcke (2006, p. 349) showed that groups of this size perform better than larger groups and that "discussion in small groups reflects larger proportions of higher levels of knowledge construction".

Each discussion group was randomly assigned to one of the three conditions of the study. Each of the three conditions in the study consisted of five randomly selected discussion groups. In Condition 1 the groups were tutored throughout the five discussion tasks. In the other two conditions, a cross-over design was applied, that is, each group participated in discussions either with role assignment or with peer tutoring. To control for the order of the introduction of role assignment and peer tutoring the role-supported discussion assignments were alternated with tutor-supported ones, so that tutor-supported discussion themes were either the first three (Condition 2) or the last two themes (Condition 3). Table 1 gives an overview of the kind of support the students in the different research conditions received during the successive discussion themes. Since this research took place in a naturalistic setting, depriving students completely of tutor support was considered unethical, so a condition in which students never received peer tutor support was not included.

In the present study, students with a specific role were asked to give explicit attention to the activities related to their role on a regular basis. However, the role assignment did not imply access to specific resources or additional information. The roles were rotated at the start of each discussion assignment. The names of the students with a role assignment were put below the discussion task. In this way, all students could see the role assignments. When students clicked on a role in this task environment, they were directed to a website with detailed explanation of the role descriptions. Earlier research (De Wever et al., 2008) pointed out that assigning roles is a recommended scripting approach that could benefit asynchronous discussion groups. More specifically, the De Wever et al.'s (2008) research showed that students enact the roles they are assigned and that they do not neglect other discussion activities. Examples of role-related messages can be found in Appendix B.

In each online tutor-supported discussion group a cross-age tutor was appointed to support the discussion. The tutor was a fourth-year student enrolled in a master (MA) course on Educational Sciences and was required to provide structure and scaffolds fostering freshmen's level of knowledge construction and cognitive development. This tutorship program was part of a 6-credit educational internship, in which all fourth-year MA students are enrolled. Since there is an

agreement in the peer tutoring literature that students need training in order to become a proficient tutor (Falchikov, 2001; Van Keer, 2004), two-day training was organised before the onset of the discussions. The training was compulsory and comprised a number of tutoring skills and practices, focusing on organisational, social, cognitive, and metacognitive strategies to moderate discussion groups. The different stages in the e-moderating model of Salmon (2000) were discussed (examples of peer tutor messages can be found in Appendix C) and the online learning environment was demonstrated. Finally, the tutors received a manual containing examples and reminders. A short overview of the content of the peer tutor training can be found in Appendix D. Moreover, except for the training, peer tutors were involved in two-weekly follow-up sessions with the staff responsible for the internship and involved in the present study.

The groups discussed five successive authentic tasks of two weeks each during a complete semester. The tasks were related to corresponding themes in the handbook that were discussed during the face-to-face lectures. The five themes were *behaviourism*, *cognitivism*, *constructivism*, an *integration* theme (behaviourism, cognitivism, and constructivism), and *instructional design*.

A one-week trial discussion was organised to give the students the opportunity to get acquainted with the discussion board system ''Web Crossing'' (http://webcrossing.com/). This system allows users to receive an outline of the discussion thread and to track individual students' input. Within the two-week periods, students collaborated online, independently of time and location. 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.

2.3. Instruments

To determine the level of knowledge construction through social negotiation, content analysis based on the analysis model of Gunawardena, Lowe, and Anderson (1997) was applied to analyse the transcripts of the interaction in the asynchronous discussion groups. This model distinguishes five different levels of knowledge construction activities: (a) sharing and comparing information, (b) identifying areas of disagreement, (c) negotiating meaning and co-construction of knowledge, (d) evaluation and modification of new schemas that result from co-construction, and (e) reaching and stating agreement and application of co-constructed knowledge. This model of Gunawardena et al. (1997) has been applied in a number of empirical studies (De Wever, Schellens, Valcke, & Van Keer, 2006; Marra, Moore, & Klimczak, 2004; Schellens & Valcke, 2005). Marra et al. (2004) compared this model with the model of Newman, Webb, and Cochrane (1995) and argued that Gunawardena's model provides ''a more holistic view of discussion flow and knowledge construction'' (Marra et al., 2004, p. 39). Research of 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 the two 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, Anderson, Garrison, and Archer (2001), messages were selected as units of analysis since complete messages are an objective unit and are considered as the unit defined by the original author of the contributions.

2.4. Coding and reliability

Three independent coders were trained during approximately three hours to perform the coding activity. They were introduced to the content analysis model, the underlying theoretical basis, and a number of examples to illustrate the coding scheme of Gunawardena et al. (1997). After the training, they coded transcripts together for four hours in order to discuss and elaborate on the coding process. Afterwards, the transcripts were coded independently. In total, 11 discussions (approximately 13% of the messages) were randomly selected and coded by the three independent coders in order to calculate interrater reliability. Krippendorff's alpha interrater reliability coefficient (ordinal level) for the applied coding scheme was .83 which corresponds to ''good agreement beyond chance'' (De Wever et al., 2006; Krippendorff, 2004; Neuendorf, 2002).

2.5. Data analysis

Taking into account the hierarchical nesting of students in discussion groups and the successive nature of the five themes, repeated-measures multilevel modelling was applied to explore the research questions (Snijders & Bosker, 1999). We refer to De Wever et al. (2007) for an in-depth discussion on this analysis technique. Due to the time-consuming nature of the coding process, the discussions of 15 discussion groups of nine students (135 students in total) were randomly selected for this study. For each discussion group five discussion themes of two weeks each were coded (this equals 6860 messages or 73,842 lines of text). The MLwiN 2.01 software was used for the multilevel analyses. The multilevel models were estimated with the iterative generalised least squares (IGLS) procedure. All analyses assume a 95% confidence interval.

3. Results

On average, students posted a little over 9 contributions per discussion theme. Less than 10% of the students failed to meet the requirement to post at least 4 messages per theme. The overall mean for level of knowledge construction (LKC) was 2.00 (see Table 2).

Table 2
Descriptives for level of knowledge construction (LKC).

	M	SD
Overall		
Overall mean	2.00	1.22
Per theme		
Behaviourism	2.00	1.20
Cognitivism	1.96	1.19
Constructivism	2.21	1.35
Integration theme	1.96	1.23
Instructional design	1.91	1.10
Per condition		
Condition 1	2.01	1.24
Condition 2	1.96	1.23
Condition 3	2.04	1.19
Per support		
Role-supported groups	1.90	1.18
Tutor-supported groups	2.06	1.24

The first research question focused on the impact of the three different research conditions on the LKC reflected in student messages. For this research question, a four-level model was estimated with messages (Level 1) hierarchically nested within the measurement occasions, that is, the five discussion themes (Level 2) that were clustered within students (Level 3) who were, in turn, assigned to groups (Level 4). The analysis models were built following a stepwise procedure and the construction of the different multilevel models is presented in Table 3.

The first model represents the four-level null model (Model 0). The random part of the null model for LKC shows that the variances on group, theme, and messages level are significantly different from zero. Specifically, 1.41% of the total variance in LKC in students' messages was situated at the group level ($p = .047$); another 4.95% was situated at the theme level (measurement occasions, $p < .001$), and 92.50% of the variance arose from differences between messages within measurement occasions ($p < .001$). Of the total variance, 1.14% can be assigned to the level of the individual students and was found not significant ($p = .061$).

Model 1 represents the compound symmetry model, in which no explanatory variables were included except for the different discussion themes indicating the levels of knowledge construction at each measurement occasion. The descriptive results for the mean level of knowledge construction showed a slightly higher mean for the third theme (see Table 2). The compound symmetry model achieved a better fit than the null model; the difference in deviance of the two models – which can be used as a test statistic having a chi-squared distribution, with the difference in number of parameters as degrees of freedom (Snijders & Bosker, 1999) – was significant, $\chi^2 = 31.02$, df = 4, $p < .001$. Model 1 showed that there were no differences between the first theme and the following themes, except for the third theme in which the LKC was significantly higher ($p = .001$).

In Model 2, the three research conditions are compared. The descriptive results for the mean level of knowledge construction in the three conditions showed no large differences (see Table 2). Condition 1, in which all discussion groups had a peer tutor assigned, served as the reference group for the multilevel analyses. As can be seen in Table 3, this model did not show a significantly better fit than Model 1 and no significant differences between the conditions were found. As to the first research question, this means that the LKC in Condition 1 in which the groups were tutored throughout the five discussion themes did not differ from the other two conditions (Conditions 2 and 3, $p = .938$ and $p = .890$, respectively). Furthermore, no differences ($p = .832$) were found as to the LKC between Conditions 2 and 3 (tutor

Table 3
Multilevel estimates for level of knowledge construction (LKC).

Parameter	Model 0	Model 1	Model 2	Model 3
Fixed				
Intercept	2.009 (.044)	2.002 (.61)	2.000 (.087)	1.877 (.068)
Theme 2 (Cognitivism)		−.026 (.63)	−.026 (.063)	−.025 (.062)
Theme 3 (Constructivism)		.209*** (.062)	.209*** (.062)	.214*** (.061)
Theme 4 (Integration theme)		−.043 (.060)	−.043 (.060)	−.033 (.059)
Theme 5 (Instructional design)		−.099 (.061)	−.099 (.061)	−.096 (.060)
Condition 2			−.008 (.109)	
Condition 3			.015 (.109)	
Tutor-supported groups				.183*** (.045)
Random				
Level 4 – group – σ^2_{f0}	.021* (.011)	.022* (.011)	.022* (.011)	.023* (.011)
Level 3 – student – σ^2_{v0}	.017 (.009)	.020* (.009)	.020* (.009)	.021* (.009)
Level 2 – theme – σ^2_{u0}	.074*** (.014)	.059*** (.013)	.059*** (.013)	.051*** (.013)
Level 1 – message – σ^2_{e0}	1.382*** (.027)	1.383*** (.027)	1.383*** (.027)	1.384*** (.027)
Model fit				
Deviance	18895.31	18864.29	18864.25	18848.01
χ^2		31.02	0.04	16.28
df		4	2	1
p		<.001	.980	<.001
Reference		Model 0	Model 1	Model 1

Values in parenthesis are standard errors. *$p < .05$; ***$p < .001$.

support at the start and role support at the end and vice versa, respectively).

The second research question compared the LKC of messages in role-supported groups to tutor-supported groups. The descriptive results for the mean LKC showed a mean of 1.90 (SD = 1.18) for the role-supported groups and a mean of 2.06 (SD = 1.24) for the tutor-supported groups (see Table 2). To examine the significance of this difference, another model (Model 3) was assessed, in which the differential impact of peer tutor support and role assignment was investigated by comparing the LKC construction of students' messages in role-supported discussion groups (reference category) and tutor-supported discussion groups. Model 3, built upon Model 1, showed a significantly better fit, $\chi^2 = 16.28$, df = 1, $p < .001$. The results indicated that student messages in the tutor-supported discussions reached significantly higher LKC as compared to the role-supported discussions ($p < .001$). However, the effect size of this significant difference was low (ES = .15).

4. Discussion

The present study focused on two structuring approaches to stimulate knowledge construction through social negotiation in online asynchronous discussions: (a) assigning different roles to the students, on the one hand, and (b) assigning a fourth-year peer tutor to each discussion group on the other hand. It was conducted in a naturalistic higher education setting at Ghent University.

Two research questions were presented in the present study. The first research question focused on (a) determining whether the level of knowledge construction of messages in the fully tutored condition differs from messages in the mixed conditions and (b) whether there is a difference between the two mixed conditions, that is, whether the order of assigning the role or peer tutor matters. The impact of the three different research conditions on the levels of knowledge construction reflected in student messages was studied. We hypothesized that student messages in the fully tutored condition would reflect higher levels of knowledge construction than those in the two mixed conditions. Furthermore, we hypothesized that the tutor/role condition would result in higher levels of knowledge construction than the role/tutor condition. However, the results showed no significant differences between the conditions, thus rejecting Hypotheses 1 and 2.

The second research question focused on determining whether differences exist in the level of knowledge construction reflected in the messages of students (a) in a role-supported group and (b) in a tutor-supported group. The results showed that messages from students with tutor-support reflected higher levels of knowledge construction than messages from students in the role-supported condition. This corroborated Hypothesis 3.

The nonsignificant results related to the first research question might be due to the cross-over design, which implied that all discussion groups were tutored at least two times. Given the fact that the results related to the second research question showed that students reached significantly higher levels of knowledge construction in tutor-supported groups, the cross-over design might have levelled out differences between the three conditions studied in the first research question. When comparing the results of the present study with prior research in the same context and with similar students (another cohort of first-year educational sciences students) engaged in discussions without role or tutor-support (Schellens, Van Keer, Valcke, & De Wever, 2007), it appears that both the role-supported (mean LKC = 1.90, SD = 1.18) and tutor-supported (mean LKC = 2.06, SD = 1.24) discussion groups in the present study reflect higher levels of social knowledge construction than that reported in the prior study (mean LKC of 1.73, SD = 0.49; Schellens et al., 2007). In this respect, it can be argued that both role support and tutor-support enhance the level of knowledge construction in discussions, with tutor-support enhancing it somewhat more (though significantly) but with a low effect size (ES = .15).

The results of the second research question lead to the conclusion that there is a small (ES = 0.15) though significant ($p < .001$) impact of peer tutor regulation since the level of knowledge construction in student messages was significantly higher when tutor support was offered. These findings indicate that peer tutoring is not only effective in face-to-face contexts (Falchikov, 2001; Topping, Simpson, Thompson, & Hill, 1997), but can have an added-value with respect to enhancing social knowledge construction in online learning as well. This can be explained by the fact that peer tutors are continuously monitoring and regulating the learning performances of the tutees (McLuckie & Topping, 2004). Moreover, Bull et al. (1999) claim that peer tutoring can be seen as a way of scaffolding and that scaffolding is more important in computer-mediated learning than in traditional education. In this respect, we can argue that peer tutoring is a more flexible way to provide scaffolds than role assignment and the present study points at the potential of engaging cross-age peer tutors in online discussions to scaffold freshmen's learning processes. Taken into account the significant impact of peer tutor support, a new question, however, emerges: which type of tutor activities trigger enhanced knowledge construction processes? Further research should focus on analyzing the tutor activities and relating them to the levels of knowledge construction reached by the tutees.

4.1. Limitations of this study and directions for future research

A first limitation of the present study is the cross-over design, implying that there was no control condition in which only roles were assigned to the students during the five themes, or in which no role or tutor support was offered. However, since the research took place in a naturalistic setting, depriving students completely of peer tutor support was considered to be unethical, especially since we assumed that tutor-support would enhance the levels of knowledge construction more than role support. Follow-up research in an experimental laboratory setting might give more insight into the differences between role and peer tutor support. When no

credits are earned by the discussion group assignment, the ethical considerations can be dropped, and three conditions could be created: no support, role support, and peer tutor support. This may avoid the levelling out of effects.

A second limitation is that since the tutors were master students, one could argue that a Hawthorne effect could be present and that the results might have been due to the mere presence of the tutors. However, the peer tutors had no formal role in the discussions. They were not involved in any evaluation or assessment procedures of the first-year students, and the latter were well informed about this. Therefore, we deem peer tutors were not seen as representing some formal authority.

Future research could also focus on making the introduction of roles less stringent, for example by providing roles but allowing students to choose one or more roles, depending on the kind of contribution they want to make.

4.2. Conclusion and practical implications

Earlier research (De Wever et al., 2008; De Wever et al., 2009) indicated that roles are a valuable structuring approach when it comes to stimulating social knowledge construction in online discussion groups. The findings of the present study also underline the value of regulation of asynchronous discussion assignments by cross-age peer tutors to foster social knowledge construction processes among freshman. The results showed that tutor-supported groups reach slightly (though significantly) higher levels of social knowledge construction compared to role-supported groups. This empirical finding is important to guide educational practice, especially since learning focuses no longer on one-to-many communication (one teacher teaching and guiding all students), but more on many-to-many communication or learning (all students teaching and coaching each other). Not only can roles be used as an instructional approach, but also peer tutoring, meaning that more experienced students can act as tutors for less experienced tutees. In this respect, the present study showed a promising effect of enhancing learning environments by going beyond classes and mix people from different experience levels.

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Appendix A. Translation of a discussion assignment from Theme 3 (constructivism)

In the course material different elaborations on the constructivist view on learning and instruction are discussed (e.g., experiential learning, situated learning, anchored instruction, cognitive apprenticeship, learning companies, problem-based learning,…). Deduce the common features for these elaborations. In other words, find the basic elements of constructivism that are found in various learning environments. Argue which elements are more central and which ones are only to be found in a few constructivistic learning settings.

In the second part of this assignment, you are asked to reflect on your own school career. Try to find constructivistic features in different examples from school practice. Use the following guidelines:

- Shortly describe your example in a way that every member of your discussion group understands the situation
- Make clear why you experienced this example as constructivistic

Discuss the constructivistic features in others' examples that were not mentioned yet.

In the third part of this assignment we put you to work. Suppose you are responsible for the training of youngsters who organise summer camps. In that respect, you want to develop a learning environment based on constructivistic principles. Give arguments to put this theory into practice.

Next, develop a learning environment following the experiential learning cycle.

Appendix B. Translation of a number of role-related messages

Sara (Moderator)

Good cooperation

As a moderator I am very pleased with everyone's cooperation. The first part of the task is going smoothly and almost everyone is participating in the discussion. The only thing I would like to ask is that you engage more in discussion and avoid writing ''next to each other''. This will make the discussion better organised and we avoid posting the same things. And I really hope that there is a contribution on the way from the two persons who wrote nothing so far, everyone should cooperate to all parts.

Eveline (Theoretician)

Theory first source

Below is the theory from the first source. This article is about (social) constructivism. Learning is an active and constructive process (see also our scheme). People learn by linking new information to prior knowledge: 'learning is constructing internal representations with the help of existing internal representations that, in their turn, are also constructed with the help of earlier existing representations. They are different for all people since everyone has other beliefs (learning is thus determined by the individual and his/her characteristics: see our scheme).

Theory in six points:

1. People are motivated by their inner self (=intrinsic) and by their environment (= extrinsic)

2. Understanding = organising structures by data
3. Throughout learning processes, mental representations are developed (the individual is developing)
4. The individual is − due to his own limitations − restricting his/her learning process (the individual is determining his/her learning process)
5. Reflection and reconstruction are stimulating learning
6. In social constructivism, the interaction with others is very important and the instructor has the role of guide, motivator, and expert (see also our scheme).

Stefanie (Source Searcher)

Sources for constructivism

Hi people. As a source searcher I noticed already a few sources while processing the course material. For instance, in the OLO [Open Learning Environment] section you can find the following site that everyone should have a look at http://lpsl.coe.uga.edu/live/. Example of an internet-based learning environment characterised by a certain domain of knowledge, in this case, for instance, about visualising the weather.

Another source I tracked down can be linked to the second source listed above, namely "constructivism, or how a human learns" that partially discusses the group event at http://www.klasse.be/archieven/archieven.taf?function=detail&nr=5333. It is the presentation of a short practical example of a teacher, a few characteristics of constructivism can definitely be found, such as the reduced role of the instructor and the enlarged autonomy of the learners for their learning process.

[…]

Joke (Summariser)

Summary 2: examples

This is a hard part to summarise, but I'll try it anyway.

All the examples are about experiencing things, Pieter (learns to manage a theatre group), Ilse (represents a political party during a debate), Alexander (learns how to run a shop), Elien (creates a play about a myth), Jocye (learns how to handle projects abroad), Inge (learns to speak French during a language course), Bart (participates to a debate), Joke (learns how to be a good manager).

We all have been actively involved, we had to search, discover, develop,… (the problem solving activity is present).

The collaboration context is also present in all the examples, the interaction between a learner and another person promotes learning and understanding.

The authentic context cannot be found in every example (for instance Joyce's example).

The role of the instructor is visible in each example; they have to give us the arrangements; they have to guide and motivate us.

The evaluation method differs throughout the examples, focussing on the goals of the arrangements and focussing on the goal of the learner.

Do you have things to add, do you see similarities or differences, or other characteristics?

Appendix C. Translation of tutor messages

Liesje (tutor)

A word of welcome

Hi everyone. I am Liesje, your tutor and I would like to welcome you all on this online discussion forum. As you all know, the aim of this discussion is to collaborate in order to come to a solution for the problem in the assignment. My job will be to guide and coach the discussion process and I will do this by summarizing, repeating elements, clarifying things,…; in short, by structuring your learning process. Eventually, it is the intention that you take over my job to a certain extent, leading to self-regulation of your learning process.

For now, I would like to stress the importance that everyone contributes to the discussions since divergent opinions yield fascinating and new insights. Moreover, the discussion group is useful to elaborate on and to comprehend the theoretical background of the course.

Our first discussion assignment will focus on behaviourism as a learning theory. You will all see we have a busy programme. Therefore, I suggest you proceed immediately.

So, that was all for now. Let me know when you have questions or problems!

I look forward to our collaboration and I wish you good luck!

Liesje

Liesje (tutor)

Planning

Hi. Some of you already started an interesting discussion. However, I would like to slow you down a little bit. I suggest you focus on the behaviouristic characteristics of RALFI, before starting with the third part of the assignment. In this way, the students who did not yet contribute to the discussion can reflect on the first two parts of the assignment as well.

This planning does not keep you from discussing the first two assignment parts! Good luck!

Liesje

Hendrik (tutor)

Quotation of sources

Hi Marlies. I really appreciate you refer to the source you read. Lies and Joke are including this information as well. Now the others!

I am really curious about the others' opinions about the possible contradiction you cite. Food for reflection???

Cheers,

Hendrik

Elias (tutor)

Some feedback

Hi everyone. Time to give you some feedback about the previous assignment…

1. Structure: During the second assignment, you introduced more structure to the discussion. This was a serious improvement!
2. Timing: Try to spread out your contributions over the two weeks discussion time. In this way, we avoid to fall silent at the end.
3. React: During tackling the assignments you went into each others' contributions. In this way, the discussion theme was elaborated on. Strength to take on in the next assignment!
4. Sources: Supplying additional sources can be a rich supplement to the discussion. Try to integrate this extra information into the assignment and point explicitly at your reason to include the additional reference.
5. Examples: The examples you include make the discussions more concrete. In this way, theory comes closer to practice, which is really important!

This feedback is more than looking back at the preceding discussion assignment. I hope it will also be a helping 'toolkit' to tackle the new task. That is what it's meant to be!

Good luck,

Elias.

Appendix D. Overview of the structure of the tutor training

The compulsory peer tutor training in the present study started with a class-wide pre-service training and also included two-weekly in-service follow-up sessions. In addition to the meetings, the students received a peer tutor manual including practical examples and reminders. Further, a tutor website was available as well, summarising the training information.

Pre-service training

The pre-service peer tutor training comprised six large clusters and was conceived as a workshop, including alternately explanation and lecture by the trainer and hands-on exercises or assignments for the students. The pre-service was organised two weeks before the start of the asynchronous discussion groups. At the onset of the training, the objectives of the training were communicated and discussed with the students.

The first training cluster was a *theoretical cluster*, focusing on the theoretical and empirical background of collaborative learning in general and of computer-supported collaborative learning in particular. In addition, peer tutoring as an instructional strategy was also theoretically and empirically discussed.

The second cluster of the training focused on *communication* and on the differences between face-to-face versus online interaction. In this respect, a distinction was made between synchronous and asynchronous online interaction as well. Taken into account the asynchronous nature of the present study, the advantages of asynchronous discussions in terms of independency of time and location and increased time to reflect, think, and search for additional information before contributing to the discussion, were discussed.

The third training cluster zoomed in on Salmon's (2000) *five-step model for e-moderating*. The taxonomical structure of the model, implying the development of consecutively more complex e-moderating skills, was explained. Further, the series of stages that e-moderating consists of was discussed separately and linked to the corresponding points of interest that tutors should take into account and the different responsibilities they should take up.

The fourth cluster in the training dealt with two important *tutor skills*, namely *asking questions* and *providing feedback*. As to the skill of asking questions, students were initiated in different types of questions, aiming at motivating the participants to engage in the discussion, eliciting reactions, activating prior knowledge, testing comprehension, encouraging in-depth discussions, evaluation,… As to the skill of providing feedback, specific guidelines were discussed with the students (e.g., linking feedback to the aim of the online discussion assignments, providing specific feedback, providing directions for improvement, giving positive or constructive feedback).

The fifth cluster concentrated on the *integration of the preceding clusters* by discussing examples of good and poor practice. The examples were developed based on the asynchronous discussion groups of a prior cohort of freshmen.

Finally, the pre-service training ended with a *demonstration and try-out of the asynchronous discussion environment*.

In-service training

The in-service follow-up sessions were built in to take into account Topping's (1996) guideline that a peer tutor training demands reflection on tutorials with other peer tutors. In this respect, we met peer tutors' need for continuous supervision and support. More specifically, the follow-up sessions were organised two-weekly, on campus, and in small groups of about ten tutors and aimed at optimising the online peer tutoring activities.

References

Aviv, R., Erlich, Z., & Ravid, G. (2003). Cohesion and roles: network analysis of CSCL communities. In V. Devedzic, J. M. Spector, D. G. Sampson, & Kinshuk. (Eds.), *Proceedings of the third IEEE international conference on advanced learning technologies* (pp. 145–150). Athens: ICALT.

Bull, K. S., Shuler, P., Overton, R., Kimball, S., Boykin, C., & Griffin, J. (March 1999). Processes for developing scaffolding in a computer mediated learning environment. Paper presented at 19th conference proceedings of the American Council on Rural Special Education (ACRES), Albuquerque, New Mexico.

Cecez-Kecmanovic, D., & Webb, C. (2000). Towards a communicative model of collaborative web-mediated learning. *Australian Journal of Educational Technology, 16*, 73–85.

Cheng, Y. C., & Ku, H. Y. (2009). An investigation of the effects of reciprocal peer tutoring. *Computers in Human Behavior, 25*, 40–49.

Cohen, E. G. (1994). *Designing groupwork: Strategies for the heterogeneous classroom* (2nd ed.). New York: Teachers College Press.

De Smet, M., Van Keer, H., & Valcke, M. (2008). Blending asynchronous discussion groups and peer tutoring in higher education: an exploratory

study of online peer tutoring behaviour. *Computers and Education, 50*, 207–223.

De Wever, B., Schellens, T., Valcke, M., & Van Keer, H. (2006). Content analysis schemes to analyse transcripts of online asynchronous discussion groups: a review. *Computers and Education, 46*, 6–28.

De Wever, B., Schellens, T., Van Keer, H., & Valcke, M. (2008). Structuring asynchronous discussion groups by introducing roles: do students act in line with assigned roles? *Small Group Research, 39*, 770–794.

De Wever, B., Van Keer, H., Schellens, T., & Valcke, M. (2007). Applying multilevel modelling on content analysis data: methodological issues in the study of the impact of role assignment in asynchronous discussion groups. *Learning and Instruction, 17*, 436–447.

De Wever, B., Van Keer, H., Schellens, T., & Valcke, M. Roles as structuring tool in online discussion groups: The differential impact of different roles on social knowledge construction, submitted for publication.

De Wever, B., Van Keer, H., Schellens, T., & Valcke, M. (2009). Structuring asynchronous discussion groups: the impact of role assignment and self-assessment on students' levels of knowledge construction through social negotiation. *Journal of Computer Assisted Learning*, *25*, 177–188.

De Wever, B., Van Winckel, M., & Valcke, M. (2008). Discussing patient management online: the impact of roles on knowledge construction for students interning at the paediatric ward. *Advances in Health Sciences Education, 13*, 25–42.

Dillenbourg, P. (2002). Over-scripting CSCL: the risks of blending collaborative learning with instructional design. In P. A. Kirschner (Ed.), *Three worlds of CSCL: Can we support CSCL* (pp. 61–91). Heerlen, The Netherlands: Open Universiteit Nederland.

Duffy, T. M., & Cunningham, D. J. (1996). Constructivism: implications for the design and delivery of instruction. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 170–198). London: Prentice Hall International.

Falchikov, N. (2001). *Learning together: Peer tutoring in higher education*. London: Routledge.

Gilbert, P. K., & Dabbagh, N. (2005). How to structure online discussions for meaningful discourse: a case study. *British Journal of Educational Technology, 36*, 5–18.

Gray, B. (2004). Informal learning in an online community of practice. *Journal of Distance Education, 19*, 20–35.

Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research, 17*, 397–431.

Hara, N., Bonk, C. J., & Angeli, C. (2000). Content analysis of online discussion in an applied educational psychology course. *Instructional Science, 28*, 115–152.

Jones, R. H., Garralda, A., Li, D., & Lock, D. (2006). Interactional dynamics in on-line and face-to-face peer-tutoring sessions for second language writers. *Journal of Second Language Writing, 15*, 1–23.

Kester, L., Sloep, P. B., Van Rosmalen, P., Brouns, F., Koné, M., & Koper, R. (2007). Facilitating community building in learning networks through peer-tutoring in ad hoc transient communities. *International Journal of Web Based Communities, 3*, 198–205.

Kirschner, P. A. (2001). Using integrated electronic environments for collaborative teaching/learning. *Research Dialogue in Learning and Instruction, 2*, 1–9.

Krippendorff, K. (2004). *Content analysis: An introduction to its methodology* (2nd ed.). Thousand Oaks, CA: Sage.

McLoughlin, C., & Marshall, L. (2000). Scaffolding: a model for learner support in an online teaching environment. In A. Herrmann, & M. M. Kulski (Eds.), *Flexible futures in tertiary teaching*. Proceedings of the ninth annual teaching learning forum. Perth, Australia: Curtin University of Technology. Available from. http://lsn.curtin.edu.au/tlf/tlf2000/mcloughlin2.html.

McLuckie, J., & Topping, K. J. (2004). Transferable skills for online peer learning. *Assessment & Evaluation in Higher Education, 29*, 563–584.

Marra, R. M., Moore, J. L., & Klimczak, A. K. (2004). Content analysis of online discussion forums: a comparative analysis of protocols. *Educational Technology Research and Development, 52*, 23–40.

Merrill, M. D. (1991). Constructivism and instructional design. *Educational Technology, 31*, 45–53.

Moule, P. (2007). Challenging the five-step model for e-learning: a new approach. *Association for Learning Technology Journal Research in Learning Technology, 15*, 37–50.

Neuendorf, K. A. (2002). *The content analysis guidebook*. Thousand Oaks, CA: Sage.

Newman, D. R., Webb, B., & Cochrane, C. (1995). A content analysis method to measure critical thinking in face-to-face and computer supported group learning. *Interpersonal Computing and Technology, 3*, 56–77.

O'Donnell, A. M., & Dansereau, D. F. (1992). Scripted cooperation in student dyads: a method for analyzing and enhancing academic learning and performance. In R. Hertz-Lazarowitz, & N. Miller (Eds.), *Interaction in cooperative groups: The theoretical anatomy of group learning* (pp. 120–141). New York: Cambridge University Press.

Pata, K., Sarapuu, T., & Lehtinen, E. (2005). Tutor scaffolding styles of dilemma solving in network-based role-play. *Learning and Instruction, 15*, 571–587.

Pfister, H. R., & Mühlpfordt, M. (2002). Supporting discourse in a synchronous learning environment: the learning protocol approach. In G. Stahl (Ed.), *Proceedings of CSCL 2002: Computer support for collaborative learning: Foundations for a CSCL community* (pp. 581–589). Mahwah, NJ: Erlbaum.

Roscoe, R. D., & Chi, M. T. H. (2007). Understanding tutor learning: knowledge-building and knowledge-telling in peer tutors' explanations and questions. *Review of Educational Research, 77*, 534–574.

Rourke, L., & Anderson, T. (2002). Using peer teams to lead online discussions. *Journal of Interactive Media in Education, 1*, 1–21.

Rourke, L., Anderson, T., Garrison, D. R., & Archer, W. (2001). Methodological issues in the content analysis of computer conference transcripts. *International Journal of Artificial Intelligence in Education, 12*, 8–22.

Salmon, G. (2000). *E-moderating: The key to teaching and learning online*. London: Kogan Page.

Schellens, T., & Valcke, M. (2005). Collaborative learning in asynchronous discussion groups: what about the impact on cognitive processing? *Computers in Human Behavior, 21*, 957–975.

Schellens, T., & Valcke, M. (2006). Fostering knowledge construction in university students through asynchronous discussion groups. *Computers and Education, 46*, 349–370.

Schellens, T., Van Keer, H., & Valcke, M. (2005). The impact of role assignment on knowledge construction in asynchronous discussion groups: a multilevel analysis. *Small Group Research, 36*, 704–745.

Schellens, T., Van Keer, H., Valcke, M., & De Wever, B. (2007). Learning in asynchronous discussion groups: a multilevel approach to study the influence of student, group, and task characteristics. *Behaviour and Information Technology, 26*, 55–71.

Snijders, T. A. B., & Bosker, R. J. (1999). *Multilevel analysis*. London: Sage.

Strijbos, J. W., Martens, R. L., Jochems, W., & Broers, N. J. (2004). The effect of functional roles on group efficiency: using multilevel modelling and content analysis to investigate computer-supported collaboration in small groups. *Small Group Research, 35*, 195–229.

Tagg, A. C. (1994). Leadership from within: student moderation of computer conferences. *American Journal of Distance Education, 8*, 40–50.

Topping, K. J. (1996). Effective peer tutoring in further and higher education: a typology and review of the literature. *Higher Education, 32*, 321–345.

Topping, K. J., Simpson, G., Thompson, L., & Hill, S. (1997). Faculty-wide accredited cross-year student supported learning. *Higher Education Review, 29*, 41–64.

Van Keer, H. (2004). Fostering reading comprehension in fifth grade by explicit instruction in reading strategies and peer tutoring. *British Journal of Educational Psychology, 74*, 37–70.

Van Rosmalen, P., Sloep, P. B., Brouns, F., Kester, L., Berlanga, A., Bitter, M., et al. (2008). A model for online learner support based on selecting appropriate peer tutors. *Journal of Computer Assisted Learning, 24*, 483–493.

Van Rosmalen, P., Sloep, P., Kester, L., Brouns, F., De Croock, M., Pannekeet, K., et al. (2008). A learner support model based on peer tutor selection. *Journal of Computer Assisted Learning, 24*, 74–86.

Veerman, A., & Veldhuis-Diermanse, E. (2001). Collaborative learning through computer-mediated communication in academic education. In P. Dillenbourg, A. Eurelings, & K. Hakkarainen (Eds.), *Euro CSCL 2001* (pp. 625–632). Maastricht, The Netherlands: McLuhan Institute, University of Maastricht.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Weinberger, A., Reiserer, M., Ertl, B., Fischer, F., & Mandl, H. (2005). Facilitating collaborative knowledge construction in computer-mediated learning environments with cooperation scripts. In R. Bromme, F. W. Hesse, & H. Spada (Eds.), *Barriers and biases in computer-mediated knowledge communication* (pp. 15–38). Boston: Kluwer.

Wong, W. K., Chan, T. W., Chou, C. Y., Heh, J. S., & Tung, S. H. (2003). Reciprocal tutoring using cognitive tools. *Journal of Computer Assisted Learning, 19*, 416–428.

Zhu, E. (1996). Meaning negotiation, knowledge construction, and mentoring in a distance learning course. In *Proceedings of selected research and development presentations at the 1996 national convention of the association for educational communications and technology* (pp. 821–844), Available from ERIC documents ED 397 849 at. http://eric.ed.gov/ERICWebPortal/recordDetail?accno=ED397849 Indianapolis, IN.

Zigurs, I., & Kozar, K. A. (1994). An exploratory study of roles in computer-supported groups. *Management Information Systems Quarterly, 18*, 277–297.