Students' collaborative peer reviewing in an online writing environment

Linda Bradley[1], Sylvie Thouësny[2]
linda.bradley@gu.se, sylvie.thouesny@research-publishing.net

[1] Faculty of Education, University of Gothenburg, Sweden
[2] Research-publishing.net, France

Abstract. Peer review is applied as a powerful tool to enhance student collaboration online writing. The purpose of this paper is to analyse learners' mechanisms of peer reviewing in the nature of student interventions and interactions in written online peer reviewing and how categorization of student comments can be used as a means for analysing student peer reviewing. The study is an in-depth investigation of computer science students participating in a technical writing course, using Google Drive as their joint work space. While writing their group text, the students were participating in peer reviewing work. Results show combining analysis models provide a better understanding of the implication of commenting in both scrutinizing the progressive scale of assistance, as well as area, nature, and type of commenting, together with what themes evolve. Further, taking turns providing feedback is an enriching activity.

Keywords: peer reviewing, collaborative learning, technical writing, online learning, content analysis

Introduction

As student online activities become more widespread, using web-based technology for collaborative writing among students is something that has been increasingly applied in language learning (e.g., AbuSeileek & Abualsha'r, 2014; Bradley, 2014; Bradley, Lindström, Rystedt, & Vigmo, 2010; Jimoyiannis & Roussinos, 2017; Leijen, 2017). Peer work in the form of review processes where joint understanding is negotiated is suggested to develop skills of critical reflection from receiving as well as giving feedback to others (Liu & Carless, 2006; Lundstrom & Baker, 2009). The shift in mindset, from embracing the teacher as the only expert to seeing fellow students as providers of feedback, has taken a central position in reviewing work.

The purpose with this research is to investigate how students contribute to and are willing to help each other in an online joint writing assignment conducted through a framework based on oral and written guidelines within a technical writing course for Computer Engineering students. To do so, the students' interventions and interactions in an online peer review environment are categorized and analysed in the research analysis, using the same framework provided to the students. In other words, the objective is to explore whether combining guidelines of content, structure and language provides a deeper insight into the nature of students' collaborative and cooperative work while reviewing their peers' written contributions in a language learning context.

Literature review

For collaborative online learning, writing is a skill that has attracted attention to further investigation from a language learning perspective (see e.g., Bradley, 2014; Bradley et al., 2010; Storch, 2013). The nature of student collaboration when producing joint text implies students becoming resources for each other in their reviewing work (e.g., Storch, 2005, 2017). Of significant concern in the rhetoric is that online writing environments offer spaces for collaboration with ease of use and access (e.g., Miceli, Murray & Kennedy, 2010). Web-based social writing tools allow several persons to contribute to the authoring and publishing of the same content, something that takes time to get used to since writing is traditionally considered private (Mak & Coniam, 2008). More studies are needed on the pedagogical implications in collaborative writing where co-construction of knowledge takes place through interaction (Storch, 2013).

When peer students engage in collaborative writing, they are frequently presumed to take joint responsibility for the text being more receptive to peer comments (Storch, 2005). This suggests that when peers perceive no ownership of the text, there is little interest to effect change, which certainly displays the complexity in collaborative writing. However, engaging in peer reviewing activities supports students' insight into writing and revision processes (Min, 2006). From such a perspective, peers are capable of giving valid feedback, a process that will likely pay back, developing skills in being self-critical when students are revising their own writing (Rollinson, 2005).

Something brought up in the literature is the implication of training of peer review, in order for it to have an effect. For instance, Zhu (1995) investigated groups of composition class students providing suggestions and seeking clarifications with their peers, which showed that training has great significance on quantity and quality of feedback. In another study, Min (2006) investigated peer review training in an English as a foreign language writing class suggesting that a step-by-step peer review training procedure was useful for inexperienced writers where students viewed texts from multiple perspectives. Paying attention to peer review training is a way forward of overcoming the issue of focusing on the product rather than the process of writing (Storch, 2005).

Ware and Warschauer (2006) presented advantages in technology-enhanced peer review environments, such as online availability and providing more targeted comments compared to non-digital feedback. Studies of peer reviewing activities in asynchronous online environments display a promotion of collaborative activities and increased communication (Caws, 2006). The idea with peer feedback is to encourage an atmosphere of reciprocal learning based on a communicative approach to language learning (Oskoz & Elola, 2011). This learning process could be collaborative, i.e., students contribute to joint production sharing decision making and responsibility, as well as cooperative, i.e., students divide roles and are willing to be of assistance to each other (Dillenbourg, 1999; Donato, 2004; Storch, 2013). As stated by Storch (2017),

> *"[a]lthough both approaches result in the creation of one joint text, the processes leading to the creation of the text and when the peer feedback is provided differ. Cooperation implies some division of labour, with contributors taking individual responsibility for specific subtasks or for composing certain sections of the text. […] In collaborative writing, the co-authors are involved in all stages of the text construction"* (p. 67).

A more in depth definition of collaborative activities is found in Parks et al. (2003), who refine collaborative processes from the perspective of how common production of text assumes different shapes in relation to division of labour, distinguishing between joint collaboration, working on the same text assuming equal responsibility for its production;

parallel collaboration, although working on the same text, not assuming equal responsibility; incidental collaboration, asking peers for help on specific items related to the writing task; and covert collaboration, retrieving information from documents and linguistic or non-linguistic sources when producing text.

Analyzing peer reviewing

When categorizing data in collaborative and cooperative student written activities in web-based environments, different schemes of coding are observed. For instance, the Collective Instrument-mediated Activity Situation (CIAS) model is used by Cerratto-Pargman, Knutsson & Karlström (2015) to investigate students' peer review activities interconnected with sociomaterial aspects of mediated collaborative learning. While focusing on different aspects of mediation, such as epistemic, pragmatic, interpersonal, and reflexive, their results showed that the materiality of two different tools used by students, Google Docs and Wordpress, influenced student interaction. Yet another example of a coding model for conceptualizing peer review is Liu and Sadler's (2003), adopted in Bradley, Lindström & Rystedt (2010) categorization of student comments in face-to-face versus online interaction. This model displays a three-dimensional coding system which classifies feedback in terms of 1) area, whether comments are global (i.e., concern development and organization of text) or local (i.e., content related to sentences or words, and language), 2) nature, whether comments are revision oriented or non-revision oriented, and 3) type, whether comments are related to evaluation, clarification, suggestion, or alteration (Liu & Sadler, 2003). Their study showed that engaging in online peer reviewing, students were more prone to give revision-oriented comments. In addition, those students also had a larger number of text revisions than in face-to-face meetings.

In a study by Li and Zhu (2017), interaction patterns with small groups of students in a wiki were examined. From a sociocultural perspective of learning, the dynamic nature of group interaction was investigated. In this study, the participants' behaviour altered during the course of the joint writing. This research points at the essence of understanding how students approach writing tasks and how they co-function in a collaborative writing environment has an impact of the outcomes.

In line with sociocultural perspectives of learning, peers are regarded as interactive mediating partners (Vygotsky, 1978). One of Vygotsky's (1978) ideas with respect to assessment was to legitimate the use of assisted performance to evaluate one's actual as well as emerging development. As highlighted within sociocultural perspectives to learning, mediated assessment is defined as a procedure that "integrates assessment and instruction into a seamless, unified activity aimed at promoting learner development through appropriate forms of mediation that are sensitive to the individual's [...] current abilities" (Lantolf & Poehner, 2004, p. 50). According to Villamil and De Guerrero (2006), mediated assistance should not solely be provided by teachers, but also by peers (p. 25). Little research has as of yet studied peer reviewing where learners obtain not only the appropriate amount of assistance they need to correct themselves but also a guided frame to help them peer reviewing on language, content and structure levels.

To date, only a few studies such as Erfani & Nikbin (2015), and Tzuriel & Shamir (2007) have explored peer mediation and the concept of mediated assessment, comparing peer and tutor mediation and concluding that peer mediation seems to be more beneficial for learners in terms of writing development (Erfani & Nikbin, 2015).

In general terms, it takes a more knowledgeable student to provide assistance to another student. However, it will take an expert to ensure that the assistance provided is in fact in line with one's emerging development. Mediated assessment approaches have been grouped into two main categories: interventionist and interactionist approaches (Lantolf & Poehner, 2004). More specifically, in an interventionist approach, the assistance provided is generally predetermined and standardized so as to facilitate a quantifiable evaluation; interventions, proposed by teachers or more knowledgeable students to learners, are clues organized in advance, arranged from implicit to explicit, and offered without considering the learners' previous responses (Shakki, Derakhshan & Ziabari, 2016).

In an interactionist approach, on the other hand, feedback is provided on a scale ranging from implicit to explicit assistance as a means to co-construct knowledge through not only interactions but also negotiations. Aljaafreh and Lantolf's (1994) seminal work, for instance, offers a 13-level regulatory scale of assistance. While students are asked at level 0 to correct themselves without assistance, at level 12, they are given additional explanations although they were already provided with the accurate form but did not quite understand it. In between, mediation ranges from "something may be wrong in a segment" up to "clues to help the learner arrive at the correct form" (Aljaafreh & Lantolf, 1994, p. 471).

Given that technology-enhanced peer review in writing tasks is likely to help students develop their writing skills (e.g., Ebadi & Rahimi, 2017), we believe that further research to thoroughly investigate students' collaborative and cooperative peer reviewing activities from a holistic perspective will deliver a more insightful understanding of the peer reviewing process. More specifically, the various turns of interaction need to be scrutinized from both the aspects of content of interaction as well as the "frequency and quality of regulation (i.e., help) negotiated between novice and expert" (Aljaafreh & Lantolf, 1994, p. 620). Therefore combining the analysis of the content in the interaction through the lens of a sociocultural perspective is highly relevant for language learning to find out more about the nature of peers' online reviewing.

Research questions

Peer reviewing as a tool for students within technical writing is investigated, and how the collaborative work that the students are engaged in is analysed; these are our research questions:

1. What is the nature of student interventions and interactions in written online peer reviewing?

2. How can categorization of student comments be used as a means for analysing student peer reviewing?

Methodology

This section describes participants and context as well as data collection techniques, coding and analysis.

Participants and context

The participants were Swedish first-year undergraduate computer engineering students taking an advanced English for Specific Purposes (ESP) course in technical writing. Technical writing and English skills are two generic skills that this Bachelor's programme

enhances as vital skills in the professional training of future computer engineers. Also, since further courses in the programme demand English skills, this particular ESP course is placed already in the first year. The study focused on the peer review activities that the students were engaged through the process of writing a group text in the form of a technical report with two rounds of reviewing over a period of five weeks. The students were instructed to pick a popular science topic within their field, computer science, such as computer gaming, computer security and software development. For the students, the objective was to work on improving and refining their argumentation in producing clear and logically structured reasoning in English. The students, who were in the end of their first year of studies, had already attended a previous course in Swedish where they were also writing a report so they were familiar with procedures of providing and receiving peer response from fellow students as a complement to teacher feedback. Since the students were participating in a technical writing course in English, they were writing in English, apart from three groups, mixing some Swedish into their interactions.

The students (N=64) formed 22 writing groups with two to three persons in each group. In order to increase collaborative opportunities in their writing, each group was asked to invite a peer group on Google Docs to discuss the form, content and language of their document by means of text highlighting and comment insertion.

Concerning training in peer reviewing, in addition to attending an introduction seminar on the course content as well as extensive explanations on the peer reviewing process, the students were given a comprehensive set of written guidelines to help them complete the learning activity. Even though the peer reviewing activities themselves were to take place online, the students were also able to bring up peer reviewing issues in the weekly classes they were attending (in line with research proposing peer-review training as a way of facilitating online interaction, e.g., Storch, 2005; Zhu, 1995). Providing peer review training initially only together with encouraging students to be self-directed in terms of bringing questions about the peer-reviewing process to class was part of the design of this study.

Included in the written guidelines, dealing with content, structure and language, a detailed step-by-step procedure to help students provide gradual feedback ranging from implicit to explicit comments was offered (Thouësny, 2013, adapted from Aljaafreh & Lantolf, 1994, p. 471). More specifically, to provide feedback, peers were asked to, wherever possible, first highlight in Google Docs the word or group of words that contained the error without providing any additional comments. If the error was not clear to or contested by the group members they could select the highlighted words in Google Docs and submit a comment asking for either further explanations or arguing why they considered their text was correct. In turn, peers could either provide additional information, on a progressive scale, to help group members correct themselves, or agree that they were correct and that the error highlighted was in fact not an error. It was made clear to peers that the progressive scale could be adapted depending on authors' responses to their annotations.

Although the students were only given brief practical training on how to provide gradual peer feedback according to the mediated assessment principles, they were nevertheless briefed on the purpose of the progressive scale. Its main intent was not only to cooperate in dividing roles, assisting each other, but to collaborative, sharing decision making and taking responsibility in the text production process (see e.g., Dillenbourgh, 1999; Donato 2004; Storch, 2013). This is in line with what Parks et al. (2003) term joint collaboration, in the sense that "two or more writers working on the same text […] assume equal responsibility for its production" (p. 40).

Concerning ethical considerations, the participants gave their informed consent outlining their rights and obligations. Further, they were informed about the project goals and how the data would be used. In addition, their names and usernames were to be protected at all times.

Data collection

The analysis of the 22 groups started with searching for peer in-text editing by manually scanning the revision history of the document. Then, all inserted peer comments were categorized. Comment blocks, representing an entire discussion on one specific item from either text group members and/or non-group members occurring in the document, were codified so as to identify the ones containing interactions and interventions from both text group members and non-group members. Out of the 22 groups, 12 groups were fulfilling the criteria of collaborating together with their corresponding peer group and were thus investigated in this study. The 10 remaining groups were disregarded, as collaboration was non-existent, or close to it. Out of the 12 groups, there were seven groups with three students and five groups with two students (n=31). The gender distribution was five female students and 26 male students, all between the ages of 19 and 22. This distribution is common within any study programme within computer science and engineering.

Further data in the study, serving as background of the context, were observations, written guidelines for report writing and peer reviewing procedures, and student online course questionnaires and evaluation after the termination of the course.

The comments were investigated from the perspective of the interaction in the comments and responses. Thus, the objective was to scrutinize the comments and not compare versions of text. Additionally, the study was investigating the entire groups' interaction and not focusing on individuals in the groups. Also, the analysis is not focusing on the gender perspective in interaction.

There was no analysis of the impact of peer-review training in relation to the students' peer-reviewing process. The reason for this is that the design of the study which was investigating what the nature of student interaction was like in a student-driven online environment.

Data analysis

The data, inserted comments and responses, were described and examined using two different coding schemes based on 1) a progressive scale of assistance and 2) a model of distribution based on Liu and Sadler's (2003) grid. With both schemes, students' turns were counted and the content and direct implications were observed in the joint production.

Firstly, all students' turns, i.e., feedback and responses, were classified. Additionally, peer review activity was labelled from level L1 to level L4 depending on the amount of assistance that was provided, where a level L1 indicates a 'very implicit' move (e.g., pinpointing the error without providing any justification) and a level L4 denotes a 'very explicit' comment (e.g., offering a metalinguistic explanation, or the correct answer even). More precisely, an incorrect word, sentence or even paragraph highlighted in text – for instance in blue – without any further explanations attached to it would be linked to the first level of assistance (L1). At L2, an inappropriate wording or structure would be signalled by its nature, e.g., incorrect agreement (grammatical) or unsuitable word choice (lexical). At L3, additional clues to help correct the error, such as in the case of an incorrect agreement, verb and subject do not agree, would be offered. Finally, at L4, the accurate form would be given. Moreover, responses to peer review were labelled as response to query, feedback

clarification, feedback agreement, replacement confirmation, feedback negotiation, and feedback refusal (Thouësny, 2013).

Secondly, students' turns were scrutinized and categorized in accordance with Liu and Sadler's (2003) model of distribution, which has a three-dimensional layer of area, nature as well as type of feedback. This model that enables a way of conceptualizing peer reviewing, founded on a model by Wolcott (1994) of the roles of the three terms description, analysis, and interpretation in qualitative inquiry. Additionally, the content of the comments was analysed in-depth from the perspective of how responses evolved in posted comments and comment turns. As a result, a few content themes were distinguished, i.e., whether content held major or detailed content issues, linguistic issues, structure, assignment or referencing issues, or general praise.

Results and discussion

Throughout the 12 groups, there were 333 blocks of comments (a block is here understood as a comment and potential turn/s related to the comment). Out of the 333 comment blocks, 132 were initiated by non-group members and 201 took place only between group members.

While no distinction was made between whether the comment was initiated by a group member or a non-group member in the analysis of comment initiations and comment turns, this distinction was kept within the mediated assessment approach where it was observed whether and how group members responded to their non-group members who were providing mediated assistance.

Progressive scale of assistance

From a mediated assessment perspective, guidelines on how to provide feedback on a progressive scale were not closely adhered to by non-group members. Of the total amount of non-group members' comment initiations (132), 17 initiated comments were non-revision oriented feedback, and since determining a level of assistance for 2 comment turns was not practical, in total 19 comments were not assigned to any level and were disregarded, leaving us with a total of 113 comments. While the instructions stated to first highlight the inaccurate sequence without offering any explanations on the error itself, the results showed that none of the non-group members intervened at the first level of assistance (L1). There were as many as 17 comments starting at level 2 (L2), simply identifying the nature of the errors (e.g. "Wrong word or wrong synonym of the word chosen", group ID14) without indicating a way forward for solving the issue. Instead, non-group members mostly provided feedback at levels 3 and 4 with 62 and 34 comment initiations, respectively. Figure 1 illustrates at which level of assistance non-group members started their discussions.

Initiating comments by providing extensive explanations on an incorrect form may denote a certain lack of terminology in terms of English metalanguage; it should be emphasized that participants were computer engineering students learning English as a foreign language and not students of linguistics. More specifically, limited knowledge of English metalanguage may explain why students did not provide feedback at level 2, thus preferring to start their discussion at a level 3 with the inclusion of verbose formulations to back up their description of an identified incorrect form, for example "This sentence sounds weird. Maybe 'But languages change every day' is more appropriate?" (group ID14). This, however, did not account for the fact that students did not provide any feedback at level 1, which should be independent of one's ability to describe the language. However, directly providing the correct form might as well designate a certain lack of grammatical metalanguage.

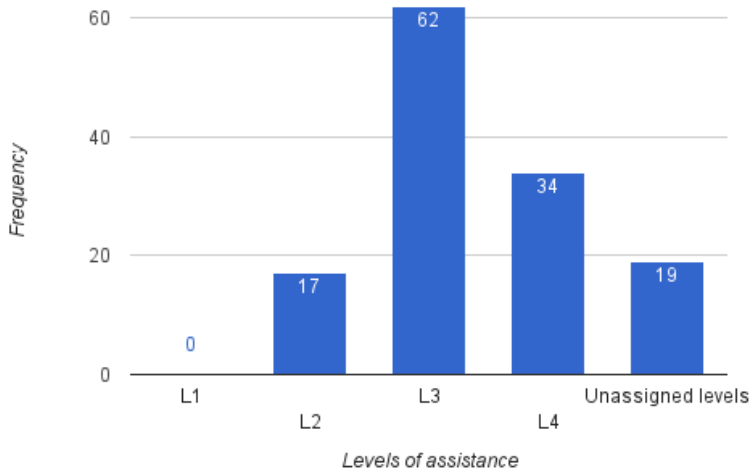

Figure 1. Level of assistance used by non-group members to initiate their comments

A simple remedy would be to test the students' knowledge of grammatical metalanguage at the beginning of the study to ensure that they not only have sufficient knowledge in describing the language, but also understand what it means to provide the nature of an error. Another means to address this concern would be to adopt a systemic-theoretical instruction in the classroom. As stated by Poehner and Infante (2017), systemic-theoretical instruction, which emphasizes the importance of abstract conceptual explanations", may serve as resources to learners as they construct and express meanings in the L2" (p. 336).

Findings indicate that non-group members rarely provided assistance on a progressive scale, ranging from implicit to explicit. From the 113 comments initiated by non-group members (17 at L2, 62 at L3, and 34 at L4), 42 of them (i.e., 37.17%) were never followed up by either a group member's response or a non-group member's next step of intervention as specified in the regulatory scale of mediation. The text analysis, however, showed that only 20 of the 42 comments were standalone feedback with no follow-up from the group members' side, and 20 were followed by changes in text in either partial or full accordance with the feedback received. As for the last 2 remaining comments, it could not be determined with certitude whether the changes brought to the text were linked to the feedback received.

From the 113 comments initiated by non-group members (at levels 2, 3, and 4), 71 of them (62.83%) were followed by either an intervention or an interaction, or a combination of both. Our data showed that group members were more inclined to intervene, as opposed to interact, after a discussion was initiated. While there were only 16 interactions in total (2 responses to a query, 2 feedback clarifications, 5 feedback agreements, 2 replacement confirmations, 3 feedback negotiations, and 2 feedback refusals), it can be noted that group members were more active in terms of interventions; 51 discussions were marked as resolved and 29 changes were made in accordance with the mediation received to the text, without overtly mentioning the feedback approval to their non-group members. The ground for not following on a discussion may relate to students' preferences. For instance, Strobl & Demetsenaere (2015), demonstrated that learners were more inclined to 1) write and annotate a text in an online mode and 2) interact in a face-to-face environment while receiving feedback when investigating cross-level tutoring in advanced L2 writing and contrasting online and face-to-face interaction. In line with Strobl & Demetsenaere (2015), students were prolific in intervening and revising text in the online environment.

Further, the data showed that students did not always correct their text in line with their peers' assistance; yet we counted only 3 feedback negotiations and 2 feedback refusals. The student online course questionnaires and evaluation corroborated reasons for not following up on a discussion being that students did not understand the feedback. However, we only counted 2 feedback clarifications, in spite of the fact that students had plenty of opportunities to ask for additional explanations. A ground for not following up on revisions is suggested to be related to students' lack of motivation and possible issues in group trust; groups who do not seem to work together were termed "Resistant Collaborators" by Bikowski (2016, p. 89).

Although students did not interact much in the sense that they did not contribute to joint discussion around a specific linguistic issue, the next section points to the fact that they were collaborating, cooperating and contributing to the same objective, i.e., the improvement of the texts.

Record of posted comment initiations and comment turns

Even if not all errors or issues were covered in the students' comments, it is suggested that feedback that is timely and relevant can motivate learners (Nix & Wyllie, 2011). From a peer review perspective, certain aspects of the comments were attended to, but far from all in the text. This connects to the purpose of peer review work for writing development in the guidelines which concerned creating a joint endeavor to comment others' texts.

From analysing the texts more in-depth, the 12 student groups were active contributing with 743 comments (333 were inserted comment initiations and 410 were responses to those initiated comments). The evolvement of the content in the turns is analysed further.

Adapting Liu and Sadler's (2003) framework with respect to area, 106 comment initiations were global, i.e., concerning text revision, which calls for more comprehensive text development, and as many as 227 comment initiations were local, i.e., concerning sentences or words, and language (see Table 1 for a summary of all comment initiations counts). This observation tends to be in line with others' findings such as Khasminder and Tan's (2016), who reported that their participants concentrated more on local revisions when providing feedback to their peers. However, Saeed & Ghazali (2017), recently found that their students focused more on global features when peer-reviewing argumentative essays in English as a foreign language.

Table 1. Comment initiations count according to Liu and Sadler's (2003) coding model

Dimension	Categories	Comments
Area	Global	106
	Local	227
Nature	Revision oriented	323
	Non-revision oriented	10
Type	Evaluation	64
	Clarification	124
	Suggestion	128
	Alteration	17

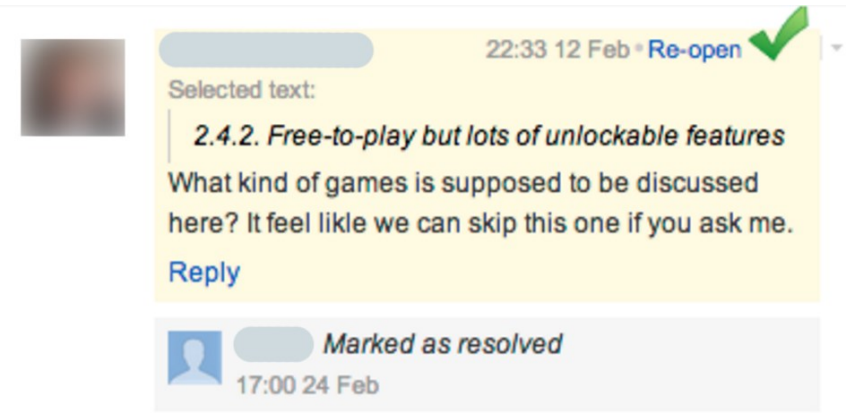

Figure 2. Screenshot of a writing exchange in the online environment

A majority of the global comment initiations embraced the themes major content, content structure, and assignment. One representative example, as illustrated in Figure 2, is *"What kind of games is supposed to be discussed here? It feel like we can skip this one if you ask me"* (global revision-oriented clarification of major content requested by one of the group members, group ID3). Concerning local comment initiations, they were primarily of the themes content detail, linguistics, and referencing.

An example of a local comment initiation is "*We are uncertain whether it should be 'is' or 'are'*" (local revision-oriented suggestion of linguistics requested by one of the group members, group ID14). The theme, general praise concerns both global and local tribute in the text.

Concerning Liu and Sadler's (2003) nature of revision, the comment initiations were revision-oriented with the exception of the theme general praise, which were non-revision oriented, for instance "Job well done" (global non-revision oriented evaluation by non-group member, group ID26). In other words, the comment initiations in the other themes were geared at concrete content improvement or reflections with the purpose of leading to revision. Out of the 333 comment initiations, the most common types of comments (Table 1) were either giving a suggestion (128) or requesting clarification (124), which shows that the online environment was inviting to collaborative work (see Figure 3).

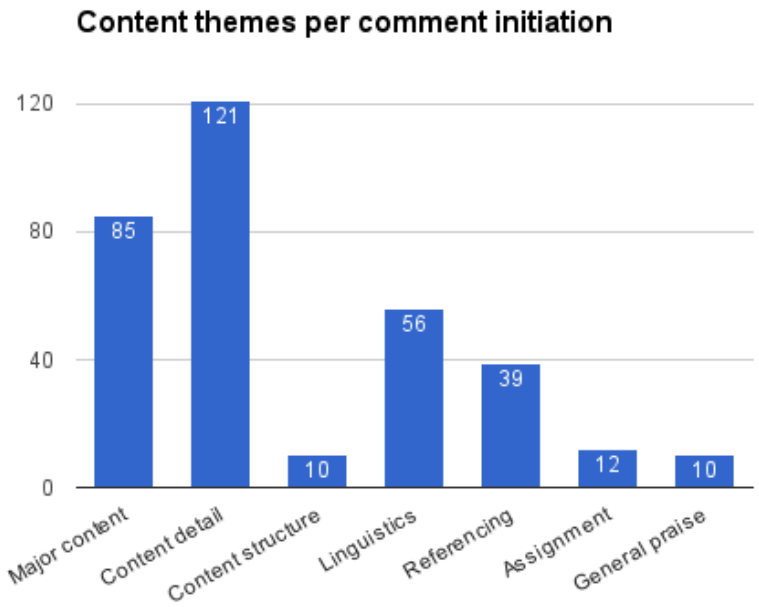

Figure 3. Distribution of all content themes in the 333 comment initiations

The following example is a suggestion to improve the text: "*Change headline to The Future of Mass Surveillance which is more in line with our focus.*" (global, revision-oriented suggestion of major content by one of the group members, group ID2). The next example is a clarification request: "*please specify which developer*" (local, revision-oriented clarification by one of the group members, group ID3). The other two types of comment initiations, offering an evaluation (64) and calling for alteration (17) are less inviting to further text development. For instance *"What a nice intro!"* (local, revision –oriented evaluation by one of the authors, group ID14) and pointing at a word in the text that should be capitalized: *"capital"* (local, revision-oriented alteration by one of the authors, group ID3).

It turned out that the four comment types (i.e., evaluation, clarification, suggestion, and alteration) suggested by Liu and Sadler (2003) also needed to be complemented by a categorization according to what themes were brought up, e.g., whether it concerned major or detailed content issues, linguistic issues, format or referencing issues, or general praise.

What students learned from turn taking and implications for learning

The students were generally active, engaging in commenting activities with an overall of 743 comments (comment initiations and comment responses) which was an average of 62 comment contributions per group. Most comment initiations (169) were responded to with one reply turn. However, 78 comment initiations had between two and up to ten comment response turns. Most groups (8) were very active, displaying several response turns in their Google Docs. Out of the 333 comment initiations, 86 were not responded to at all.

The following representative examples of the interaction turns taking place within the groups display turn taking. Each comment initiation was categorized according to comment area, nature, type, theme provided with group members/non-group members, and group ID. The first one shows an example of the most common theme, content detail with one comment response turn with the most common comment type suggestion and one response turn, i.e., the most recurrent number of comment response turns. One of the group members raised a point in the comment, which was followed up by being marked it as resolved:

> Comment initiation: "*rewrite as 'creates rules based on the information...' or something like that? or, at the very least, a comma is needed somewhere…"* (local, revision-oriented suggestion, content detail by co- group member 1, ID group14)
>
> Comment response: "*Marked as resolved*" (co- group member 2)

Responding by marking a comment as "resolved" was the most frequent response to the fact that the comment was adhered to (See screenshot in Figure 2). Only in a few cases did the text group members interact with their peer group with a usually brief follow-up, such as: "is this better?".

From the turn-taking in the interaction, it was possible to see that the students contributed with ideas for the continued writing process. This is displayed in the next example dealing with the theme referencing, negotiating content/ mentioning what was needed to be backed up (Group ID26). Co-group member 1 points at the word "Sources" in the text:

> Comment initiation: "*Sources I've found so far! Wikipedia so that we can read a bit ourselves and then some real articles, both online and physical, which we can use as sources if they are good"* (co-group member 1).
>
> Comment response: "*Marked as resolved*" (co-group member 1).
>
> Comment response: re-opened. *"I have used articles by both Kurt Squires and Russel Francis. Do I remember correctly that there are rules for how many times one must refer to a source in order for it to be included?"* (co-group member 2).

> Comment response: *"Oh, I don't know… I still think that you need to refer to a source even if it's only mentioned once"* (co-group member 1).
>
> Comment response: *"Ok, if you haven't heard about it or read it somewhere I think we should presume that I got it wrong"* (co-group member 2).

This quote is a typical example of how understanding was negotiated among students. It is suggested that providing input from peers contributes to learning about how to refine writing skills, where handling of references in the text is one such central component in technical writing, which is also supported by the students online course questionnaires and evaluation.

In sum, exploring how students interact with each other online when engaging in peer reviewing is something that has great bearing for language learning. It is suggested that in order for peer reviewing to work one of the prerequisites is training in revision behaviour (Chang, 2012). There are implications of the necessity of peer review training to shape revision quality in writing, i.e., tactics writers could use in order to provide suggestions and seek clarifications together with their peer (e.g., Zhu, 1995). In their study of blogging among students of information science and media studies, Baggetun and Wasson (2006) claim that "[a]s a student, you need to learn how to frame an issue you want to raise, relate it to a current issue, and know how to invite or ask questions so that someone feels tempted to reply" (p. 460). Certain participation skills are needed and that it is essential that students learned the procedures of such participation.

Limitations

Although students received informational guidelines on how to provide mediated assistance, the initial instructions was evidently not sufficient for students to follow a rather unusual way of providing assistance to their peers. Training is indeed one important aspect of peer reviewing; research has shown its importance (Min, 2006). However, with respect to mediated assessment, there is a paucity of research in this direction. Studies, such as the one from Erfani and Nikbin (2015) who reported that their participants were trained in how to provide feedback to peers' writing in a mediated assessment context, generally lack crucial information with respect to training content and how this content is provided. In learning contexts with students who are non-linguists participating in a language course, such as computer engineering students participating in an ESP course, training becomes even more important. Future research in mediated assessment should stress the training aspect in order to establish that students understand how to provide assistance tailored to their peers while focusing on language learning development as opposed to language learning product.

Additionally, given that our data set is smaller than anticipated (10 groups had to be excluded from the analysis due to non-existent peer activities), and the fact that the data collection timeframe is rather short due to the course setting, our data, shows no evidence to back up whether students were willing to adopt such a demanding role that is required with mediated assessment. Although course questionnaires and evaluation after the termination of the course point at a general interest in that direction, future research should include continuous interviews with students to follow up on their interventions and interactions, and equally importantly on how students see their roles as peers. Interviews or think aloud protocols, along with quantitative data, should provide a deeper insight into the feasibility of applying progressive scale of assistance in online peer review.

Conclusion and future research

Introducing technology involving peer reviewing activities, the responsibility is shifted from teachers to students who become resources for each other in their reviewing work (Lundstrom & Baker, 2009). This research contributes to the area of online language learning writing in displaying how combining two various ways written peer review data can be analysed.

With reference to the first research question "What is the nature of student interventions and interactions in written online peer review?" our analysis shows that the interventions and interactions in peer reviews taking place move the texts forward in the writing process. The multifaceted comments and turns provide potential for the students to improve their texts. However, our findings show that peer mediation was not systematically provided on a progressive scale of assistance and certainly not offered with the aim of tailoring one's personal needs with respect to language development. Even though peers did not offer feedback ranging from implicit to explicit, they did provide metalinguistic feedback or correct answers as one standalone interaction. Additionally, our outcomes show that students intervened more extensively with their peers than they interacted, making changes in the text in accordance with the feedback received, without necessarily notifying their peers.

With regard to our second research question "How can categorization of student comments be used as a means for analysing student peer reviewing?" our results suggest that combining models of analysis on online peer review data provide a better understanding of the implication of the commenting in both scrutinizing the progressive scale of assistance, as well as area, nature, and type of commenting, together with what themes evolve. Thus, taking turns providing and receiving feedback is an enriching activity that promotes joint responsibility, which is suggested to be beneficial for development of the text (Storch, 2005). Collaborative online writing offers a way of achieving an insight into text from various perspectives, from the partners' engagement in the writing process and from the joint construction of meaning (Warschauer & Grimes, 2007). Using the same guidelines given to the students for our categorization turned out to be a way forward in order to be able to analyze various aspects of student reviewing in terms of finding out how they approach each other and what kind of themes evolve in their collaboration. The analysis showed that the students were primarily engaged in what Parks et al. (2003) define as parallel collaboration, where although working on the same text they were not assuming equal responsibility; and only on rare occasions were the students engaged in joint collaboration, assuming equal responsibility for the text. Investigating the nature of the collaboration further, in terms of scrutinizing the content of the interaction turns between students will likely inform how students can make use of an online environment for learning as well as what students find problematic in the topic of ESP and technical writing.

In the future, it would be interesting to scale up this type of study, embracing a greater number of students in order to achieve more data. However, there is a challenge to make large scale studies of students' peer responses since classes are generally delimited to a low number of students. Even if there were over 64 students to start with in our study, what eventually constituted our data was only half of that number, 31 students (see Li & Zhu, 2017). One way forward is to set up studies with parallel classes of students. In this way, it would be possible to achieve a higher number of participants. Furthermore, while we hypothezise that combining the analysis of aspects of interaction as well as their frequency to investigate student collaboration and cooperation should be transferable to other languages and possibly tasks, this will require further research and analysis to be ascertained.

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