

The effects of teacher' feedback: a case study of an online discussion forum in Higher Education

Efectos de la retroalimentación del profesor: un estudio de caso de un foro de discusión en línea en Educación Superior

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Abstract

Despite its importance, the effects of feedback in online environments has not been widely assessed; nor is there any consensus on how it should be measured. The aim of this exploratory study is to analyse the effects of teacher feedback during the development of an online discussion forum. Over a three-week period, the participants (14 university students and their tutor) engaged in a virtual debate on the use of *Wikipedia* for academic purposes, using the *Knowledge Forum* platform (participants made 328 posts in total). Based on characteristics of online learning environments, we developed a multidimensional model to study feedback and its effects during online interaction. The results show the main effects of the teacher's feedback both on the students' discussion about learning topics –chain effect and cluster effect– and on the rules of participation in the debate. The paper concludes with a discussion on the theoretical and practical implications of these results. **Key words:** effects of feedback, engagement, higher education, interactional perspective, online discussion

Resumen

A pesar de su importancia, los efectos de la retroalimentación en entornos en línea no han sido ampliamente evaluados; tampoco hay consenso sobre cómo deben medirse. El objetivo de este estudio exploratorio es analizar los efectos de la retroalimentación del profesorado durante el desarrollo de un foro de discusión en línea. Durante un período de tres semanas, los participantes (14 estudiantes universitarios y su tutor) participaron en un debate virtual sobre el uso de *Wikipedia* con fines académicos, utilizando la plataforma *Knowledge Forum* (los participantes realizaron 328 publicaciones en total). Sobre la base de las características de los entornos de aprendizaje en línea, desarrollamos un modelo multidimensional para estudiar los comentarios del profesor y sus efectos durante la interacción en línea. Los resultados muestran los principales efectos de la retroalimentación tanto en la discusión de los estudiantes sobre los temas de aprendizaje -efecto en cadena y efecto en

racimo-, como en las reglas de participación en el debate. El documento concluye con una discusión sobre las implicaciones teóricas y prácticas de estos resultados.

Palabras clave: efectos de la retroalimentación, implicación, educación superior, perspectiva interactiva, discusión en línea.

1. Introduction

Online collaborative environments are particularly conducive to encouraging communication among participants. Their ability to promote the discussion and construction of increasingly rich and complex knowledge has generated high expectations. However, these expectations have not always been accompanied by positive results: several studies have reported how difficult it is to stimulate debate and to progress towards the construction of shared knowledge (Coll & Engel, 2014; Coll, Engel, & Bustos, 2009; Galikyan & Admiraal, 2019; Garrison, Anderson & Archer, 2000; Gross & Silva, 2006; Zhu, 2006). In this situation, researchers have studied educational tools, among them teacher feedback, in order to assess their influence on the construction of knowledge in online learning environments (Coll, Rochera, & De Gispert, 2014; Guasch, Espasa, Álvarez, & Kirschner, 2013; Stein, Wanstreet, Slagle, Trinko, & Lutz, 2013; Yang, 2016).

The interest in the study of feedback has a long history, especially on face-to-face situations (Evans, 2013; Hattie & Timperley, 2007; Shute, 2008), and attention in the literature to this topic in online environments is increasing (Cheng, Liang, & Tsai, 2015; Gikandi, Morrow, & Davis, 2011; Martin, Wang, & Sadaf, 2018; Stein et al., 2013). In the research on this field, several ways of understanding feedback are described. Traditionally, feedback is defined as information about the gap between the learner's performance and the reference level (Ramprasad, 1983). Other studies see feedback as a continuous process of guidance for students rather than as a procedure, in which advice is given at a series of separate, unrelated points in time (Attali & Van der Kleij, 2017; Shute, 2008). In recent literature, more and more authors argue that the effectiveness of teacher feedback does not depend solely on its intrinsic characteristics, but on the fact that students can use it to engage in and improve their learning (for example, Ajjawi & Boud, 2018; Price, Handley, & Millar, 2011; Winstone, Nash, Parker, & Rowntree, 2017). These authors maintain that the relationship between teacher feedback and students' construction of knowledge is not linear, but should be understood in a more complex way that takes into account not only the teacher's action but also the students' responses to the feedback offered.

Trying to capture this complexity, in recent years, research on feedback has shifted its focus of interest away from the study of feedback itself to the analysis of its effects on knowledge construction (Ajjawi & Boud, 2018; Zimbardi et al., 2017). From a socio-constructivist perspective, feedback should be seen as a social and dialogical process on constructed through the interrelated action of participants (Ajjawi & Boud, 2018; Boud & Molloy, 2013; Carless, 2013; Hattie & Gun, 2011; Nicol, 2010). From this perspective,

we need to explore students' responses to feedback from an interactive perspective in order to understand the potential of feedback for promoting engagement and knowledge construction.

In parallel, the literature has revealed the lack of a widespread consensus on how to measure the effects of teacher feedback in knowledge construction regarding online situations, since its assessment depends on the perspective from which it is studied (Espasa, Guasch, Mayordomo, Martinez-Melo, & Carless, 2018). Often, the effects are valued and measured through the work produced at the end of the instruction, the results achieved (grades), or the satisfaction of the students (Getzlaf, Perry, Toffner, Lamarche, & Edwards, 2009). However, several authors propose that the effects of feedback should be analysed within the framework of the process of discussion and interaction between participants (Ajjawi, & Boud, 2018; Stein et al., 2013). Despite its importance and the obvious interest that it has aroused, feedback impact and its effects have not been explored in depth from a relational and dynamic perspective, especially in natural settings. In view of this growing interest, the objective of this article is to explore the characteristics of teacher feedback and the main effects that these characteristics have on the knowledge construction among participants in an online collaborative learning process.

2. Theoretical framework

2.1. Knowledge construction process through interaction in an online collaborative learning environment

The main aim of online collaborative environments is to allow students to share and build knowledge through the discussion of dilemmas or problems that arise in the context of joint activity (Scardamalia & Bereiter, 2006). In these environments, the interaction between the students is fundamental; through their joint participation, they contribute to building a body of shared knowledge that grows ever more profound and complex (Galikyan & Admiraal, 2019). Häkkinen and Järvelä (2006), state that the participation of students in online collaborative environments involves a process of joint construction of meanings about the learning content, but also the coordination of their interaction to find joint solutions to the task set. In fact, collaborative learning situations are the stage for a dual process of construction of meanings: one related to the learning contents, and the other related to the ways of organising the joint activity or interaction. Both processes are closely interconnected, and so the ways in which participants organise, control and regulate their joint activity affects the meanings they construct, either facilitating or hindering the process (Coll & Engel, 2018).

Online collaborative environments are generally asynchronous, based on written communication, and do not involve direct visual contact; as a result (and in contrast to face-to-face interaction situations), the forms of organisation of the joint activity in online environments are not usually evident to the participants. In fact, teachers have to explicitly formulate the organisation of the joint activity that they are going to perform. That is, what they are going to do and how they are going to do it, who will do what and in what order, the work they will produce or the results they will generate, what characteristics

this work will have, and so on. Not only must these rules of organisation be explicit, but efforts must also be made to ensure that all participants know what the rules entail from the very beginning of the learning process. Likewise, during the interaction, participants must identify and challenge actions that do not respect these rules (and be reminded of the rules, if necessary). The collaborative construction of ever richer and more complex shared meanings regarding the learning will depend on the outcome of this negotiation between the teacher and the students (Galikyan & Admiraal, 2019; Coll & Engel, 2018; Coll, et al., 2009).

One of the main advantages of online collaborative environments is that they allow the creation of a systematic structure of student support, facilitate sustained interaction between the teacher and the students, monitor participants' contributions (i.e., the comments they post) and offer feedback based on these posts (Ludwig-Hardman & Dunclap, 2003). For the collaborative learning process to be successful, the teacher must specify the characteristics of the academic work and the rules of participation that s/he has designed for the learning situation. The teacher must also help students negotiate these rules must guide them in the collaborative construction of knowledge. This aid from the teacher can take different forms, as coaching and feedback (Stein et al., 2013). Feedback, which allows a more personalised approach, is potentially one of the most useful (Coll, et al., 2014; Leibold & Swarz, 2015) and one of the most appreciated guide by students (Martin et al., 2018).

2.2. A multidimensional model for studying feedback and its effects in an interactive online environment

Based on the characteristics of online collaborative learning contexts and on our review of the literature on feedback, in previous work we proposed a model that comprises four fundamental dimensions for studying feedback in online collaborative environments (Coll, Rochera, De Gispert, & Díaz-Barriga, 2013; Coll, et al., 2014). The first dimension is the focus of the feedback: the teacher could offer information on the content or topics of the discussion or on student participation. The second dimension is the type of feedback offered in relation to these aspects: *verification* feedback, when the teacher indicates whether the student's performance is correct or incorrect, or *elaboration* feedback, when the teacher offers information to guide the student's actions (Guasch et al., 2013; Attali & Van der Kleij, 2017). The third dimension is the recipient of the feedback, i.e., whether the teacher is addressing a particular student or the group in general. Finally, the fourth is the temporal dimension; since students' needs change over the course of the process, it is important to consider the moment in which the feedback is offered, as well as its relation with students' previous performance (De Laat, Lally, Lipponen, & Simons, 2007).

With respect to the effects that feedback of teacher can have in knowledge construction, is important to analyse how the teacher engages the different students through the feedback s/he provides (Hatziapostolou & Paraskakis, 2010). In this context, once again, it is important to bear in mind the temporal dimension (De Laat et al., 2007). Considering temporal dimension permit to assess whether, because of teacher feedback, students become more engaged in the activity (for example, for more days). The time students spend on activity to respond to the instructor's feedback might help grasp the depth with

which they discuss and construct knowledge. Certainly, this aspect is not enough to fully understand the effects of teacher feedback, it is also necessary to consider the contributions content (Stein et al., 2013). Additionally, in online collaborative learning environments communication is public, and one or several participants can respond to previous posts made by teacher and other participants and is important considerer how many student engage in the discussion as a reaction to feedback. From this perspective, it is agreed that the characteristics of feedback is fundamental to support collaborative processes of knowledge building in online learning environments. However, it is also agreed that students' responses to this feedback are not automatic, but depend on the dynamics of the interaction. In this sense, teacher feedback is also seen as a dynamic process that is built within the framework of the joint activity that the participants (teacher and students) pursue over the course of the instructional process (Álvarez, Espasa, & Guasch, 2012; Coll et al., 2014). Thus, the analysis of teacher feedback in collaborative online learning environments involves, first, to study on key dimensions of feedback and second, to focus on reactions of the participants in response to the feedback given.

2.3. Purpose and Research questions

In this paper, we aim to analyse how the feedback offered by the teacher influences the collaborative construction of knowledge in an online discussion forum. More specifically, our purpose is to answer the following questions:

- 1) What are the characteristics of the feedback offered by the teacher during the discussion process, in terms of: (i) the focus (content, or participation); (ii) the type of feedback (verification, or elaboration); (iii) the recipient (individual participants, or class groups); and (iv) its distribution over time in the online teaching and learning process.
- 2) What effects does the teacher's feedback have on the discussion in the forum, in terms of (i) the number of different students who respond; (ii) the time they take to discussing an answer to teacher's feedback and (iii) the content of their responses.

3. Method

To address these questions, we carried out a descriptive, exploratory study using a case study method in a natural setting (Yin, 2009). The case study is a methodological approach that is commonly used to analyse and develop an understanding of online discussion activities (Schrire, 2006). The selection of the case was intentional due to the teacher's expertise in supporting and guiding collaborative online knowledge construction processes. We selected as a single case study an instructional sequence of this teacher with his regular students in the subject "quantitative studies in education". The main pedagogical activity was a debate developed over a relatively long period of time, which had specific learning objectives and had detailed guidelines for students on the rules of participation.

3.1 Participants and setting

Participants in the study were one teacher and 14 undergraduate students of psychology (11 women, three men, between 22 and 23 years old) at the National Autonomous University of Mexico. Those 4th grade students of psychology had previous experience in online discussions, but not specifically in the use of the Knowledge Forum. The data presented here were gathered by monitoring the participants during the development of an online debate on the Knowledge Forum platform. The discussion topic was whether Wikipedia was sufficiently reliable to be used in academic assignments.

The teacher started the debate by asking students whether they thought Wikipedia was a reference work that could be relied on as the source of information (either exclusively or in addition to other sources) for carrying out their course assignments. The teacher argued that a discussion on the reliability of Wikipedia was relevant, as many different opinions have been expressed in the literature; to exemplify the point, he provided various articles for and against Wikipedia for students to use in their arguments in the debate. Similarly, he encouraged students to seek information on the internet to support or illustrate their arguments and to help them to refute the arguments of others. In his initial contribution to the forum, the teacher summarized the two opposite stances on the reliability of Wikipedia, and stressed that there were a wide range of positions between these two extremes.

The Knowledge Forum (Version 4.5), a digital platform for asynchronous multi-way communication via the exchange of written texts, was used for the debate. It was specifically designed to support a learning method based on the creation of a Knowledge Building Community (Scardamalia & Bereiter, 2006). The forum offers a series of resources and tools: graphic representation of the posts and the relations between them in discussion threads, the opportunity for participants to respond to previous posts or start as many new discussion threads as they consider relevant, a system of *notes* that can be used to directly insert comments into other participants' posts without changing the original text, or the possibility of including links to files in the shared space or to external sources. One of the most interesting features of the Knowledge Forum is probably the possibility of labelling the content of posts using scaffolding. In the case study, scaffolds or labels such as “my theory”, “a better theory”, “opinion”, “different opinion” or “I need to understand” were used to engage students in forms of dialogue that encourage them to review, compare and constructively negotiate their ideas and those of others, and in this way enhance their collective knowledge.

At the outset, the teacher informed students of the rules of the debate: they were to contribute at least three arguments or counter-arguments a week during the three-week debate, use the Knowledge Forum scaffolds in all of their posts, provide thoughtful, well-supported opinions, examine and discuss the positions of the other students, try to persuade their interlocutors, and reflect on the ideas posted by others.

At the end of the debate, students had to hand in an assignment in which they analysed and assessed the reliability of a Wikipedia entry and reflected more generally on what they had learnt.

3.2. Data collection procedure

For this study, a total of 328 posts were recorded (84 by the teacher and 244 by the 14 students, an average of 17.5 posts per student) over the 23 day-period. Some complementary information was also gathered, such as the design of the teaching sequence created by the teacher, the students' final assignments and the grades awarded by the teacher. This complementary information provided elements of interest for the analysis and interpretation of data.

3.3. Data analysis procedure

In accordance with the objectives of the study, the data were analysed in two stages. In the first stage, the objective was to identify and characterize the feedback provided by the teacher, taking as the unit of analysis the post or part of the post that contained an evaluation of a student's previous post. To differentiate between teacher's posts that might be considered feedback from those that were obviously not, we used two operational criteria: feedback had to include a positive or negative evaluation, and had to relate to a previous post by the student. Once the teacher's posts that met both criteria had been identified, we characterized them according to the three dimensions determined in previous studies: feedback type, focus and the intended recipient (Coll et al., 2014; Coll et al., 2013).

Firstly, each example of the teacher's feedback was classified according to *focus*: i) feedback on content, i.e., whether information was provided that was directly related to the teaching and learning content (i.e., the qualities of Wikipedia on which its reliability is based: whether it is accurate, verifiable, comprehensive, up-to-date, comprehensible), including presentation of explanations, formulation of doubts, requirements, request for clarification, summary, etc.; or ii) feedback on participation, when the information was related to the establishment of rules or instructions on who could or et do what, how, when, with whom, how frequently, etc. (i.e., how students should participate in the debate, the types of contribution are expected of them, how frequently they need to contribute, etc.).

Second, to classify *feedback type*, we distinguished between verification and elaboration feedback. In verification feedback, the teacher indicates whether the student's performance is correct or incorrect. In elaboration feedback, the teacher offers information to guide the student's action

Third, with regard to *the recipients of the feedback*, we distinguished between individual students and the entire group. Table 1 shows the categories used to characterize the teacher's feedback, adapted from the original model by Coll et al. (2014) to the characteristics of the teaching sequence analysed here.

Table 1
Categories of teacher feedback (adapted from Coll, et al. 2014)

| Focus | Type | Category | Description | Recipient |
|---|---|--|---|------------------------------------|
| Teaching and learning content | Verification | Favourable appraisal | Expressions of agreement and acceptance in relation to contents previously presented by students | Individual student or entire group |
| | | Critical appraisal | Expressions of disagreement or discrepancy in relation to contents presented previously by students | |
| | Elaboration (includes one favourable or critical appraisal) | Provision of meanings | Extension, more detailed exploration, arguments, explanations, personal opinions, comments provided by the teacher directly or through external sources | |
| | | Requirement | Students are asked to offer new meanings | |
| | | Request for clarification | Students are asked to clarify previously presented meanings | |
| | | Response to a requirement | Clarifications or explanations about content in response to a question by the students | |
| | Response to a request for clarification | Clarifications or explanations following a request for clarification of meanings | | |
| | Rules of participation in the debate | Verification | Favourable appraisal | |
| Critical appraisal | | | Critical or negative appraisal of the rules of participation and/or compliance with them | |
| Elaboration (includes a favourable or critical appraisal) | | Reminder of the rules | Reminder about the rules governing participation in the debate | |
| | | Proposed revision of the rules | Proposed revision or reformulation of the rules governing participation in the debate | |
| | | Request for clarifications of the rules | Request for clarifications of the rules of participation in the debate | |
| | | Response to a question regarding the rules | Formulation of clarifications about the rules governing participation in the debate, at the request of the students | |

Finally, regarding the *temporal dimension*, we examined the distribution of posts of the participants (both teachers and students) during the 23 days of the discussion forum, and drew up a diagram of all of the discussion threads (Hara, Bonk, & Angeli, 2000) started by the participants on the various topics of debate. Discussion threads comprised responses that participants link to others' previous posts, and by the notes that participants insert in others' posts. We used the visual representation of the debate to analyse the distribution of the participants' posts over time, and the relationships between posts in the same thread. This provided elements for interpretation that were situated and

contextualised in the development of the debate. The diagram could also be used to situate the teacher's posts in the development of the threads, and to interpret the teaching functions of the feedback provided during the debate.

The second stage was focused on identifying the effects of teacher feedback on the students' actions. In this case, the unit of analysis was the discussion thread that participants created during the debate. The criteria used to identify these effects were directly related to the focus of the feedback: thus, when the focus was the learning content, the procedure involved identifying students' posts that responded to, or were directly related to, the teacher's appraisal. For example, if the teacher positively evaluated a student's ideas about a certain topic and highlighted them as relevant, all of the subsequent posts in the same thread that focused on this topic as an object of discussion were considered to be affected by this particular item of teacher feedback.

A similar procedure was used to identify the effect of teacher feedback on the rules of participation in the debate. Thus, when the teacher evaluated the rules of participation and proposed the introduction of a new rule or asked for clarifications about the rules, the effect of the feedback was assessed according to whether students' subsequent posts were directly related to the teacher's appraisal (i.e., posts aimed at evaluating the new proposal, or responses to the teacher's request for clarifications). However, there were two exceptions: firstly, when the feedback was aimed at assessing the number of posts of students to the debate, in which case an increase in the number of student posts was considered an effect; and second, when the teacher provided several successive items of feedback on the same focus, for example, asking students to comply with a specific rule of participation. In this case, a lack of further feedback on this focus was taken to mean that the initial items of feedback had had the required effect, making further comments on this aspect unnecessary. Therefore, in both these cases, the effects were identified not by analysing the content of participants' posts, but through their action (or lack of action).

The analytical procedure involved distinguishing between feedback that had an impact and feedback that did not in the threads created by the participants. We quantified the impact of feedback in three levels: the number of student posts that reflected the teacher's feedback, the number of different students who made these posts, and the number of days during which these posts were made.

In order to meet the criteria of reliability and consistency required in the content analysis, members of the research team implemented a protocol in pairs to identify and analyse the teacher feedback. The pairs of analysts met periodically (with 25%, 50%, 75% and 100% of the coded data) to compare their coding. Consequently, an iterative back-and-forth process between data and their interpretation was applied. Any discrepancy between coders was resolved by discussion until a consensus was reached. In cases in which the coders did not reach an agreement, the opinion of a third independent rater was sought. In all cases, the Kappa index reached a value above 0.90. The same procedure was used between raters to identify students' posts that were directly related to each piece of feedback. In these cases, all the Kappa index values were above 0.85.

4. Results

Participants in this teaching sequence created a total of 40 discussion threads. Most of the posts (98%) were organized into threads; only seven were independent posts, made by four different students. The teacher only started the first of the threads; the remaining 39 were started by students.

Table 2 shows the characteristics of the threads in terms of their duration. We find 4 longer threads (developing over a fortnight) and 6 threads developing between 11 and 15 days. In contrast, there are 19 threads of a short duration (between 1 and 5 days) and mid-term duration (between 6 and 11 days). The longest thread lasted 23 days, and the shortest just one day. Table 3 shows the characteristics of the threads in terms of the number of posts made by the students and teacher. We find threads with quite a number of posts; more concretely, 5 threads with more than 16 contributions, and 4 threads with 11 to 15 contributions. In contrast, 18 threads only present 2 to 5 contributions, and finally 13 threads present from 6 to 10 contributions.

The number of posts ranged from two to 34. Altogether, the average duration of the threads was 7.4 days, with an average of eight posts per participant. The teacher contributed to all the threads but three (threads 3, 15 and 31), and made an average of 2.1 posts in each one. Equally, the teacher made posts that included at least one example of feedback to all of the threads in which he participated, except one (thread 25), and the average amount of feedback per thread was 1.8 items. The number of teacher posts that contained feedback was quite high, at 85.7%.

Table 2

Duration in days of the threads created by participants during the debate

| Duration in days | Number of threads |
|-------------------------|--------------------------|
| Between 1 and 5 | 19 |
| Between 6 and 10 | 11 |
| Between 11 and 15 | 6 |
| Over 15 | 4 |
| Total | 40 |

Table 3

Number of posts of the threads created by participants during the debate

| Number of posts | Number of threads |
|------------------------|--------------------------|
| Between 2 and 5 | 18 |
| Between 6 and 10 | 13 |
| Between 11 and 15 | 4 |
| Over 16 | 5 |
| Total | 40 |

Figure 1 shows only a section of the diagram of threads created, corresponding to four threads (numbers 8, 9, 10 and 11), due to space limitations. The upper row shows the dates during which the threads were active, and the first column indicates the number of the thread. As shown in the expanded section of thread 8, for identification purposes each post was assigned a number. The number of the post that it responded to was noted, as was the participant who made the post (to respect anonymity, we used the letter E for students followed by a number, and the letter P for the teacher). In addition, posts of P identified as feedback on the rules of the debate were marked with vertical lines, while feedback on learning content was marked with horizontal lines. Posts that contained feedback with both focuses were marked with both vertical and horizontal lines to form a grid (there is no feedback of this type in the threads in Figure 2), and teacher's posts that were not feedback were not marked with any lines. Finally, annotations were marked in dark grey: these were the clarifications or comments that the participants decided not to include in the thread, but inserted in the posts of other participants.

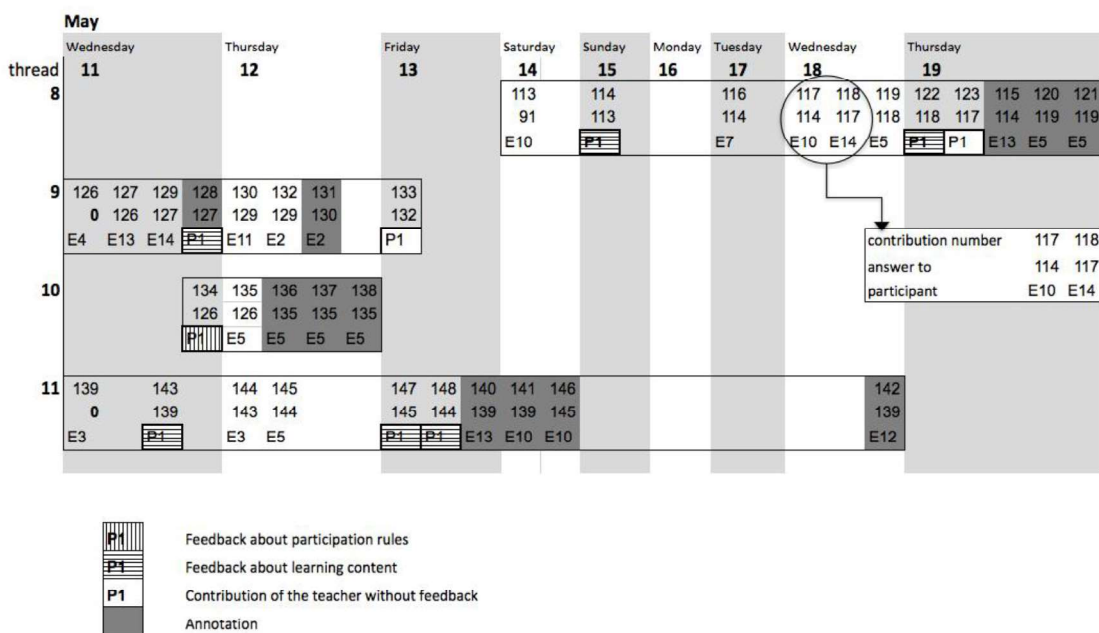


Figure 1. Map of the threads (threads 8 to 11)

The results regarding the characteristics of the teacher's feedback according to the focus, type and recipients are described below, and are followed by results corresponding to the effects of feedback during the debate. Finally, we present the results referring to the learning outcomes obtained by students in the teaching sequence analysed.

4.1. The nature of the teacher's feedback

Out of the 72 teacher's posts that contained feedback, 64 (79%) focused on learning contents, 17 (21%) on the rules governing the debate, and nine covered both focuses. Consequently, there were 81 items of feedback in 72 posts (see Table 4). Feedback relating to the learning contents focused on topics such as the accuracy of Wikipedia,

the functions of the editing team, the reliability of its contents, the sources of information, the functioning of the encyclopaedia, and the need to teach how to use Wikipedia critically. Thirty-one of the items were verification feedback, and 33 elaboration. In the verification feedback, 19 items were aimed at individual students and 12 at the entire group and in the elaboration feedback 22 were aimed at individuals and 11 at the entire group.

Table 4
Characteristics of feedback provided by the teacher during the debate

| Type of feedback | Verification | | | Elaboration | | | Total |
|--------------------------------------|--------------|-------|----------|-------------|-------|----------|-------|
| | Individual | Group | Subtotal | Individual | Group | Subtotal | |
| Learning contents | 19 | 12 | 31 | 22 | 11 | 33 | 64 |
| Rules of participation in the debate | 12 | 5 | 17 | - | - | - | 17 |
| Subtotal | 31 | 17 | | 22 | 11 | | |
| Total | 48 | | | 33 | | | 81 |

All the feedback focused on the rules of participation in the debate was verification feedback. In all cases, the teacher used this kind of feedback to assess students' compliance with the rules. Specifically, he evaluated the use of Knowledge Forum scaffolds in the posts, the contribution of sources of information and resources, and students' participation in the debate. The teacher directed this type of feedback at individual students 12 times and at the group five times.

Table 5 illustrates the teacher's posts that provided feedback on the learning contents and on the rules of participation in the debate. The use of Knowledge Forum scaffolds by participants aided the categorization of the teacher's feedback.

Table 5

Examples of the teacher's feedback on learning contents and on the rules of participation in the debate

| | Type | Category | Description |
|---|--|----------------------------|--|
| Learning contents | Verification | Favourable appraisal | <i>Putting our knowledge together</i> : "Jessica, this distinction between incorporation or introduction and appropriation of technological resources is fundamental". [P22,C1, 17.05]** |
| | | Critical appraisal | <i>Different opinion</i> "Do all of us really know exactly when and how to use Wikipedia? Is it so reliable as a document resource? I don't think so, Diana..." [P310, C37, 30.05] |
| | Elaboration (includes one favourable or one critical appraisal) | Contribution of meanings | <i>A better theory</i> "We should clarify, Lorena, that Wikipedia's directors have referred to it as a work that does not aim to cover "primary data", that is, original information such as unpublished research reports or theoretical essays. So Wikipedia, as an encyclopaedia, does not aim to become a place that generates knowledge, but one through which established knowledge is disseminated." [P114, C8, 15.05] |
| | | Requirement | <i>Putting our knowledge together</i> "We have not discussed this much, but it is definitely an interesting topic: How could Wikipedia be improved?" [P80, C5, 19.05] |
| | | Request for clarifications | <i>I need to understand</i> "Is it clear that Wikipedia does not provide reliability?" [P75, C5, 19.05] |
| | | Response to a requirement | <i>Putting our knowledge together</i> "Diana, the system of citations and references that Wikipedia uses is not generally as accurate or rigorous." [P148, C11, 13.05] |
| Response to a request for clarifications | <i>Putting our knowledge together</i> "Diana, it's like a magazine that disseminates scientific knowledge to a non-specialist readership, not a scientific journal. This obviously has its consequences" [P195, C19, 30.05] | | |
| Rules of participation in the debate | Verification | Favourable appraisal | <i>Putting our knowledge together</i> Congratulations on being the first to participate, E. (...) [P3, C1, 9.05] |
| | | Critical appraisal | Please remember to categorize your posts. [P12, C1, 13.05] |

* In *italics* the scaffolding the teacher inserts in his posts.

** Legend: P22 (teacher's post nº 22), C1 (in thread number 1), 17.05 (posted on 17 May).

The analysis revealed a type of feedback that had not been considered initially, whose function was to reinforce previous feedback. For example, in thread 1, the teacher's first feedback was aimed at a student, congratulating him on his post and inviting the other participants to discuss it. However, the same student was the only poster to make further contributions on the topic: the teacher again highlighted the relevance of the student's

original post, with the clear intention of encouraging the other students to take it as a starting point for further debate. In total, there were 24 reinforcing items of feedback, referring to 16 previous items. Three of these referred to the rules of participation, and the remaining 21 to the teaching and learning content. In most of the latter cases, the reinforcing feedback was of the same type as the preceding feedback; only on four occasions were there different combinations (initially elaboration followed by verification, or vice versa).

4.2. The effects of teacher feedback throughout the debate

In this section, we first focus on the impact of teacher feedback on student knowledge construction, and then move onto its effect on the rules of participation. When an initial item of feedback was followed by one or two reinforcing items, we decided to consider just one effect of the combination, taking into account all the posts related to it.

The results for the impact of feedback on the learning content revealed that 51 of the teacher's posts (80%) had an influence on students' subsequent posts, but the remaining 13 items of feedback (20%) did not. The 51 items of feedback, 21 of which were reinforcing, had an influence on 31 posts made later by students. We considered that the effect of a piece of reinforcing feedback (or even two) and the previous feedback was cumulative, and so we counted this as one.

Table 6 shows the number of students who react to the different types of teacher feedback. From 31 feedback messages, 18 receive a concrete reaction from 1 to 3 students. Another 10 feedback messages receive between 6 and 8 reaction posts, and 3 feedback messages receive more than 7 reaction posts.

Table 7 shows the number of students' posts associated with each of the teachers' feedback messages. 14 out of 31 teacher feedback messages receive between 3 and 5 reaction posts, 10 feedback messages receive between 6 and 8 reactions, and 7 feedback messages receive over 9 answer posts. Finally, Table 8 shows the number of days during which each feedback message receives student reactions. Of the 31 feedback messages the teacher sends, 17 receive reactions between 1 and 5 days later. 10 messages receive answers between 6 and 10 days later, and the remaining 4 feedback messages receive responses for longer than 11 days.

The feedback with the greatest effect (in terms of numbers of student responding) was responded to by 15 students, and this was also the feedback that elicited the highest number of posts (22). The feedback with the longest lasting effect had an impact for 19 days, and the one with the shortest impact lasted for only 2 days (see Table 8). On average, 3.7 students responded to the feedback, making an average of 6.6 posts over an average period of 6.3 days.

Table 6
Number of students who responded to teacher feedback

| Number of students | Feedback (n) |
|--------------------|--------------|
| Between 1 and 3 | 18 |
| Between 4 and 6 | 10 |
| Over 7 | 3 |
| Total | 31 |

Table 7
Number of student posts in response to teacher feedback

| Number of student's post | Feedback (n) |
|--------------------------|--------------|
| Between 3 and 5 | 14 |
| Between 6 and 8 | 10 |
| Over 9 | 7 |
| Total | 31 |

Table 8
Number of days that the teacher feedback has its effect

| Number of days | Feedback (n) |
|-----------------|--------------|
| Between 1 to 5 | 17 |
| Between 6 to 10 | 10 |
| Over 11 | 4 |
| Total | 31 |

In short, the data highlight the notable impact of teacher feedback on the learning content in the students' discussions, in terms of the number of students who responded to the feedback, the number of posts they made, and the number of days during which these posts were made.

A second relevant result is that some feedback had a cluster effect: that is, students' posts directly related to the feedback were found in the same thread (chain effect), but, in some cases, in other threads as well. For example, in thread 1 the teacher provided three items of feedback to which two students linked their posts in thread 5 and 6, one student in thread 3, and four students in thread 2. In thread 12, four students associated their posts with feedback that the teacher provided in thread 11. The cluster effect of these examples of feedback further highlights their strong impact on the development of the debate. Summarizing the above-mentioned, we find two different types of feedback effects on the teacher. The chain effect occurs when students develop the debate and respond to the teacher's feedback in a single discussion thread (see thread 1 in Figure 2); the cluster

effect occurs when students react to teacher’s feedback and continue the discussion in new threads (see the arrows in Figure 2).

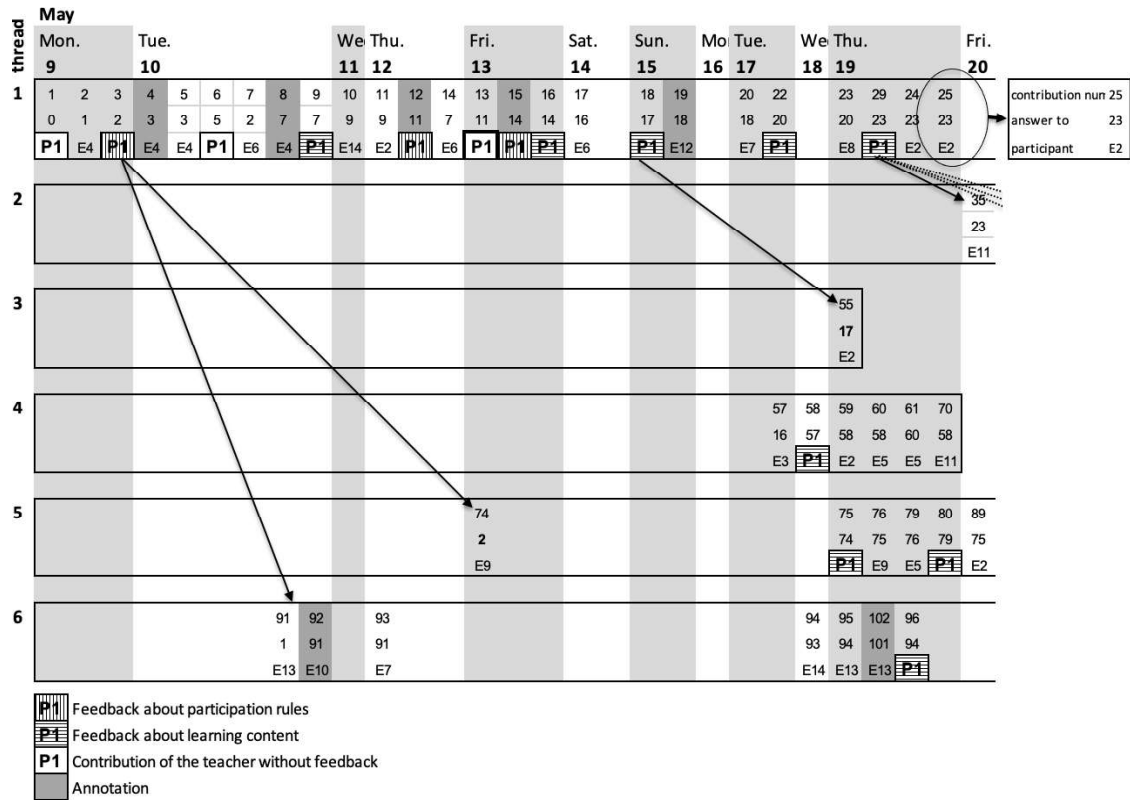


Figure 2. Chain effect and cluster effect of teacher’ feedback

Thirdly, the results indicate that the 13 items of teacher feedback (8 elaboration and 5 verification) that did not appear to have any on students’ subsequent posts can be divided into two types. The first comprise interventions that combined a critical appraisal or the identification of an error or misunderstanding in a student’s post, together with a request for clarification of meaning, for example: “*Different opinion* “How exactly would you define the reliability of the dictionary? I found a different definition from the one you shared” [P282, C34, 26.05]. On the two occasions that this kind of intervention appeared, the participant did not answer. The other kind of intervention that did not have an impact comprised generally positive evaluations of students’ contributions of meaning, which may or may not have been accompanied by an elaboration of the meanings on the part of the teacher. These items of feedback did not elicit a response from the student they were aimed at or from the rest of the students; in fact, they tended to be posts that brought a thread to a close (threads 8, 12, 17, 19, 20, 32, 35, 37 and 38).

Results on the impact of feedback regarding the rules of participation indicate that this type of feedback was directly related to the evolution of the debate over time. Indeed, during the first four days (9 to 12 May), the teacher provided four items of feedback of

this type (3 group and 1 individual), whose focus was to draw students' attention to the need to include Knowledge Forum scaffolds in their posts. The accumulated impact of these four items of feedback on students' subsequent posts was shown in two ways: first, the teacher's feedback led the students to use scaffolds in almost all of their posts until the end of the debate, and second, the teacher did not remind students of this rule of participation again. The lack of new requirements in this area indicates that the teacher was satisfied with the students' use of scaffolds.

In the second stage of the debate (11 to 22 May), the teacher provided feedback regarding the rules of participation seven times (6 individual messages, and 1 group message). All of these were appraisals of students' posts providing information and resources (articles, videos or websites) to support their arguments or refute those of others. The impact of the feedback was reflected in the fact that during this period, the students posted 14 new sources of information, whereas prior to the feedback they had not posted any. In addition, towards the end of the process, two students posted two new sources of information (29 and 30 May) that were not evaluated by the teacher. As the debate was drawing to an end, perhaps the teacher did not consider the posts providing of new information to be particularly relevant.

At a third point in the debate, coinciding with the last week (26 to 31 May), the teacher posted feedback on rules and participation six times (5 individual messages and 1 group message) aiming to evaluate the students' participation. Most of these posts followed the teacher's announcement on 27 May that there were only a few days left before the end of the debate, and that all students should "keep to the point and take a clear stance on the initial question: Is Wikipedia reliable as a support for university students to carry out academic assignments?" [P307, C37, 27.05]. The only exception was feedback posted on 26 May, in which the teacher positively evaluated a summary of the debate that one of the students had shared with the group. The remaining five feedback posts were all positive evaluations of the posts of five students, noting that they were following the instructions, for example: "Thanks for your opinion on the invitation to end the debate, D" [P299, C36, 27.05], or "*Opinion*. Very good post to the end the debate, I.: comprehensive and conclusive. Thanks for responding to my final call" [P312, C37, 30.05].

5. Discussion

This exploratory study analysed the characteristics of teacher feedback and its effects in both knowledge construction among participants and participation in an online discussion forum.

5.1 The characteristics of teacher feedback

With respect to the teacher feedback the results of this study show, firstly, that, over the course of the forum, a significant number of posts included feedback aimed at guiding and stimulating students' discussion of the relevance and reliability of Wikipedia in their academic work. Specifically, we detected the presence of teacher feedback in practically

all the discussion threads created, a finding which underlines the importance of feedback for fostering debate among students. Because we used a multidimensional approach to the study of feedback, we could identify the existence of different focus for feedback over the course of the discussion. Specifically, we found that a large proportion of feedback is directed at guiding the knowledge construction on contents of the forum among students (i.e., the relevance and viability of the use of Wikipedia for academic purposes), and a smaller proportion offered help regarding the rules of participation in the debate (see Table 4). While the feedback on the content of the discussion aims above all to push the debate further, the feedback on the rules of participation aims to ensure that the agreed rules are being respected and that all the students are engaging appropriately. A plausible explanation for this is the highly structured nature of the debate (Gielen & De Weber, 2015), which establishes the rules for participation clearly at the beginning, and so the teacher only has to remind the students of the rules only very occasionally.

Our results also highlighted differences in the type of feedback depending on the focus: elaboration feedback for learning content versus verification feedback for the rules of participation (see Table 4). These results can help us to build on the results of previous studies which have indicated that feedback should both check what knowledge has been constructed and also offer guidance in order to promote deeper knowledge construction (Álvarez et al., 2012; Attali & Van der Kleij, 2017). But specifically, our study highlights the need to consider the focus of the feedback offered: either the construction of meanings regarding the content, or the rules of participation in the debate (Coll et al., 2014; Häkkinen & Järvelä 2006).

Analysing of feedback from an interactional and dynamic perspective during online discussion forum has allowed us to make a broader interpretation of its potential for adapting to the actions of the participants during the discussion process. While feedback on the rules of participation is offered at specific moments in the debate and with very specific functions –for example, reminding students of the requirements for participation if they are not complying– feedback on the learning content is offered in a continuous and sustained manner throughout the debate, helping the students to address the discussion of the issue at hand in fuller, deeper ways. By taking into account the temporal dimension (De Laat et al., 2007), and the dynamic and constructive nature of the interaction (Ajjawi & Boud, 2018) we were able to interpret the potential of feedback for promoting the participation and engagement of students in this activity (Price et al., 2011; Winstone et al., 2017). This approach also drew attention to the presence of a particular type of feedback –reinforcement feedback– that the teacher provided continuously inside the various threads, until s/he considered that the students had reached a satisfactory level of understanding about learning topics. This type of feedback reveals itself as nuclear according to previous literature with respect to students' difficulty in online successful participation (Galikyan & Admiraal, 2019).

5.2 The effects of teacher feedback in online discussion forum

As for the second question that we posed at the beginning, related to the effects of teacher feedback in the online discussion forum, the results obtained indicate that its effects

differed with respect to the two focus: the discussion of the contents and the ways of participating in the forum. The fact that, after receiving feedback on the contents of the discussion, different students posted contributions over a relatively long period of time shows that feedback played a fundamental role in continuously engaging students over the course of the online debate (see Tables 6 and 8). More specifically, we noted two main effects of feedback related to the discussion of topics in the forum: the chain effect, and the cluster effect (see Figure 2). The chain effect occurs when students continue to debate and respond to the teacher's feedback in a single discussion thread, going further into the topic or topics that are being discussed. The cluster effect occurs when students react to feedback and start new threads to continue the discussion of other topics that the teacher has also suggested are relevant. Thus, while the chain effect of feedback leads to a deeper analysis of a topic over several days by different students, the cluster effect extends the discussion to other issues related to the main topic of debate. Finally, the feedback provided to remind students of the rules of participation and the objectives of the debate at specific times helps them to stay within the limits of the activity proposed. Taken together, these findings shed light on the different effects that feedback can have on students' participation and knowledge construction (Hatziapostolou & Paraskakis, 2010), and stress that its effects are influenced by its focus: the learning content, or the rules of participation.

Our consideration of the temporal dimension can also help to interpret the situations in which the feedback had little or no impact on the successive actions of the participants. For example, we identified of a type of teacher feedback which has the function of winding up the discussion, giving a positive evaluation of the students' posts and of the levels of discussion achieved; there is no room for further action by students. The teacher also gave some feedback that might have been expected to elicit a reaction from the students, although this was not finally the case; in fact, the lack of any detectable of this type of feedback (compared with the multiple and varied effects on the students of the other types) is a strong argument in favour of the key role of feedback in supporting discussion in an online learning environment (Stein et al, 2013; Yang, 2016).

5.3. Limitations and future research

Obviously, our results of the characteristics and effects of teacher feedback must be interpreted considering its limitations. Firstly, because this is an exploratory study on feedback we cannot extrapolate our results to others online learning environments. This in-depth analysis in particular complex natural setting (Ajjawi & Boud, 2018), has shown the importance of feedback to support student discussion through sustained interaction during the course of an online forum. However, the fact that it is a single case study obliges us to be extremely cautious regarding the generalisation of our results. Case studies of other online discussion forums developed in platforms other than the Knowledge Forum, with different tasks and contents, are now needed to verify the viability and effectiveness of the analytical model used. The high degree of structuring of the forum studied, with detailed and explicit rules of participation, allowed us to identify feedback effects (Gielen & De Weber, 2015) but, once again, it is important to assess whether the results are replicated in the case of less structured forums (Salter & Conneley,

2015). In addition, in the online forum studied here the teacher also offered support of a different kind –questions to initiate, stimulate and conclude the debate – whose analysis would undoubtedly shed light on the different kinds of aid given and would complement our understanding of the help provided by feedback for scaffolding the students' discussion (Stein et al., 2013). In sum, although feedback has emerged in our study as a key source of aid, the analysis of all the kinds of support that students receive from the teacher (Stein et al, 2013), -and in some cases from other students-would provide a more complete view of the range of activities that can foster Knowledge construction in online discussions.

Secondly, the protocol we developed to analyse the effects of teacher feedback on online interaction has been shown to be a useful analytical tool. The logic underlying the methodology allowed us to operationalise the impact of feedback depending on its focus and to quantify them according to three different aspects: the number of posts, the number of students involved, and the duration of the interaction. In addition, the visual representation of the threads has highlighted the distribution and articulation of teacher feedback according to its focus; it has also made it easier for us to assess the effect of this feedback in the successive posts made by the students in the same thread, or in other threads in the debate. However, we are aware of the need to refine and contrast the procedure for identifying the impact of feedback and its visual representation in future studies.

Considering the results of our exploratory study, two lines of research are especially relevant in the attempt to understand feedback processes in online learning environments. The first would be to consider the ways in which feedback can help improve the semantic relationships established between participants' posts or their cognitive level in the construction of knowledge in asynchronous learning networks (Häkkinen & Järvelä, 2002; Schrire, 2006; Stein et al., 2013). The second would be to analyse how different students, and not only the teacher, offer feedback in online interaction (Barberà, 2016; Cheng et al., 2015; Filius et al., 2018; Gikandi & Morrow, 2016). More specifically, the notions of distributed educational influence and distributed feedback (Coll & Engel, 2018; Coll et al, 2013) open up another new perspective for research and raise relevant questions such as establishing the optimal distribution of feedback between the teacher and students in discussion forums, and assessing how teacher and student feedback differ in terms of form, focus, and the moment it is provided.

6. Conclusion

The purpose of this exploratory study was to provide an understanding of the characteristics of feedback and its impact on the participation and joint construction of knowledge in an online discussion forum. Despite its importance and the obvious interest that it has aroused, feedback impact and its effects have not been explored in depth, especially in natural setting. This research reveals new empirical findings from a multidimensional perspective of interactions of participants.

We have found that the effects of feedback are mediated by its focus: topics or participation. Feedback on the content of the discussion provoked two types of effects in the manner that students engage on the discussion of topics after receiving feedback: the chain effect and cluster effect pics. Thus, while the threat effect of feedback leads to a deeper discussion on a topic over time, the cluster effects extends the discussion to other related topics. Surprisingly, we identified on type of feedback (reinforcement feedback) that the teacher provided continuously inside the threads to help students to reach a satisfactory level of understanding on topics. This type of feedback takes on particular importance in the light of previous accounts on the difficulty students have in engaging in online discussion forum and in attaining learning goals.

Intermittent feedback on participation proofed to be effective, in the case of the structured forum, so that students' would participate according to the given rules. In other words, the variation of form (type and focus), and the moment in which feedback is provided, seems to be essential to influence the engagement and advancement of the students in the construction of knowledge. In addition, the instructor's monitoring of feedback's effects on students' actions plays a key role in promoting satisfactory levels of discussion in the online forum.

The results of this study offer practical implications on the potential benefits of teacher feedback on engagement and knowledge construction of students in an online discussion forum. The first important implication for designers and instructors is that feedback must be offered on different focus (rules of participation, topics of discussion) to promote engagement and a construction of shared meanings. Specifically, the focus of feedback seems to depend on the structure of the forum (stronger or looser structure) and on the participation and content provided in students' posts. Moreover, in order to achieve participation and deeper levels of discussion, it is important to vary the type of feedback in correspondence with students' needs at different moments of the discussion. This implies knowing different forms of feedback (verification, explanation, suggestions, etc.) to be able to choose the most appropriate one for each specific moment. What seems to be more important for designers and instructors is that the effects of feedback need supervision (e.g. check if students engage or not, or which level of discussion they reach after receiving feedback) in order to decide on how to continue offering feedback. Furthermore, it seems necessary for instructors to promote the development of feedback literacy (Carless & Boud, 2018), fostering student's participation and engagement in requesting and using feedback.

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