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Negotiation on the assessment of research articles with academic reviewers: application of peer-review approach of teaching

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Abstract This study provides an insight into the dominant negotiation processes that occur between the authors of research articles and academic reviewers at the peer reviewing stage. Data of reviewers comments and authors responses on 32 science and engineering based journal articles covering four decision categories (accept as is, accept with minor revisions, major revisions and reject) were collected. A commonly practised peer-review approach in teaching was applied to analyse the data and to identify the key negotiation attributes, their frequency of occurrence, authors' reaction and approach to negotiate with the reviewers. Six main negotiation attributes were identified. Technical quality was the most frequent (31% of all instances) attracting mixed reactions from the authors. The remaining attributes constituted suggestion (20%), explanation (20%), restatement (15%), grammar (13%) and structure ($\sim$1%). With the exception of 'explanation' where authors had to counteract to clear misunderstood concepts or contents by the reviewers, the other attributes were of highly collaborative nature and were willingly accepted by the authors. All these negotiations were found to help authors in improving the overall quality, clarity and readability of their manuscripts, besides forcing them to rethink about unclear contents. The negotiation trends emerged here can help the academic researchers to improve the quality of their articles before submission to the peer-reviewed journals. It can also provide a link through which their classroom teaching experience involving supervision of peer review negotiations among students can be utilised in writing their research articles and negotiating with academic reviewers.

Keywords Academic reviewers · Publishing research · Peer review negotiation · Articles evaluation · Teaching, learning and research

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Introduction

There has always been a standing pressure on academics to publish their research in high quality peer-reviewed international journals (Ferguson 2003). It is not only a foremost requirement for the growth of an academic researcher, but also brings exposure and prestige besides quantifying their individual's impact on scientific research (Hirsch 2005). The rejection rates of reputed journals in the area of engineering and sciences are increasing with the increasing rates of submissions (Ferguson 2003), posing greater difficulty to publish research in high impact factored journals (Carrió 2008; Saha et al. 2003; Aarssen et al. 2008). Moreover, limited availability of time to personally conduct research due to over commitment for teaching and administrative duties makes it even more challenging to pass through the complex and difficult reviewing loop, as illustrated in Fig. 1. In this situation, a relevant question could be that can the teaching practices (such as

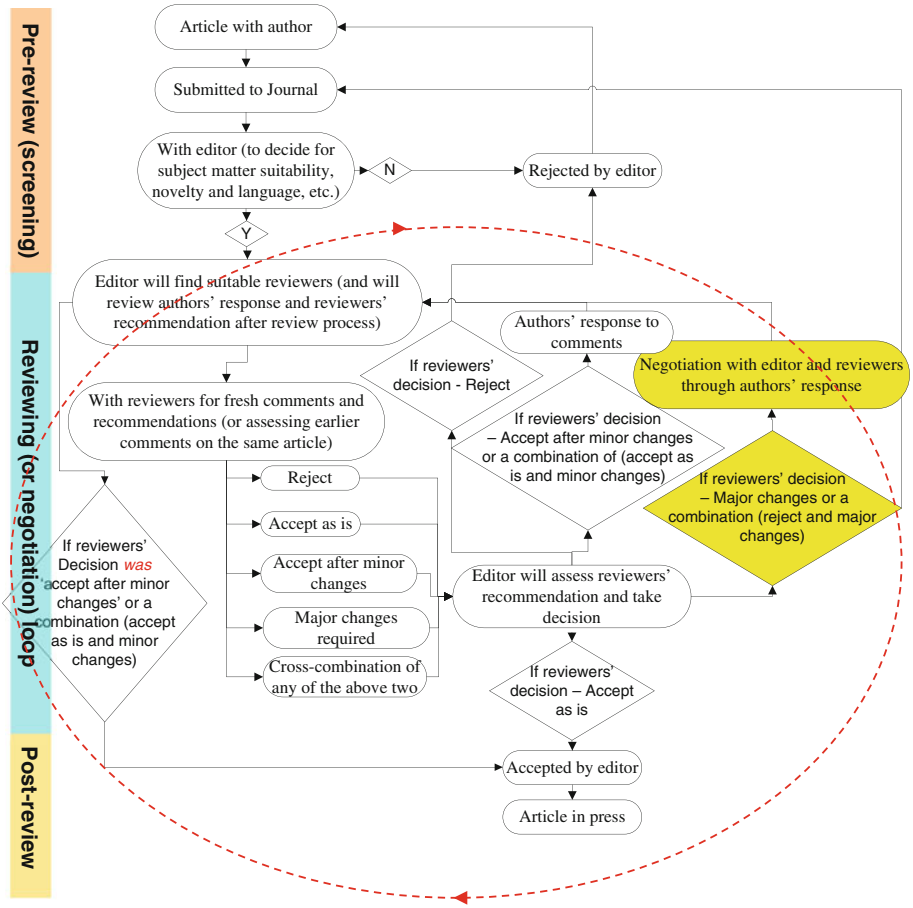

Fig. 1 Typical publication cycle of a peer-reviewed journal article; also shown are different stages of the review process. *Dotted line* indicates the reviewing (or negotiation) loop and *coloured boxes* indicate the stages at which various types of negotiations (see Sect. 2.2) occur between the authors and the reviewers

peer-review) employed by various academics to enhance student learning be applied to benefit their research outputs?

Peer-review process encompasses a number of research areas such as software engineering (Linhares et al. 2009), computer assisted on-line language learning (DiGiovanni and Nagaswami 2001), international business (Sahnoun and Zarai 2009), judging the teaching of peers (Courneya et al. 2008), social constructivism in scientific peer reviewing (Bedeian 2004) or reviewing each others work in academia (Quinlan 2002). Substantial attention has been paid to the peer-review negotiation in University teaching and learning (Courneya et al. 2008). It is an old and popular approach that is being practised by several academics for many years to improve learning outcome of their teaching (Barnes 1976; Courneya et al. 2008; Lasry et al. 2008; Mendonca and Johnson 1994; Zamel 1985). The peer-review in teaching, like interpreting a set of unfamiliar historical documents, is a scholarly activity that require substantial amount of intellectual reasoning and experience (Boyer 1990; Quinlan 2002). Irrespective of any discipline (teaching, research, learning or business), this approach has demonstrated improved intended outcomes as compared to the traditional approaches (Buelens et al. 2008). However, very little is known regarding what goes on during peer-review of research articles and how the experiences of academic researchers that are involved in teaching can help them to improve outcomes of their articles submitted to peer-reviewed journals.

Of the notable research efforts carried out in the area of scientific peer review in recent years has been the work by Bornmann, Bedeian and their co-researchers. For example, Bornmann (2008) discussed the peer review process from the perspective of the North American school of sociology of science, social constructivism and social system theories. Recent work by Bornmann et al. (2008) presented a quantitative assessment of editors' and referees' criteria for accepting or rejecting the manuscripts. Likewise, Bedeian (2003) analysed the manuscript review process in the area of management and described the role of authors, referees and editors. Bedeian (2004) presented social constructivist sociology of science dealing with the peer review process in scientific evaluation. A most recent review by Bornmann (2010) summarises the relevant literature on this topic. Some of the concepts from these studies are utilised while selecting the negotiation attributes in our study (see Sect. 2).

A well-perceived peer-review negotiation approach of teaching (Barnes 1976; Mittan 1986; Mendonca and Johnson 1994; Topping 1998; Dochy et al. 1999; Topping et al. 2000) has been used for the first time in this study to evaluate the reviewers' comments on journal article submissions. In this approach, a group of individuals rate the work produced by their peers of similar status by asking questions, offer explanations, restating peers work, giving suggestions or correcting grammar mistakes (Mendonca and Johnson 1994). The criteria for assessing peers work may or may not be agreed or discussed earlier and the feedback from peers may be qualitative (i.e. comments) or quantitative (i.e. marks) in nature (Dochy et al. 1999; Topping et al. 2000). An earlier study by Barnes (1976) found that peer review approach increases opportunities of interaction and allows students to engage in exploratory talks (p. 200), which was later supported by several others (Mittan 1986; Mendonca and Johnson 1994; Topping 1998; Dochy et al. 1999; Topping et al. 2000; Courneya et al. 2008). Mendonca and Johnson (1994) analysed what goes on during the peer-review negotiation process between level 2 students and their peers (class mates) during essay writing. They divided the entire negotiation process into five categories (i.e. questions, explanations, restatement, suggestions and grammar corrections). This study modifies the definition of these attributes along with introducing new ones (see Sect. 3) by analysing the negotiation process that generally occurs between the authors and reviewers.

The key difference between peer-review negotiation in teaching and in this study is the absence of *face-to-face interactions with the reviewers*. Unlike other cases, authors do not receive opportunity for personal interaction and discussions, requiring them to be precise and clear in their responses.

The objectives of this article are to quantitatively analyse the dominant negotiation processes that occur between the authors of research articles and the academic reviewers at the reviewing stage using the basic principles of peer-review in teaching. Note that the social and cognitive aspects examining editors' or referees' evaluation criteria are not discussed here in detail. Comprehensive information on these topics can be found elsewhere (Bedeian 2003, 2004; Bornmann 2008, 2010; Guba and Lincoln 1990). To achieve these objectives, we analysed the reviewing process of 32 journal articles covering four decision categories (accept as is, accept with minor revisions, accept with major revisions, reject) along with a cross-combination of any of the earlier two. Comments of the reviewers and responses of the authors were assessed to identify the trends of key negotiation attributes, their frequencies of occurrence, authors' reactions and approach to negotiate with the reviewers. Since there is very limited information available on this particular topic, we believe that findings from this article will develop a novel link between the studies either focussing on negotiation in teaching or research separately.

Methodology

Identifying negotiation needs in typical publication cycle of a peer-reviewed journal article

The typical publication cycle of a journal article can be broadly divided into three stages, as seen in Fig. 1: (i) pre-review (screening stage) (ii) reviewing (or negotiation) loop, and (iii) post-review (processing for publication). The following participants are involved in it (Lawrence 2003):

- *Authors* are the persons who submit their work for publication.
- *Reviewers* are the persons having technical knowledge to identify, evaluate and describe the flaws in the article under review. They are expected to constructively and critically evaluate the contents of an article. In this article, we are referring 'academic reviewers' to the scientists, researchers and academics involved in the area of science and engineering.
- *Editors* are the persons responsible for the final decision making. In the pre-review stage, editor can reject the article on his own. In reviewing stages, editor is responsible for assessing both the reviewers' comments and recommendations and the authors' response. At the post-review stage, he can either send the article back to the authors if rejected by the reviewers, or forward it to the press when accepted for final publication.

In the pre-review stage, the editor checks the article for subject material suitability and other generic features such as language (Southgate 1991). If found suitable, it enters the reviewing loop (Fig. 1) where any of the decisions (accept as is, reject, minor revisions major changes or a combination of two) can be expected. The first three decision categories are straightforward in which either the article will get rejected or accepted after the completion of the first reviewing cycle and does not provide much opportunity to the authors to negotiate with reviewers. However, the last two decision categories (i.e. major changes required or a combination of major changes-reject) provides substantial

opportunity to the authors to negotiate with the reviewers on several points (including the points where they felt that reviewers assessment was not fair; Aarssen et al. 2009) by responding to their comments in a persistent, comprehensive and professional manner. If negotiations at this stage are made strategically, the border-line decisions can be converted into authors favour. These can help the authors to satisfy the reviewers' concerns along with reaching to a mutually satisfactory outcome. It will help the authors to minimise the time spent during the reviewing loop with positive outcome in the very first or in the second attempt. Such a favourable decision can save substantial amount of time and efforts that will be required if negotiations were not satisfactory and authors had to re-submit their articles elsewhere (see Fig. 1). In the post-review stage, once the article is accepted for publication it is sent to the press by the editor for publication. The focus of this study is limited to the negotiations between the authors and the reviewers of the research articles, predominantly occurring during the reviewing stage when the decision category was 'major changes required'.

Data collection

Reviewers and responses of authors from 32 peer-reviewed journal articles submitted by 10 different researchers (9 males, 1 female) working in the area of science (chemistry, physics and material science) and engineering (aerospace, mechanical, chemical, civil and environmental) have been collected for this study. Proportions of science and engineering related journal reports and associated researchers considered in this analysis were 28 and 72%, respectively. These were 3, 6 and 19% for chemistry, physics and material science, respectively, compared with 3, 6, 9, 25 and 29% for aerospace, mechanical, chemical, civil and environmental engineering, respectively. All these 10 researchers were corresponding authors in their articles; they were experts in their respective disciplines and were having between 4 and 12 years of research experience after their master's degree.

The collected reports were grouped into four decision categories, as shown in Table 1. There were 17 articles which fall in the category of our interest (i.e. 'major changes required'). These articles included a total of 765 comments (i.e. 45 comments per article on average). Each comment was then tested against definitions of all six negotiation categories (see Table 2) and was counted towards the suitable ones. The chosen negotiation categories are selected considering the peer review negotiation attributes in teaching (Mendonca and Johnson 1994), quantitative assessment of peer review criteria (Bornmann et al. 2008) and role of reviewers and authors in scientific reviewing process (Bedeian 2003). The predominant reason for selecting these six negotiation attributes were their

Table 1 Description of case studies showing editors' assessment in different decision categories

Total number of reviewers' report assessed	Relative contribution of each decision category (%)	Decision category	Final outcome
2	6	Accept as is	Published in submitted journal
5	16	Accept with minor revisions	Published in submitted journal
17	53	Major revisions: decision will be considered after re-evaluating corrections	All published in submitted journals; six of them were send for re-reviewing
8	25	Reject	1 published elsewhere; results of others unknown

Table 2 Assessment of reviewers' comments and authors' reaction on studied cases. Some of the definitions of negotiation attributes given by Mendonca and Johnson (1994) have been modified to suit the context of our study. Letters A, PA and DA stand for agreed, partially agreed and disagreed out of the total (T) instances, respectively; numbers against them represent the average percentages of occurrence and the subscript of 'T' denote the first letter of each negotiation attribute

Attributes	Nature of reviewers' comments on studied cases	Authors' reaction
Quality (questions *on technical quality, novelty, synthesis, evaluation and application*)	• Technical information (or nomenclature used) need to be expanded further to make them clear and concise; figures, tables or illustrations are confusing and need to be improved • Interpretations, results or conclusions are not sound and comparable with the existing evidence; these are not justified by the presented data and is inconsistent with the objectives or hypothesis • Concerns about the design of experimental set up and presented experimental data; methods are not correctly described and sufficiently informative to allow replication of the research • Over assessment or interpretation of data and authors have not provided good explanation; some of the data is unnecessarily presented and can be removed • Results are interesting, novel, of global interest and importance but the application areas of work are not clearly stated	T_Q (31%), A (23%), PA (5%), DA (3%)
Suggestions[a] (*and recommendations on unclear references, contents and opinions*)	• Suggestions and recommendations for correcting references and modifying sentences at few places; removing repeating contents in text or duplicating data in tables and figures; adding or removing information on unclear references and contents • Articles do not include adequate awareness on the information on other articles in the area, so suggestions that new references can be included or replaced with old references • Suggestions for changing keywords and rephrasing titles as these are not aligning with the contents; abstract need bit more clarity to stand alone by rewording few sentences	T_S (20%) A ($\sim$20%)
Explanation (*on misunderstood and unclear contents and concepts*)	• Explanation on misunderstood, unclear, over or under interpreted and misleading contents and concepts; authors needed to remind the reviewers about information that was present in the articles • Misunderstanding such as other investigators have already published similar work; some results are not accurate and issues regarding non-standard technical terminology requiring explanation to address reviewers misunderstanding	T_E (20%), A (3%) PA (6%), DA (11%)

Table 2 continued

Attributes	Nature of reviewers' comments on studied cases	Authors' reaction
Grammar[a]	• Grammatical and editorial corrections (e.g. typos, improvement of sentences, editing of text and references in right journal format, etc.); inappropriate use of symbols in the text	T_G (13%), A (~13%)
Restatement[a] (*comprehension or knowledge check*)	• Repetition of key contents by reviewers to show their understanding about the subject	T_R (15%) A (~15%)
Structure	• Organisation of the article is not clear; few paragraphs need to be shifted at different places to enhance the clarity of contents	T_{St} (~1%), A (0.65%), PA (0.35%)

[a] Most of the negotiations in 'minor revision' category were of such nature

suitability to our context; these also represent majority of negotiations found in near-identical peer review process to our work (i.e. negotiations in peer review of teaching; Mendonca and Johnson 1994).

Analysis of the contents of each comment and its count towards an individual or more than one negotiation attributes (i.e. coding exercise) is an important process. It depends on the content analyser and may vary if different set of people perform the coding exercise. To minimise these differences, all the authors of this article performed the content analysis separately and then came up with an inter-coder agreement for each comment through an open discussion. It should be noted that the reason for such a high number of comments per article was that some of the comments were counted towards more than one category. Key points were picked up from the reviewers' comments along with authors' reaction and these were then placed as examples in Table 2 under different negotiation attributes. Authors' reactions (agreed, partially agreed or disagreed) were also placed in front of each negotiation category. Authors' reactions (i.e. disagreed or partially agreed) were the main negotiation categories requiring communication, offers and counteroffers from the authors to satisfy the reviewers for reaching to a mutually agreed arrangement (Linhares et al. 2009; Vetschera 2006).

Note that the relative contribution of each decision category in Table 1 corresponds to the cases studied here. These should not be misinterpreted by comparing them with the global values in various decision categories. For example, the rejection rates shown here are only 25%. This is much lower than actual rejection rates which can be well over 60% depending on journals (Ferguson 2003; Southgate 1991). The predominant reason could be that the authors who provided data for our study were either uncomfortable in passing the information on rejected articles or were having extremely high rate of acceptance. However, the objective of this study is not to investigate the rejection rates but to analyse the cases that provided opportunity for negotiations.

Results and discussions

Subject matter suitability was found to be the dominant reason for the 'rejected' articles, which has also been reported elsewhere (e.g. Ferguson 2003; Aarssen et al. 2008; Bornmann et al. 2008; Bedeian 2003). The common observations for the contrasting cases 'accept as is' and 'reject' were the 'quality' of presented work and 'novel contribution' to

that particular research area (Table 1). Similarly, analysis of the reviewers' comments on the decision category 'accept after minor changes' showed that authors were suggested to make trivial changes (e.g. typing errors, suggestion for changing or correcting references and sentences at few places, repeating contents or adding some information) falling into the negotiation categories of suggestion, grammar and restatement (see examples in Table 2). All the suggested changes were made by the authors. The editor accepted these articles without sending them to the reviewers for re-review. The above three cases contributed about 47% of total selected cases in our study (see Table 1). Since these cases do not provide much opportunity for the authors to negotiate with the reviewers, these are ignored from detailed analysis and only cases with 'major changes required' are discussed further.

Assessment of peer-review negotiations

Six different types of negotiation attributes emerged during the reviewing process, as seen in Table 2. Figure 2 summarises the overall reaction of the authors in terms of agreement (75%), disagreement (14%) and partial agreement (11%) with the reviewers' comments; their distribution in each negotiation category is given in Table 2. It is interesting to note that majority of the disagreements or partial agreements were related to explanation (11 and 6% in case of disagreements and partial agreements, respectively) and quality (3 and 5% in case of disagreements and partial agreements, respectively). On the other hand, the agreements were spread all over the negotiation attributes; these were dominated by quality (23%) and suggestions (20%), followed by the restatement (15%), grammar (13%), explanation (3%) and structure ($\sim$1%). The percentages of negotiation occurrence between the authors and reviewers in each negotiation category are shown in Fig. 3 whereas the detailed analysis of each case is presented in Fig. 4. The following paragraphs discuss each negotiation attribute in detail with the help of excerpts that are picked up from selected cases.

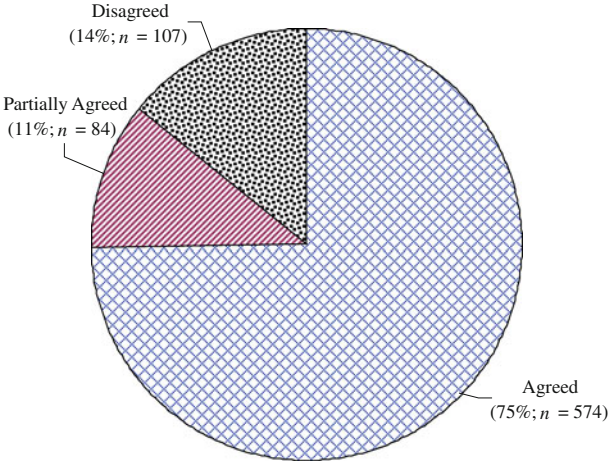

Fig. 2 Overall reaction of the authors (in percent) showing agreement, disagreement or partial agreement with the reviewer's comments. The values represent all the six negotiation attributes covering 765 comments. The symbol '*n*' denote the total number of comments that fell in each reaction category

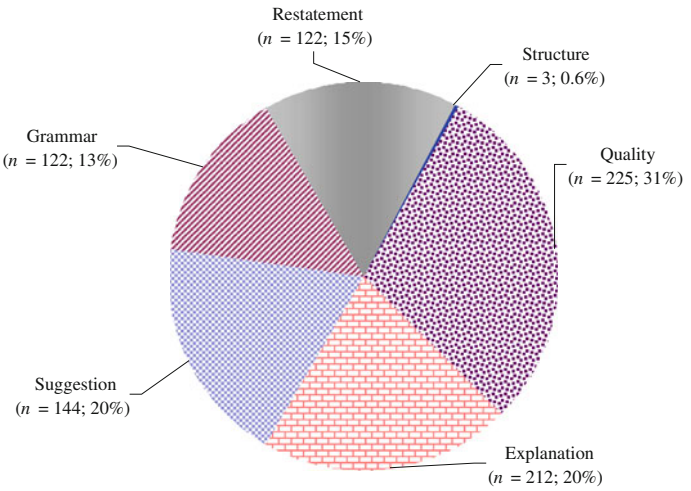

Fig. 3 Average percentages of negotiation attributes by type. The symbol '*n*' represents total number of each type of negotiations that occurred in a total of 765 instances; % sign indicates the average frequency of their occurrences

Quality related negotiations

As expected in case of scientific articles, quality related negotiations dominated (31 ± 12%) other types of negotiation attributes (see Fig. 4a). These results seem to compliment the findings of Bornmann and co-researchers (Bornmann et al. 2008, 2010). They found that quality of research (i.e. underlying theory, design, conception or discussions of results) is of high significance for both the editors and reviewers in the assessment of scientific manuscripts. An interesting interpretation of these numbers can be that if about 69% of the technical quality of an article is of acceptable level to the reviewers, it is likely that an article will enter the reviewing loop (Fig. 1). Authors have then the chance to negotiate on the remaining 31%. Such negotiations required authors to address several questions on the quality of results, discussions, novelty, experimental design, data collection, interpretation of results, and application of work, as is illustrated in the excerpts below:

1. Reviewer	Please be more specific. What do you mean by thermal effects on the flow [*Quality: explanation required to make technical contents clear*]
Authors	We have modified the sentence on page 10 (line 19) as: 'The density and … each simulation'
2. Reviewer	The text on synthetic sorbents is short, with a rather superficial discussion. There is a substantial amount of recent information is not added [*Quality related question to add information*]
Authors	This section has been substantially increased in size [*authors agreed*]
3. Reviewer	The point of this conclusion is unclear … since no analysis or testing was presented to assess this mechanism, I do not feel it is a supported conclusion. [*Quality: some conclusions not justified by presented data*]
Authors	As suggested, the statement 'Although chemical diffusion …' is removed from the article. [*authors agreed*]

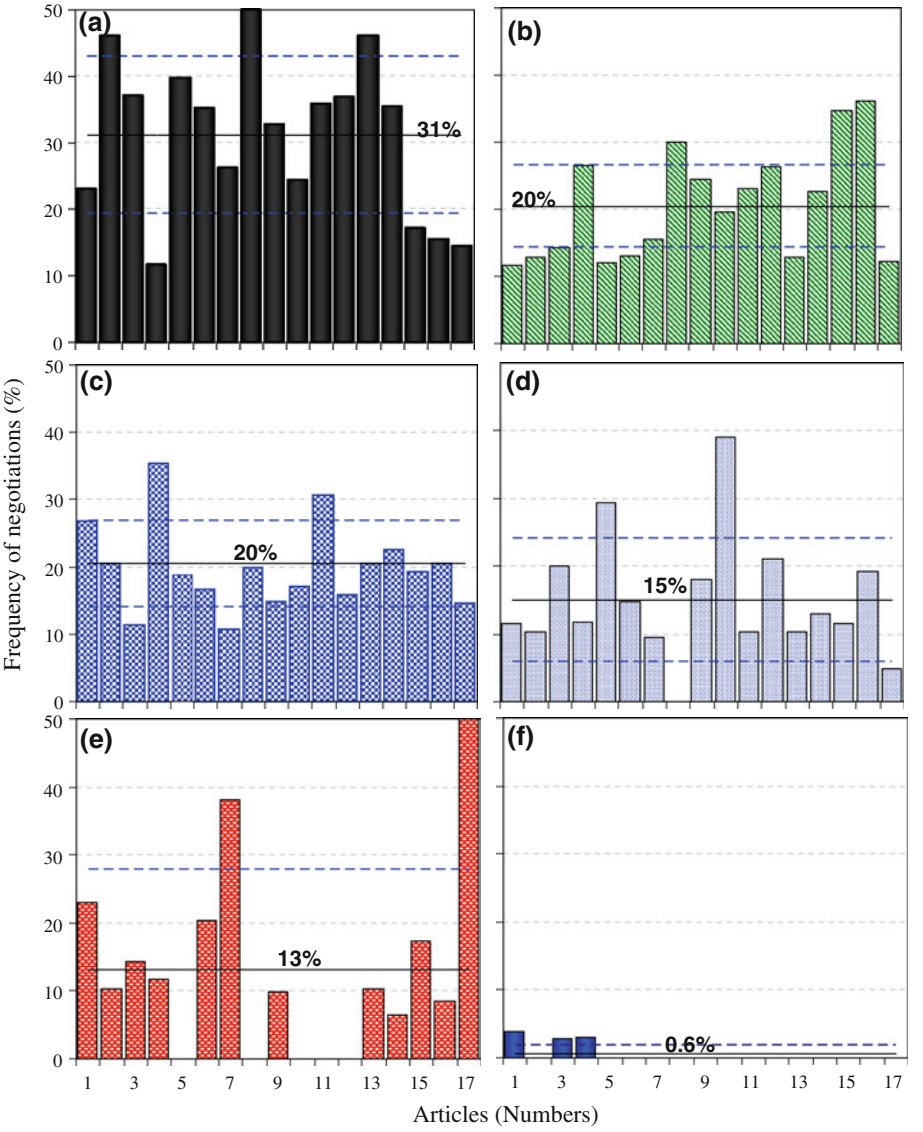

Fig. 4 Occurrence frequencies of the **a** quality, **b** explanation, **c** suggestion, **d** restatement, **e** grammar, and **f** structure related negotiations for each individual case. The values written on top of *dark lines* are average of all cases. Both *dotted lines* in each figure show standard deviations from average values

4. Reviewer Figures 2 and 3: May be, if possible, it would be helpful to insert some major contour lines into the figures. This would help in identifying concentration differences. [*Quality: Figs needed improvement*]

Authors We believe the concentration differences are clearly visible in supplied figures, and adding extra contour lines may diminish the clarity. However, we have changed the text in the levels to improve the quality of figures.

[*authors disagreed for first change and partially agreed for second by providing counteroffers*]

5. Reviewer In the comparison of measured and modelled PNCs, the authors can also show the time evolution of …. In this figure, the differences of … can also be analysed [*Quality related suggestions to include additional technical information*]

Authors Because the same data has already been presented in Fig. 6 and similar results on suggested topics have been recently presented in our article Kumar et al. (2009), authors would avoid duplicating the results for the reasons of brevity. [*authors disagreed*]

6. Reviewer The presented profile is against most experience and data found in the literature and authors do not provide a good explanation [*Quality related question requiring explanation*]

Authors Authors' response was about 1,200 words long. Authors disagreed on first question. They first presented the available literature in a Table and compared their results with it, highlighting that only few studies (not all) are comparable and these show similar trend. On the second question, they partially agreed that enough explanation is not provided, but they expanded this section considering the reviewer's comments. [*authors reactions were mixed i.e., partially agreed and disagreed on some point and provided counteroffers*]

Authors' reaction on technical quality related questions, suggestions and explanations were mixed, as described in the above excerpts. They agreed, in many instances (about 23%), to improve (excerpt 1), include (except 2) or remove (excerpt 3) technical contents. Such negotiations helped the authors to improve certain topics that were unclear and requiring minor or substantial revisions. Authors mostly disagreed (about 3% of quality related cases) on those comments that were challenging technical aspect of a particular topic. They had to provide counteroffers and substantially long explanations in such cases to justify their disagreement (excerpts 4 and 5). Authors' explanations in these cases clearly demonstrated their deep understanding about the subject as opposed to the reviewers. Furthermore, such comments facilitated authors to further enhance their learning on that particular topic and be more clear and specific in their writing. In about 5% of quality related cases, authors partially disagreed with the reviewers; they provided clarification on some points and counteroffers on others and incorporated the comments selectively in their revisions (see excerpts 4 and 6). This case was particularly interesting as the authors were found to have reacted strategically on some of the reviewers' comments. They exploited well the opportunities where the reviewers' comments were somehow uncertain (for instance, note the words '*may be, if possible*' in the beginning of the comments in excerpt 4). However, this quality related part of negotiation assisted the authors to focus and improve technical contents of the article that are essential for their acceptance in a good journal (Hargens 1988). These observations are in accordance to those found by Bedeian (2003). In their study, a vast cast majority (89%) of the authors felt that the net effect of the review process was to improve the quality of their published work.

Explanation related negotiation

Explanation related negotiation occurred 20% of time, with a considerable deviation (±8%) from the average values, meaning that these were frequent in few articles but not so

frequent in others (see Fig. 4b). Examples of such cases are illustrated in the following excerpts:

7. Reviewer	This paper is short communication, but the authors are going to explain their hypothesis. However, data and logic development to prove the hypothesis are poor. Moreover many investigators (Peter et al. 2009 or Bob et al. 2009) have already provided detailed investigation on this subject. [*Explanation on misunderstood concepts*]
Authors	The response of the authors was of about 750 words as the reviewer suggested major changes based on this comment. The key points of authors' response were (i) they first provided information about their study and highlighted its novelty (ii) they then described the objectives and key findings of other studies, and (iii) finally, they mentioned that '*the reviewer seems to misunderstand the differences between the objectives (and instrumentation used) in our article and above mentioned articles are totally different and should be seen from different perspective*'. [*authors disagreed*]
8. Reviewer	I do not understand why the meteorological conditions during the measurement campaign are described in Sect. 3.3.4 which is a subchapter of the CFD model. [*Explanation on unclear contents*]
Authors	The reason for providing this description in Sect. 3.3.4 was that the Reynolds number, which is given in next line after meteorology, could be estimated using … that are required to estimate … [*authors explained*]
9. Reviewer	I do not agree with the terminology used by the authors to call particles in this size as …, these should be called as … [*Explanation on accuracy of used technical terminology*]
Authors	Authors disagree with the reviewer's suggestion as terminology used in our article is also used by several other authors (Richard et al.…). Moreover, it is based on our measured data that …. , therefore we would like to stick with the same terminology. [*authors disagreed*]
10. Reviewer	General—what is the role (and relative contribution) of particle coagulation for ultrafine particle count in determining transmission efficiency [*Explanation to enhance reviewers' understanding*]
Authors	The role of particle coagulation is … Our calculations were consistent with this as … [*authors explained*]

Such negotiations required further explanation to neutralise reviewers' comments. The distinguishing features of such negotiations were that the author's responses were just to address the reviewers' comments on misunderstood or unclear contents, but *not* to include in the text of the manuscript. Note that such explanation is different from the quality-related explanation that requires modification or addition in the text. Majority of articles showed one or more such type of comments by the reviewers which were not encouragingly perceived by the authors. In general, authors' reactions were in disagreement (see excerpt 7–10) as in about 17 of total 20% they either partially or completely disagreed with the reviewers comments. These results seem to follow the observations by Bedeian (2003). About 64% of the authors in their study reported a feeling that some reviewers try to find points to object the contents of a manuscript just to convince an editor that they have done a conscientious job in preparing their reviews. In our study, the authors appeared to be successful in proving their points as the final decision by the editor went into their favour, indicating an author-favourable nature of this negotiation. Authors were persistent in their replies and they reminded the reviewers that their comments lack deep understanding

(excerpt 9) or is driven by some other factors (e.g. lack of time to review the manuscript or conflict of interest, etc.; see excerpt 7 for example). While preparing the response, authors used the existing text in the article along with additional new information that was overlooked by the reviewer to substantiate their statements (excerpt 9).

Suggestions related negotiations

These occurred quite frequently (20%) and showed a relatively modest consistency (±6%) in their occurrence (see Fig. 4c). In almost all cases, authors agreed to incorporate the suggestions made by the reviewers in their revised manuscript, as shown in the following excerpts:

11. Reviewer	In Sect. 1 (Introduction), references [13] and [14] are related to composites and are not relevant. [*suggestion on unclear opinion*]
Authors	Yes, we agree. Both these references are deleted. [*authors agreed*]
12. Reviewer	As for the measurement of the transient state of the nanoparticles, some of the recent references (Robert et al. 2009 and Woods et al. 2009) can be added at appropriate places. [*suggestion to include recent references*]
Authors	We thank the reviewer to bring these recent articles to our notice. We have included them in Sect. 1 (Introduction) and Sect. 3 (Results and discussions). [*authors agreed*]
13. Reviewer	Please table the measurement period, traffic volume and vehicle type constitution, a situation of the wind speed, and so on. The title must be changed in order to mislead readers. In Sect. 2, paragraph 1, add symbol for the mean correction. [*suggestion to include additional information and changing title*]
Authors	Considering the reviewers' suggestion, we have included the suggested information in the Methodology section and changed the title to … The symbol '$\sigma_{\mathrm{m}}^{'}$ is added. [*authors agreed*]
14. Reviewer	The authors discuss the likely increase of particle number emissions from diesel-engined vehicles. May be you should also discuss the fact of a … that has been discussed in literature recently. [*suggestion to include additional information*]
Authors	As suggested, following sentence has been added on Page 2 lines 5–6: '*This will also lead to a shift towards smaller size distributions as discussed by Cheng* et al. *(2008)*' [*authors agreed*]

As clearly reflected in excerpts 11–14, reviewers' suggestions were very well perceived by the authors, indicating a reviewer-favourable nature of this negotiation. The dominant reason of acceptance appears to be the reviewers' constructive approach. They provided additional information to the authors on various raised issues that helped the authors to address them comfortably. As expected, occurrence of this type of negotiations were relatively larger (20%) compared with the peer-review negotiation process (11%) between level 2 students and their peers (class mates) during essay writing (23%) but the level of acceptance by the authors were of similar degree.

Restatement related negotiations

Restatement of the contents by the reviewers for comprehension and knowledge check occurred frequently (15 ± 9%) (Fig. 4d), as illustrated in examples below:

15. Reviewer	This study presents high time-resolution of the measured … aiming to distinguish differences between the … particles. This study also presented justification for dispersion models. This is of great importance to understand the aerosol particle behaviour at a micro-scale within a city. [*generic restatement on entire article*]
Authors	Authors have nothing to respond and negotiate in such case, but they quoted this comment in their response to make sure that this statement is read by the editor while deciding on article.
16. Reviewer	One page 3, the authors state that a number of workers tested a range of adhesively bonded joints and found that the endurance limit on a traditional S–N curve corresponding to between 15 and 35% of the quasi-static strength of the joint. I assume that all of these results were under room temperature conditions where the quasi-static strength is the room temperature strength. Is this correct? [*comprehension check*]
Authors	Yes, we have modified the following sentence to make it more clear by adding words in italics: 'A fatigue endurance limit was found which often appeared to range between 15 and 35% of the quasi-static strength of the joint *for a number of adhesives at room temperature*. [*authors voluntarily added information to make the contents clearer*]
17. Reviewer	Figure 2 gave penetration of particle number concentrations in different length of sampling tubes. Were losses of particle mass also considered? [*restatement with comprehension check*]
Authors	As shown in Fig. 2 and described in Sect. 2.4, particle mass distributions are calculated from the corrected particle number concentrations that implicitly take into account the losses for mass (whatever the losses are). The following description is added to further clear the issue in the caption of Fig. 7 '*The particle mass distributions are estimated from corrected particle number distributions*'. [*authors voluntarily added information to make the contents clearer*]

Reviewers generated such type of negotiations by asking questions and answering to those questions themselves (excerpts 15). Reviewers wanted to report their understanding about the article and they involved authors' finding in their statements (see excerpts 16). Unlike the attributes discussed above that helped the authors to identify unclear and incorrect contents, restating helped them to learn what was clear to the reviewer and what needed further clarification. Authors voluntarily added explanations in the text to further enhance the readability and clarity (see excerpts 16 and 17 for example).

Grammar related negotiations

Grammar or editorial related negotiations emerged more often (13%; see Fig. 4e) than is generally expected in case of scientific article submissions in peer-reviewed journals (Southgate 1991). These also showed a substantially large deviation (±15%) from the average values. It indicates a significantly higher occurrence in few cases (see for example articles 7 and 17 in Fig. 4e those alone contribute from one third to half of the total occurrences) and almost negligible in others (see cases 5, 8, 10, 11 and 12 in Fig. 4). Such suggestions also reflected the knowledge of the reviewer about the grammar and his attention to every aspect of the article. Few examples of such occurrence are illustrated in the following excerpts:

18. Reviewer	Line 25–28 (Page 11): In sentence 'The HRT … 2.12–3.75 KgCOD m^{-3} d^{-1}.' Values needs to be changed as 2.12 to *3.90* KgCOD m^{-3} d^{-1} as per what the authors report in Table 3. [*typing error*]
Authors	Suggested changes have been made at required place. [*authors agreed*]
19. Reviewer	The overall manuscript could greatly benefit from a good grammar and spell checker. For example, Line 47 (page 7). The title should read 'Conclusions' instead of 'Conclusion' [*grammatical error*]
Authors	The above changes have been made. [*authors agreed*]
20. Reviewer	In Conclusions section on Page 8, the word 'or' in the sentence 'Thus, longer … efficiency' needs to be replaced with 'for'. [*grammatical error*]
Authors	Suggested changes made. [*authors agreed*]
21. Reviewer	Page 4, line 32 is not clear. Too many 'and' in the sentence [*grammatical error*]
Authors	Page 4 line 31 to Page 5 line 2: these lines are reworded as: "The main aims of *these* measurements were to determine the *effects* of mixing and physical and chemical conversion processes, *as well as* the competing influences of rooftop wind speed and traffic volume on *both* the PNDs … at both levels". [*authors agreed*]
22. Reviewer	Throughout you use the "on the order of "(∼) symbol, rather than that for "approximately equal to", e.g. ∼6.5 (p. 2), ∼0.3 s (p.6), ∼13 mm (p. 8), ∼99.9% (p. 10) and many more. Use the true minus sign, not a short hyphen (e.g. on p. 13, line 28. Please change. [*editorial corrections*]
Authors	The symbol (∼) used for 'on the order of' has been changed to the symbol (≈) used for 'approximately equal to' in all the manuscript. Hyphen sign has been changed to true minus sign in all the manuscript. [*authors agreed*]

The possible reasons identified for such occurrences were (i) the authors tended to concentrate more on the technical contents of the article and were often inclined to overlook the grammar or editorial aspects, and (ii) first authors of many studies considered here were non-native English speakers. In some instances, authors appeared to get confused in the use of articles such as *'a, an, the*' resulting in frequent comments of such types (see excerpt 21). Another interesting aspect of it emerged through conversations with our colleagues that some authors strategically leave grammatical corrections to distract reviewers' attention from the technical contents. However, such a high frequency of their occurrences also raise an important question 'whether the grammar or editorial corrections need to be taken seriously before submissions?' In our opinion, the short answer to this question is 'yes'. Such grammatical infelicities can drastically increase the chances of rejections at the pre-review stage (see Fig. 1) where the editor checks generic features of the article (e.g. subject suitability and language, etc.). The data presented here reveals that, for some reasons, once less grammatically efficient articles cleared the first stage of screening by the editor and entered in the reviewing loop (see Fig. 1); all such articles were eventually accepted for publication. It was presumably due to their strong technical contents despite having significant grammatical infelicities. Furthermore, it appeared that authors were aware with such weakness in their articles and accepted all the suggestions made by the reviewers. Clearly, the nature of such negotiation was reviewer-favourable but of considerable help to the authors to improve such local issues. Substantial occurrence (13%) of 'grammar' related negotiations suggest that authors seem to overlook this aspect despite strict instructions by numerous scientific journals. It is important to treat them with

adequate care as grammar not only plays an important role at pre-reviewing stage (Southgate 1991; Bornmann et al. 2008), this can also help to minimise the number of comments at the reviewing stage providing a healthy chance for the acceptance of their articles.

Structure related negotiations

Structure or organisation of the article related negotiation occurred rarely (0.6 ± 1%), as seen in Fig. 4f. Few examples of such negations are given below.

23. Reviewer	Section 2.2 should be abridged with Sect. 2.1. It should be revised as authors first discuss the calibration and later specifications? [*Structure: organisation of paragraph need to be changed*]
Authors	As suggested, this section has been revised. [*authors agreed*]
24. Draft 1	Current regulations address the ambient particulate matter (PM) level as PM_{10} ($D_p \leq 10$ μm) and $PM_{2.5}$ ($D_p \leq 2.5$ μm); these use mass concentrations of particles, not particle number concentrations.
Revised	Current regulations address *amount of* the ambient particulate matter (PM) as PM_{10} ($D_p \leq 10$ μm) and $PM_{2.5}$ ($D_p \leq 2.5$ μm); these *regulations* use mass concentrations of particles, not particle number concentrations.

As is evident from their negligible frequencies of occurrence, such types of negotiations were rarely generated by the reviewers. However, authors were keen to improve the readability of their article and did made voluntary changes in their revised drafts although these were not suggested by the reviewers. For example in excerpt 24, the words 'level' in first draft was functioning but the authors changed it to 'amount' in revised version. They both provide same understanding in this context, but the authors were keen to use most appropriate words to enhance the clarity.

Summary and conclusions

Publishing high quality research articles in highly rated peer-reviewed journals is getting increasingly difficult but is an essential requirement for researchers for their academic development. Therefore, it becomes paramount to understand the review process of research articles and the kind of negotiations that occur between the authors and reviewers of peer-reviewed journals. A peer-review negotiation approach that is commonly used in teaching to enhance students' learning is applied for the first time to investigate the types of negotiations and their frequency of occurrence between the authors of peer-reviewed research articles and the academic reviewers. Reviewers' reports on 32 articles were collected from various researchers working in the area of engineering and science. Seventeen articles, which included 765 reviewer-generated comments, in the category of 'major changes required' were thoroughly assessed to identify key negotiation attributes and how the authors were helped by considering them in their revised draft.

Six broad categories of negotiation were identified; these were quality, explanation, suggestion, restatement, grammar and structure. Quality related negotiations were the most frequent (31 ± 12%) ones with mixed reactions of the authors agreeing, disagreeing or partially agreeing on some comments. It was observed that such negotiations forced authors to re-exercise their thinking and had to demonstrate their deep and conceptual

understanding on several technical points by counter-offering solutions to the reviewers' comments and modifying the text accordingly.

Suggestion, restatement, grammar or structure related negotiations were of highly collaborative nature. These were gladly accepted by most of the authors, indicating their flexible participative approach in addressing such comments (Linhares et al. 2009). As opposed to the above, 'explanation' related negotiations, which occurred about 20% of total instances, were of highly argumentative nature as authors had to clear the conceptual misunderstanding of the reviewers. Interestingly, structure related negotiations rarely occurred, indicating that authors were clear about the organisation of their articles. This is opposed to the results obtained by Mendonca and Johnson (1994) where they found in their peer-review instruction for student writing that students revised their draft in 37% of the instances. This difference can be understood through an obvious fact that the researchers are expected to be much more mature in their writing than the students.

Most types of negotiations helped authors to improve presentation of their underlying concepts, quality, clarity, readability, grammar and technical contents of the article, besides offering an opportunity to rethink about several other aspects of the article that they overlooked during the preparation of manuscript. These findings are in line with the results reported by Bedeian (2003). They analysed experiences of 173 lead authors in the area of management studies and reported that overwhelming majority (74%) of authors agreed that the revisions after the review process were beneficial enough to justify the additional labour and delay in publication. Similar findings were reported by Mendonca and Johnson (1994) for peer-review negotiation in students writing, Crouch and Mazur (2001) and Lasry et al. (2008) for peer instructions in student learning. Similar to the peer-review negotiation approach in teaching that is practised by several academic researchers for enhancing students learning (Ramsden 2003), our findings on different negotiation attributes can help them to improve the overall quality of their articles before submission. Moreover, findings of this study provide a novel link between the studies either focussing on negotiations in teaching or research separately.

This study presents assessment of a small number of articles representing only few researchers and limited journals in selective disciplines. Thus, one should be cautious in generalising these findings outside the scope of this study. A detailed study including reviewers' thoughts on this process, a large number of journal articles representing various disciplines and quantitative assessment of cognitive attitude of both the authors and the reviewers could be helpful to further understand this topic.

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