Best Contribution Grading (BCG): a guide for teachers

An educational approach to increase quality of peer review assignments in higher education.

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1   Introduction

Teachers in Higher Education often use peer-review or peer-feedback assignments in their courses. In these assignments, students review each other's work. Usually the purpose of these peer review assignments is many fold:

➢ Students learn the criteria on which their own work will be assessed. By critically reviewing others they indirectly reflect on their own work.

➢ Students tend to learn more critically from comments and suggestions received from peers in comparison to feedback received from teachers. Feedback from teachers is often interpreted as the opinion of an expert and therefore accepted without much critical thinking.

➢ Students are confronted with a diversity of perspectives from their reviewers, which help them to improve their products.

➢ Offering peer feedback stimulates the development of problem-solving skills by means of analysing work of others, diagnosing problems, identifying areas for improvement and suggesting solutions.

➢ Peer feedback makes it possible to offer individual feedback to every student even when the number of students increases.

Now-a-days, a substantial body of literature describes diverse learning benefits from student participation in peer review activities. For example the use of peer-feedback in online courses was shown to be an efficient strategy to stimulate deep learning in students (Van Popta et al 2017, Filius et al 2018, 2019). Nevertheless, in practice many teachers feel that the peer review activities in their courses do not reach their full potential. In the perception of teachers, the peer review provided by students often remain superficial and lack critical depth. It seems students are not always motivated to actively contribute to peer review, and therefore either participation is low or the peer review activity does not reach the expected quality.

If you are a teacher and recognize this, probably the approach described in this teachers guide provides you (part of) a solution.

In this teacher guide we describe our approach called:

'Best Contribution grading (BCG)'

*We will offer practical guidelines derived
from implementation of BCG in four academic courses.*

As starting point, we assume that peer review assignments have the potential to offer diverse learning benefits for students. Therefore we do not aim to provide an overview of current evidence for the benefits of peer review, nor do we aim to offer a practical guide to implementing peer review in general. For this we refer to other publications (see chapter 5: References & further reading). Instead, we will described our approach, called 'Best Contribution Grading" (BCG), and will offer practical guidelines derived from implementation of BCG in four academic courses at Wageningen University.

2 Best Contribution Grading (BCG)

2.1 Principle

We developed an approach called 'Best Contribution grading (BCG)' which aims to increase both student participation and quality of peer reviews in course assignments.

Best Contribution Grading: grading the best comments
students provide as part of their peer review.

We ask students to self-select their 'Best Contributions' from the peer review(s) they delivered on work of others. Next, these 'Best Contributions' are graded by their teacher(s). This as an alternative for grading complete peer reviews, which in many courses or programs is common practice. Since grading based on the quality of all peer reviews is time-consuming from a teachers perspective, in some courses grading is solely based on timely delivering of feedback and the number of peer reviews delivered. BCG is different, because it not only grades *part* of the peer review (Best Contributions only) but also takes the quality of the peer review into account. In BCG, students are asked, after completion of peer review or online discussions, to select those contribution(s) that they *themselves* judge as their best piece of work. To communicate expectations on the quality of the peer review, rubrics are provided to the students at the start of the peer review assignment. As a teacher you decide on the number of contributions students need to identify as being their best ones. Next, teachers grade the best contributions delivered by the students according to the grading rubric. As teacher you decide in what way these grades contribute to the final grade of a course or module. BCG can be applied not only to peer review assignments (see case study 1-3) but also to online discussions (see case study 4).

2.2 Aims of BCG

Increase the quality of peer review

When you implement BCG for a peer review assignment, students will aim to provide at least a few contributions to the peer review which qualify as a 'good' or 'excellent' as described by the grading rubric. This triggers the students to reflect on their comments. This enhances the overall quality of the peer review, of which both reviewers and reviewees benefit.

Increase participation to peer review

It is only possible to deliver one or more good contributions for grading when a student participates in the peer review. Therefore (almost) all students will participate in a peer review or discussion assignment in order to pass the course.

Offer a safe learning environment

Learning involves making flaws, errors, expressing misconceptions or asking questions, for example in an online discussion. Therefore a safe learning environment in which students are free to do so is crucial. In BCG students select their best contributions by themselves. Therefore flaws or mistakes do not influence their course grades as long as they do not select those as their best contribution.

Deliver a scalable teaching method

Budgets these days are tight in both traditional classrooms as well as in online training due to increases in student numbers and reductions in budgets for staff and resources. BCG is to a certain extent scalable without sacrificing quality, as long as you put a reasonable limits on the number of best contributions students are allowed to deliver.

2.3 Implementation within the learning environment

BCG can be implemented without a specific learning platform. For our first pilot of BCG, students were asked to copy-paste their best contributions from the peer review platform to a simple word document which subsequently was submitted for grading (see case study 4). However, in order to optimize both the selection of the best contribution(s) and the grading process, Feedbackfruits B.V. (https://edtechconsortium.Feedbackfruits.com/) developed a platform for BCG, which is currently available as beta version[1]. This platform supports the whole BCG process, which consists of the following steps (see Fig. 1 for examples within the Feedbackfruits platform):

Step 1: Submit original document (student)

Step 2: Submit peer review (student)

Step 3: Select best contribution(s) (student)

Step 4: View peer reviews (student/teacher)

Step 5: Grade best contributions (teacher)

Step 6: (optional) Write reflection based on received reviews (student)

➢ Step 1: Student submits assignment, either individually or as study-group. Depending on the nature of the assignment this can be a text (case study 2 and 3), video (case study 1), or PowerPoint presentation.

➢ Step 2: Student reviews assignment(s) of others. As teacher you determine how many assignments the student has to peer review. As teacher you may also set criteria for review including the number and nature of contributions (Fig. 1A).

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[1] At the moment of writing, February 2020, BCG is implemented as a tool within Feedbackfruits (Figure 1, see for more information www.Feedbackfruits.com). This BCG tool makes it possible to add BCG to peer review assignments. Currently this tool is available as beta and on request available to use for peer review assignments (see https://help.Feedbackfruits.com/en/articles/2080644-setup-participation-grading-beta). In the near future it will also be possible to add BCG to discussions within the Feedbackfruits tool 'interactive documents' in order to let students select their best contributions to online discussions.

- ➢ Step 3: Student selects their best contribution(s) out of all the written comments (s)he delivered. As a teacher you can set the number of best contributions a student is required to select and hand in as 'Best Contribution' (Fig. 1B).

- ➢ Step 4: Both student and teacher can view the reviews. The students studies the received reviews and may respond to the reviewers' comments. Teachers can provide feedback on both the original product and the peer review (Fig. 1C).

- ➢ Step 5: Teachers grade the best contributions selected by the students. While grading, the teachers are able to view the selected best contributions within the context of the original peer review product and (if any) the replies of the student.

- ➢ Step 6: (optional) Student writes a reflection based on received reviews. A teacher can turn this option on/off.

Step 6 is the final phase of the Best Contribution grading process. After this, usually, but not always, the student is asked to improve his original product and submit the final product for grading.

BCG can also be applied to online discussions.

BCG can also be applied to online discussions (see case study 4). This involves the following steps.

- ➢ Step 1: Students discuss a topic/proposition on an online discussion board. When necessary teachers moderate the discussion.

- ➢ Step 2: Student selects their best contributions to the discussion after the discussion is finished.

- ➢ Step 3: Teachers grade the best contributions submitted by the student.

Implementation of the principle of BCG is also possible without using Feedbackfruits. Before the BCG tool was developed in Feedbackfruits, we asked students to manually select their best contributions from within the Blackboard learning environment discussion or peer review assignment and copy-paste their best contributions to a word document submitted for grading by their teacher. The drawback of this procedure is that it requires effort from the students to search, copy and paste their best contribution to a separate document. In addition, the grading process is less valid since a teacher needs to grade Best Contributions isolated from their original contexts in which the contributions were given.

Implementation of 'Best Contribution grading'

is also possible without using Feedbackfruits.

Although not yet tested in any of the case studies, it may also be possible to use the options offered by discussion boards in learning environments such as BrightSpace, Canvas or Blackboard. Most of these discussion boards offer the options to use Up/Down vote or (5-)stars rating systems. These rating systems are originally intended to let students rate contributions of other students and not their own contributions. However, as a teacher you may ask students to use this function to rate their own Best Contributions, which in turn will be graded by their teacher. These discussion board usually offer the options to sort comments by author and rating. This makes it possible for teachers to grade the best contributions while the original context in which the contribution was made is still immediately accessible for the teacher (usually one or no mouse clicks away).

Figure 1A: Step 2, student peer reviews the work of other students. At the left the original submitted document, a video presentation is shown. At the left students give feedback.

Figure 1C: Step 4, teacher reviews original document and peer reviews. Both the original document and peer review comments are visible. Teacher may provide additional feedback.

Figure 1B: step 3: Student selects his best contribution to the peer review. At the left the original submitted document, a video presentation is shown. At the right all peer feedback comments given by this students are shown. The students selects his best two comments.

Figure 1D: step 5: teacher grades the best contributions delivered by the student. In one view the teacher is able to see the original document, the peer review comments self-selected by the student as best contribution and, if any, replies on the peer review.

3 Case studies

This chapter describes four courses from Wageningen University in which BCG was implemented and evaluated. For the purpose of evaluation, students' satisfaction with BCG was evaluated using an evaluation form consisting of several agree–disagree questions using a five point Likert scale. Furthermore 'time on review' and 'review quality' was compared between groups who were asked to deliver the Best Contribution and groups who were not. The practical lessons learned from these courses resulted in a list of Do's and Don'ts described in Chapter 4.

3.1 Case study 1: Course "Presentation skills" .

General course characteristics

The course 'presentation skills' runs 4 times a year. In each edition of this course 15-30 students from various master programs from Wageningen University are enrolled. The course teaches important skills necessary to deliver an authentic and persuasive presentation in an academic context. The 8-week course consists of three face-to-face sessions of four hours on Thursdays, respectively in week 1, 3 and 8 of the academic period. In between the sessions an online module has to be followed, consisting of knowledge clips and assignments. Within the sessions time is used for discussion and practicing of presenting. The full length of session 1 is a plenary setup with smaller exercises. In session 2 and 3 students have a plenary introduction and then split up into subgroups of 8 students to deliver a 7-minute presentation and receive feedback on this from their fellow-students. The subgroups are facilitated by peer-tutors.

Problem before BCG
In past evaluations of the course a recurring comment was that students appreciated the course but would like to have more practice moments. Also from a didactical point of view, the trainers agreed that the elements of practicing presentations that included peer-feedback were the most important ones. However, since this is a relatively small course with interference from simultaneously running larger courses that have high workload and at that time a platform to facilitate video sharing for peer-feedback was not available, the online module did not include peer-feedback assignments on personal presentations. Using BCG within Feedbackfruits enabled the possibility to create extra moments for personal presentation feedback in a way that ensured participation within a safe learning environment.

Assignment with BCG
In between session 1 and 2, and session 2 and 3 the students have to prepare their 7-minute presentations. Currently the online module in combination with BCG provides the space to include a personal feedback assignment. This personal feedback assignment is included both in between session 1 and 2, and in between session 2 and 3. Before the feedback assignment students are guided through several steps that help in the preparation of the presentation. After the finalization of preparing the body of the presentation an BCG assignment is added as a final step in the preparation, a practice-presentation. The presentation does not have to be fully ready but at least should have a comprehensible structure and be completed enough so that useful feedback can be given. Students are however stimulated to complete the presentation as much as possible before starting the practice-presentation assignment.

The students start by recording and uploading their 7-minute presentation. In the instructions it is clarified that the grading is not related to the practice-presentation. If the presentation is not fully ready students are asked to explicitly state what they would like to have feedback on. Furthermore, they are instructed to record in such a way that their visuals/slides and their full body is within the

frame, some suggestion on how to do this are provided. To support specificity of the feedback, the students are asked to state at the start of the recording their learning goals regarding improvement of presentation skills that they specified earlier in the online module. The deadline for uploading of the video is a soft deadline 6 days in advance of the session (on Friday).

Next, they have to provide feedback to two randomly assigned fellow-students. With two videos there is enough material to provide feedback to, and it makes sure the assignment can be followed through even if one of the videos turns out to have technical issues. For the student receiving the feedback it ensures that at least some feedback is received. In the instructions of this step it is strongly suggested to go through the rubric that shows the criteria on which feedback is graded and to make use of an observation sheet created by the trainers (see chapter 6.1 for the rubric). The feedback criteria differentiate between criteria on delivery and on content in order to diversify the feedback. For both criteria 2 comments are required so that the students are stimulated to give more comments than they have to select as best contributions. The deadline is two days before the face to face session (Tuesday). This is a hard deadline as before the session the students have to complete the assignment by selecting their best comment. Next to this, this hard deadline guarantees that the feedback receivers can include the feedback in the presentation they will deliver.

As last step students have to select three feedback comments that they consider high quality. Again this step refers to the Feedback rubric. The deadline for this step aligns with the starting time of the session.

Evaluation Results

For the purpose of evaluation of BCG a cross-over design was used during several course editions. For this experiment, the course consisted of two peer review assignments. In the first assignment only half of the students were asked to deliver their best contribution to the peer review for grading. The second peer review assignment followed a similar approach, asking the other half of the students to select their best contributions for grading. The evaluation results with respect to student satisfaction are published elsewhere (Busstra et al 2019). In short, students indicated that selecting their best comments motivated them to participate in the peer review and to provide high quality feedback (average score of 3.5 or higher on a five-point Likert scale ranging from totally disagree to totally agree). Students who were asked to provide their Best Contributions were in general equally or slightly more positive about both, the quality of the peer review they delivered and the quality of the peer review they received, compared to students who were only asked to deliver a peer review but not to select their best contributions. The time spend on the review was on average 25% higher for students who were asked to select their best comments compared to students who were only asked to deliver the peer review but without selection of the best comments.
We also graded the complete peer review of students in a course in which BCG was implemented and compared this to a graded peer review in a similar course in which we did not implement BCG. The average grade (on a 10-point scale) for the peer review as a whole in the course that implemented BCG was 0.34 point higher compared to the course in which BCG was not implemented (p-value for mean difference = 0.01).

Teachers experience.

Positive experiences
- Extra practice moments could be included in a way that assured a relatively high level of participation equal to a face-to-face feedback session.
- The feedback given in the practice-presentation was of higher quality and more extensive than expected, showing seemingly added value to useful feedback received in the course.

- Every time the course was given including BCG in the session, there was asked how students perceived the practice-presentation assignment. There has not been a single student expressing strong critique towards the assignment.
- Feedbackfruits worked in general very stable. A high percentage of the students was able to deliver feedback in time.
- Almost all students completed giving the feedback, probably also due to the fact that there was a grading element included.
- In the face-to-face sessions, students referred to the feedback given in the practice-presentation assignment.
- Trainers were able to get an impression of the level of feedback given in the online training sessions and could discuss this in the face-to-face sessions.
- There seem to be less cases of unprepared or not-practiced presentations in the sessions as students had to practice at least once through the assignment.

Less positive experiences
The less positive experiences were mainly about workability. Technical problems created individual cases were students could not finish the assignments. These individual cases took relatively a lot of time. The technical problems were mostly not due to the Feedbackfruits environment but due to students recording in wrong file format, uploading corrupted files, files without audio, etc. Technical issues were sometimes raised by students as critique. Individual students that missed deadlines because of valid reasons were not easy to re-integrate in the timeline of the assignment and also took relatively more time.

In general there was a high variability in the amount of comments and personal engagement of feedback. Seemingly more eager or committed students had a much more personal tone of writing and much higher number of high-quality comments. A significant proportion of students seemed to have a strategic approach and give the feedback that was necessary but not more. They anticipated on the selection. Although also the feedback from strategic students had considerable value it raises the question whether BCG really stimulates an open learning environment where students experiment and feel allowed to fail.
The trainer got the impression that there is a cultural difference to be found. It seemed that cultures that are less used to give direct feedback (e.g. Asian and African exchange students) in general had shorter and less explanatory comments.

3.2 Case study 2: Course "Systematic Reviews in Health and Society"

General course characteristics

The course Systematic Reviews in Health and Society is an mandatory course for BSc Health and Society students at Wageningen University. It is held once a year with approximately 60 students participating. The course aims at teaching students the knowledge and skills necessary to conduct a literature review. Among other things, students are taught how to select a topic and theoretical perspective, formulate relevant research questions, and conduct a (systematic) literature search. Students are further taught how to critique the literature developing their argument, and how to critically appraise each-others work by formulating constructive feedback.

During the course students are required to work on a research proposal for a (systematic) literature review (assignment 1). This assignment consists of 3 sub-assignment (A through C). The sub-assignments are provided with feedback by means of peer-review. The peer-review is conducted in groups of four students. Within the groups, each student peer-reviews three assignments and in return receives feedback on their assignment from the other three students.

Problem prior to BCG:
Overall the peer-review was evaluated positively by students. However, the contribution to the peer-review assignment and the quality of the feedback given varied between students. Some students for example did not (actively) participate in the peer-review process. They, for example did not provide (constructive) feedback yet received this from others. Also, the quality of the feedback was sometimes poor (e.g. providing general remarks). To increase students contribution to peer-review and to improve the quality of the feedback/comments given we implemented with BCG.

Assignment with BCG
Assignment 1 (the research proposal) consists of three sub-assignments (Assignment 1 A through C) and 1 final assignment (the final product). A total of 4 products. Best Contribution Grading was implemented for sub-assignment 1 A through C. Prior to the start of peer-review students were randomly assignment to (peer-review) groups of 4. Within the groups, each student peer-reviews three assignments and in return receives feedback on their assignment from the remaining three students. A total of 16 groups were formed.

Assignment 1 A consisted of handing in the draft version of the introduction (including research questions) and theoretical framework. All groups did the peer-review assignment but only groups with an even number were required to hand in their best contribution to the peer-reviews. They were instructed to select 3 comments that reflected "good quality feedback", one per research proposal reviewed.

Assignment 1 B consisted of the revised introduction and theoretical framework (based on the feedback given), and a draft version of the methods section. Again all groups were required to do the peer-review assignment but this time groups with an uneven number were required to hand in their best contribution.

Assignment 1 C consisted of handing in the concepts version of the full research proposal including the revised introduction, theoretical framework, and methods section. All groups were required to do the peer-review assignment and also hand in their best contribution. For this final peer-review they were instructed to select 5 comments that reflected " good quality feedback". An overview of all peer-review activities can be found in Table 1.

The Rubric in Appendix Figure 5 was used to assess the quality of the feedback for all assignments. Criteria for good quality feedback and the rubric were discussed with students during the tutorials of the course.

Table 1 : Overview of Activities for Peer-review

	Assignment 1A	**Assignment 1B**	**Assignment 1C**
Peer-review	All groups	All groups	All groups
Hand in peer-feedback given	Groups with even numbers	Groups with uneven numbers	All groups
Number of full comments that need to be handed in.	3, one per research proposal reviewed	3, one per research proposal reviewed	5, one per research proposal reviewed

Evaluation Results & teachers experiences

All students participated with the assignment and peer-review. Students seemed more motivated to participate with peer-review that the previous years. Before implementing BCG it was impossible for me as a teacher to grade the feedback given by students (due to the mass amount of info) having students select their own comments made this possible, and was also appreciated by the students as well.

The evaluation results with respect to student satisfaction are published elsewhere (Busstra et al 2019). In short, students indicated that selecting their best comments motivated them to participate in the peer review and to provide high quality feedback (average score of 4.1 or higher on a five-point Likert scale ranging from totally disagree to totally agree). Students who were asked to provide their Best Contributions to an assignment were in general equally positive about both, the quality of the peer review they delivered and the quality of the peer review they received, compared to students who were only asked to deliver a peer review but not to select their best contributions.

3.3 Case study 3: Course "Quality Systems Operations"

General course characteristics

This yearly course is attended by around 160-180 students, of which the majority is from the Bachelor Program "Food Technology" at Wageningen University. In four weeks we give students an introduction into the principles behind effective operational quality systems in complex food production chains. The four week course is build-up of four major elements, food quality, operations management, quality control and quality assurance, each being the main topic of 1 week of the course. For each of these four elements, students get one introductory lecture, perform a group assignment, perform peer feedback, and get a final feedback lecture by the teacher. The assignments are at the core of the course (>50% of total time spent by students on the course). In the assignments, the theory of each of the four major elements needs to be applied to a real-life situation. Questions of a similar nature also form the basis of the final exam of the course.

Problem prior to BCG:

Each week, students study operationalize food quality management from a different angle, resulting in a report prepared by groups of four students. These reports contain a combination of calculations and interpretations of the outcomes of the calculations, where the grading of the assignment is mainly based on the interpretation. Until 2016, the student reports were only graded by the teachers and only marginal feedback could be given due to the large numbers of groups (then 30). To stimulate students to more actively engage in the assignment, as well as to have individual feedback for all groups, peer feedback was introduced. Initially, each group had to give peer feedback on the report of one other group. The disadvantage of this approach was that usually a single student was providing the feedback, so the majority of the students were not actively involved in providing feedback. Also, the fact that peer feedback was not graded was seen as a disadvantage by the students, leading to low motivation. This was also reflected in the student evaluation, where the received peer feedback was not seen as something that positively contributed to their learning.

Assignment with BCG

In 2019, when BCG was introduced, peer feedback was changed to as system were individual students had to give feedback to the report of another group. On the one hand, this increased the contribution of individual students to the peer feedback, and on the other hand also increased the amount of peer feedback received. In addition, the BCG also made it possible for student to feel rewarded for the peer feedback given.

In the current setup, with BCG, each individual student reviews a randomly selected reports from another group. Students have received a general introduction to peer feedback during the introductory lecture to the course. The specific requirements of the peer feedback, as well as the grading for BCG, was explained in the course guide. Finally in Feedbackfruits, students see a number of elements that they would have to grade on a 7-point scale, including a minimum number of open comments for each element. Generally, the peer review focusses on each other's interpretations of the outcomes of the calculations, not the calculations as such, also because this interpretation is what students need to learn during the course. The rubric shown in appendix Figure 6 expresses the feedback criteria.

Evaluation Results

For the purpose of evaluation of BCG a cross-over design was used. In detail, BCG was used on one half of the group at a time. For assignment 1 & 2 groups 1-20 used BCG and for assignment 3 & 4, groups 21-40 used BCG. In both cases, the sum of the grades for the two assignments in which this

system was used counted towards the assignment grade, as detailed in the assessment strategy (assignment 1, 2, 3, and 4 and the peer feedback all counted equally towards the overall assignment graded, that counted for 20% towards the final grade of the course).

The evaluation results with respect to student satisfaction are published elsewhere (Busstra et al 2019). In short, students indicated that selecting their best comments motivated them to participate in the peer review and to provide high quality feedback (average score of 3.6 or higher on a five-point Likert scale ranging from totally disagree to totally agree). When asked whether students thought that it was fair that only their best comments contributed to the course grade and whether they would recommend using "Best Contribution Grading" to other courses they scored both statements with a 2.9 on a 5 point scale.

Students who were asked to provide their Best Contributions to an assignment were in general equally or slightly more positive about both, the quality of the peer review they delivered and the quality of the peer review they received, compared to students who were only asked to deliver a peer review but not to select their best contributions. However, compared to the other courses (case study 1 and 2) student in this course enjoyed the peer review less (average score of 2.5 in this course versus 3.4 and 3.7 in the other two courses).

Time spend on the review was 60% higher for students who were asked to select their best comments compared to students who were only asked to deliver the peer review but without BCG. The combination of providing feedback individually and being graded, seemed to have stimulated students understanding of the course topics, as the average grades during the exam increased (6.5 to 6.7 previous year), taking into account that the majority of the exam question relate to the assignment).

Teachers experience.

Implementing BCG seems to have improved the general peer feedback perception by students, as evidence by the fact that after many years of students complaining about the peer feedback (both giving and receiving), this year no such comments were made in the student evaluation. However, some students did select comments that were actually not very good, as evidence by several students scoring <6 for the peer feedback part of the course grade. This seems to be related to insufficient understanding of what is expected. In a next year, I will explain this more extensively in the introductory lecture to the course.

The digital interface worked very easily, both for students and for me as a teacher, making the execution of the experiment very smooth. Without BCG and the Feedbackfruit interface, grading peer feedback would not have been possible due to the large number of students.

3.4 Case study 4: Course "Integration of Evidence within the field of Epidemiology".

General course characteristics

This is a small four week fully online week course followed by around 20-30 students. Most students are from the fully online part-time master program "Nutritional Epidemiology and Public Health". The students in this course are usually professionals, combining work and family life with a part-time master study. This course introduces students to the broadness of the nutritional research domain i.e. mechanistic research in vitro (cell lines), in vivo research and observational research on (human) individuals and populations. The focus is on several approaches used to integrate and judge strength of scientific evidence for a proposed causal relation between a certain (nutritional) exposure and a health outcome. This course builds on the introductory courses in epidemiology in which the basic observational and experimental study designs are presented. After the course students will be able to:

➢ Discuss strengths and limitations of observational studies, human intervention studies and animal or cell line studies.

➢ Show understanding of causal models (e.g. the Rothman pie, counterfactuals, evidence pyramid, hill criteria, etc) by applying these models to specific examples of exposure-outcome associations

And a few other more specific learning objectives related to Epidemiological study designs.

To accomplish the above mentioned learning objectives students study short knowledge clips, readings, and assignments in which they practice with the obtained knowledge. Figure 2 depict the outline of this course. An important assignment that runs throughout the whole 4 week course is an discussion assignment in which students apply the concepts covered by this course on a practical case study by means of a structured group discussion. We implemented BCG for this discussion assignment.
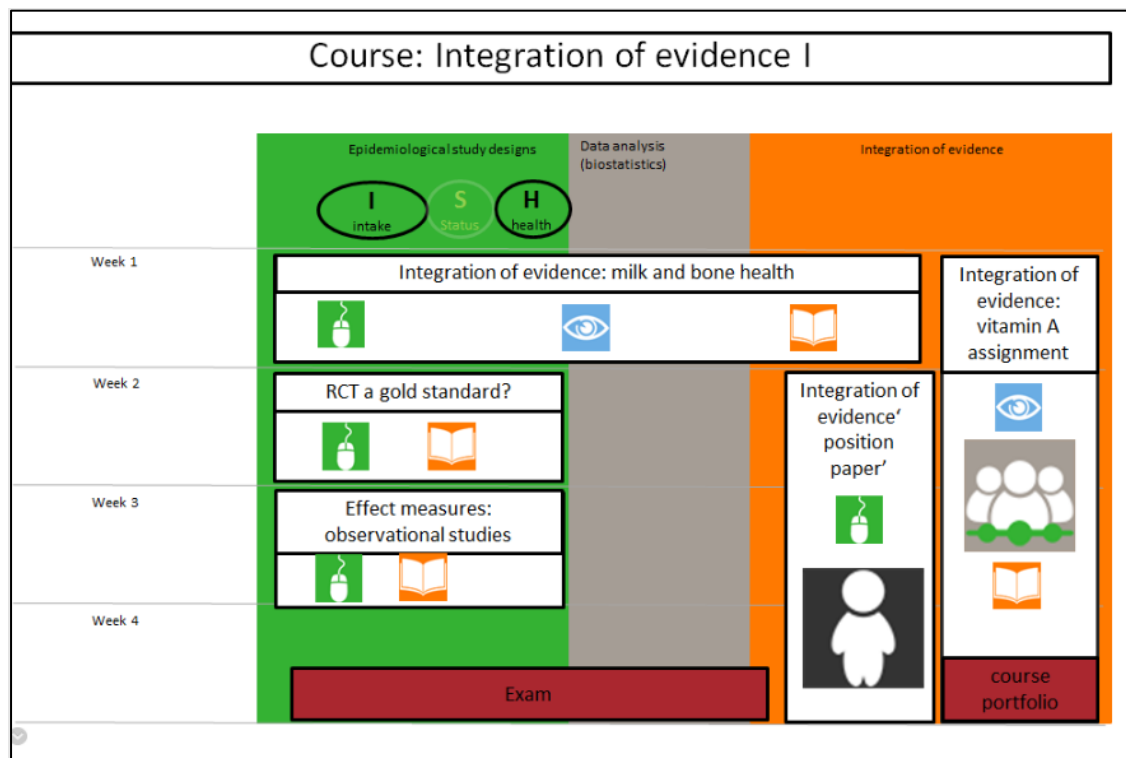

Figure 2: overview of the topics and educational approaches in the course, with knowledge clips (blue eye), readings (orange book), interactive e-modules (green mouse), individual assignment and group discussion assignment running over all four weeks).

Description of assignment for which BCG was implemented

The assignment for which BCG was implemented is a group discussion around the topic "vitamin A supplementation and childhood mortality in developing countries". In this group discussion students are asked to judge the strength of scientific evidence for the relation between vitamin A deficiency and childhood mortality. Evaluating scientific evidence is something that is usually done within an expert panel. Therefore this discussion took place within a group of 4-5 students behaving like such an expert panel. Each week new discussion topics about vitamin A and childhood mortality were given related to the theory covered in that week (see Figure 3). Each week one of the students in the group takes the role as moderator. (S)he provides a summary of the week-discussion and if necessary stimulates the group members to provide input to the discussion. This online discussion was implemented using the discussion environment in Feedbackfruits 1.0[2]. We asked students to collect their 'best' contributions' to the week discussions in a small personal course portfolio (1-2 page A4 format – with at least ten different contributions) by copy- and pasting those best contributions from the Feedbackfruits environment into a word document which was submitted for grading. The grading was done using a rubric which we provided at the start of the course (see Appendix).

Week	topic	Discussion questions	deadline
1A	Causal/Biological mechanism	- Make a D-I-S-H model for vitamin A and childhood mortality, - Discuss for each chain (D → I → S → H) what kind of studies need to be done to provide more and stronger evidence	End of week 2
1B		- How will the 'Rothman pie's' look for childhood mortality? What is the role of vitamin A intake. Give examples of Sufficient causes, Component causes and Necessary causes.	
2	DEVTA trial	- Look back at the DISH chain. Do the results of this DEVTA trial provide evidence for some of the chains. Summarize this evidence. - Do you consider this DEVTA trial as a 'gold standard RCT'? Why or why not?	End of week 3
3	Observational study	- Give a summary of the results of this study with respect to vitamin A. What effect measure was used, describe in words how to interpret this effect measure. - Look back at the DISH chain. Do the results of this study provide evidence for some of the chains? Describe this evidence.	End of week 4
4A	An alternative hypothesis	- Do you think the 'vaccination hypothesis' is plausible? - How would you test this hypothesis, what kind of studies are needed to test this hypothesis. Describe a study that can be used to test this hypothesis.	
4B	Summarizing the evidence	- Summarize the results of the meta-analysis or systematic literature review. - Apply the Hill criteria to the evidence you found. Which Hill criteria do apply? What does this say about the strength of evidence? - Do you recommend vitamin A supplementation in developing countries?	

Figure 3: overview of the weekly discussion questions.

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[2] This was done because at that time BCG in Feedbackfruits 2.0 was only implemented for peer review assignments and not for more unstructured group discussions.

Evaluation results & teachers experience

The implementation of BCG was not formally evaluated since this course was followed by a small number of students. A few things we observed as teachers that may also be useful for others implementing BCG for online discussions:

➢ Initially we implemented this discussion assignment without BCG. At that time the discussion was not graded and only aimed to give students the opportunity to apply and practice with the concepts covered in this course. Afterward some students asked whether it is possible to grade their discussions because they were convinced that during the discussion they were able to show the best of themselves, more that on the graded exam. Therefore for the next course edition we developed the principle of BCG for online discussions. In addition, we developed BCG for peer review assignments as described in case studies 1 – 3.

➢ Sometimes it was really obvious that a specific comment in the discussion was posted with the intention to select later on as 'best contribution'. Although this seems somewhat artificial and unnatural, usually those contributions were indeed of good quality and stimulated the other group members to reply or think further. Which resulted in deepening of the discussion.

➢ During the discussion we noticed more than once that a student posted a contribution that obviously, in the student's opinion, fulfilled the criteria for an excellent contribution. After posting this 'best contribution' we noticed that the student did not contribute any longer to the ongoing discussions. Sometimes this required intervention of the teacher in order to point the student to misconceptions or flaws in his "best' contribution, to keep the discussion going until the discussion reached the required depth/level.

➢ It happened that students indicated that they were not able to provide something new or good to the discussion since other students already said everything that there was to say. This requires intervention from the teachers side as in all cases there was much more to add, to elaborate or to contradict to earlier comments in the discussion. As teachers we intervened by asking some critical questions hinting to aspects that were not yet covered or not completely elaborated on. This also illustrates that applying BCG to (online) discussions is only advisable when the discussion topics are open, broad and stimulates students to voice different opinions.

➢ A few students indicated that they did not consider their posts as 'good contributions' because they only posted critical questions. Therefore, we now explicitly state in the rubric that critical questions could qualify as good contributions as well, as long as those questions indeed point to relevant weaknesses in others comments or bring new and relevant issues into the discussion.

4   Do's and Don'ts

Inform students: *not only on the purpose*
of the specific assignment
but also explain why you implement
peer review and Best Contribution Grading.

➢ Consider the use of a short practice feedback activity in which students are trained in providing peer review, become familiar with the rubric, BCG and the system used for peer review and BCG. Depending on the experience student have with providing peer review this practice session can be omitted. See further readings in chapter 5.1 for materials that can be used to explain the benefits of participating in peer review activities to your students.

➢ With respect to BCG explain
   o What you expect from your students (explain the procedures)
   o That you want to grade students contribution to the peer review (or online discussion) because when a student is able to critically reflect on work of others it shows to what extent the course content is understood. So excellent contributions to peer review are worth to acknowledge in the final grade since these are good indications of the level of performance of students.
   o That only their best contributions are graded because you want to offer a safe learning environment in which the student is allowed to make mistakes, errors or show incomplete understanding of the course content in order to learn from those. As long as a student does not select those not-perfect contributions as being their best ones, those do not influence their final grade.

Provide a rubric with peer review criteria in advance.

➢ Provide rubric to students in advance and discuss the criteria for good quality peer review with the students (either in a face-to-face session or an online session or video).

➢ In your rubric add criteria on both content and delivery of feedback. With respect to content criteria, for some subject domains it is important to acknowledge whether subject matter knowledge is applied correctly in the review comments.

Provide a clear framework with respect to the
length and nature of feedback comments

➢ Strategic students sometimes will provide several small comments and then a few larger overarching ones they selected for grading. An advice would be to create a clear framework for what kind of comments the students need to deliver, for example :
   o Each comment should discuss only one issue/topic/remark. This will make it also more convenient to respond to reviewer comments (in case you offer students this opportunity).
   o Add word limits to the peer review comments.

Carefully consider the number of best contributions
the student is supposed to submit

➢ From the three case studies we estimated that it takes about 1-2 min to grade every contribution. Try to set a reasonable number of contributions the student is supposed to deliver. Keep in mind that the purpose of BCG is not primarily the assessment of students' knowledge or performance for a course or subject as a whole. The main purpose of BCG is to increase the contributions to and quality of peer reviews and to acknowledge students' knowledge.

When you add BCG to online discussions
some moderation of the teacher may be necessary.

Moderation of online discussions may be necessary

➢ to prevent that students become silent after posting something that they later on will select as best contribution. Sometimes this required intervention of the teacher in order to point the student to misconceptions or flaws in his "best' contribution, to keep the discussion going until the discussion reached the required depth/level.

➢ to prevent that students think all useful input to the discussion is already given, stopping particular students to add something that qualifies as a good contribution. This requires some intervention from the side of the teacher in cases there is much more to add, to elaborate or to contradict to earlier comments in the discussion. As teachers we intervened by asking some critical questions hinting to aspects that were not yet covered or not completely elaborated on. This also illustrates that applying BCG to (online) discussions is only advisable when the discussion topics are open, broad and stimulates students to voice different opinions.

5 References & further reading

5.1 Further reading

Surf, Uitgave online onderwijs: Peer feedback en peer assessment. https://www.surf.nl/uitgave-online-onderwijs-peer-feedback-en-peer-assessment

Surf, tools voor peer feedback en peer assessment. https://www.surf.nl/tools-voor-peer-feedback-en-peer-assessment

University of Melbourne, academic guide to student peer review, including handouts for students. http://peerreview.cis.unimelb.edu.au/resources-3/teaching-resources-2/

5.2 References

Busstra, M.C. Garcam F.K. Hettinga, K.A., Huijgen, L., Gresnigs, M.C., Hinteman, B (2019). Improving peer review quality by grading the best contribution of each student: educational principle and evaluation design. 18th International Conference on Information Technology Based Higher Education and Training, ITHET 2019, Magdeburg, 2019-09-26/2019-09-27

Filius, R.M., De Kleijn, R.A.M., Uijl, S.G., Prins, F.J., Van Rijen, H.V.M., & Grobbee, D.E. (2019). Audio Peer feedback to Promote Deep Learning in Online Education. Journal of Computer Assisted Learning.

Filius, R.M. (2019). Peer Feedback to Promote Deep Learning in Online Education; Unraveling the Process. PhD Thesis, Utrecht University.

Van Popta, E., Kral, M., Camp, G., Martens, R.L., & Simons, P.R. (2017). Exploring the value of peer-feedback in online learning for the provider. Educational Research Review, 20, 24-34.

6 Appendices

6.1 Rubrics

Criteria: Score: Characteristics	Insufficient 0-5.5 (0/4)	Sufficient 5.5 – 7.5 (6.5)	Good 7.5 – 8.5 (8)	Outstanding 8.5-10 (9.5)
Supportiveness	- The feedback is not constructive; it refers to what is not good instead of supporting someone. Or it only refers to positive aspects without indicating how to make use of the strengths. - The feedback undermines the preparation of the presentation by being overly critical or going into obvious unfinished aspects. - The feedback is judgemental, provided as a truth or seems a personal preference not supported by neutral reasoning.	- The feedback includes both qualities and improvement points. - The feedback supports improvement of the presentation. It takes into account the context of a practice presentation and does not comment extensively on obvious unfinished aspects. - The feedback is given as a personal observation in a non-judgemental and neutral way supported by observations. It is clearly not a personal preference.	- The feedback includes both qualities and improvement points. - The feedback clearly supports improvement of the presentation. It includes the specific context of the presentation; its specific goal, target group, location, etc. - The feedback is given as a personal observation in a non-judgemental and neutral way supported by observations and reasoning.	- The feedback includes both qualities and improvement points. - The feedback gives a sound personal interpretation of the personality and style of the presenter and takes this into account in the feedback. - The feedback includes the context of the presentation and considers aspects beyond it by supporting how the context (goal, target group, setting, etc.) itself can possibly be specified further or addressed more. - The feedback is given as a personal observation in a non-judgemental and neutral way supported by detailed and insightful observations and reasoning.
Observational quality	- Observations are absent or do not describe behaviour but are interpretations. - The observations are very general and ambiguous, it is difficult to understand what he/she is referring to.	- The observations describe behaviour in a neutral manner (what you can see and hear), mostly behaviour that is easy noticeable. - The behaviour is described but remains somewhat general. It gives a sufficient idea of what someone means and at least relates to parts of behaviour/elements that can be adapted.	- The observations describe specific behaviour in a neutral manner (what you can see and hear), it includes both to behaviour that is easy noticeable and behaviour that is more detailed, underlying or hidden at first. - The behaviour is described specifically. It is clear what it refers to and someone can work on this, possibly this is not always realistic within the context of the course.	- The observations are very specific and remain concise. It points at behaviour and aspects that are not always easy noticeable or obvious and could uncover blind spots. - The observations are detailed and keen. It is immediately clear what it is referring to and this is something that someone can work on within the timeframe. Several observations refer to a specific point or time within the presentation.
Analytical quality	- No relation is made between the observations and the effectiveness of the presentation. - The analysis provides incorrect or irrelevant information. - Delivery and/or content are not addressed.	- There is a relation made between observations and the effectiveness of the presentation. The information is correct. - Both delivery and content are addressed in the feedback. - Future actions are considered.	- There is a sound relation made between observations and the effectiveness of the presentation. The information is correct and based on the provided information in the course. In depth explanation is lacking. - The feedback recalls /names concepts from the course content (from the observation form, classes, rubric, knowledge clips, external sources, etc). Mainly as isolated concepts. - Both delivery and content are addressed in the feedback. - Future actions are considered.	- A sound and clear relation is made between observations and the effectiveness of the presentation taking to account the specific context of this presentation. The relation is made based upon concepts from the course (from the observation form, classes, rubric, knowledge clips, external sources, etc) and in-depth and concise. Possibly it adds other concept from outside of the course that are suitable for the specific situation. - Different concepts are linked with each other and the analysis gives an integrated view of how the effectiveness of the presentation can be improved. It provides new viewpoints for the presenter. - Both delivery and content are addressed in the feedback. - One or several tailored possibilities for future actions for the specific speaker are given (adapted behaviour, practices, experiments, possibilities regarding deepened understanding, etc.).

Figure 4: rubric belonging to case study 1 to indicate the quality of peer review contributions.

This rubric will be used to assess the quality of students' feedback in peer-review.

		Insufficient 1-5	Sufficient 6-7	Good 8-10
1	**Balanced** *(strength and suggestions for improvement)*	The feedback refers to only positive or only negative aspects. It is not constructive; it refers to aspects without explain why and how to improve these aspects.	The feedback includes both qualities and areas for improvement. But with limited explanation and suggestions for improvement.	The feedback is balanced by giving both qualities and areas for improvement. It explains why and how to improve these areas.
2	**Specific** *(explanation and examples)*	The feedback is very general and ambiguous, it is difficult to understand what he/she is referring to. It does not provide any examples.	The feedback gives some explanations, but not in depth. Sufficient examples are given.	The feedback provides in depth explanation. It is immediately clear what it is referring to. It points at aspect that are not always easy noticeable or obvious. Relevant and useful examples are given which are well explained.
3	**Clear** *(understandable and focus)*	The feedback is not clearly written and is difficult to understand. Irrelevant information is given. It is not concise.	The feedback is written well, but it does not (logically) flow from the observations or cannot (fully) be understood.	The feedback is written well and provides relevant information. It is specific and concise.
4.	**Correctness** *(up to date and accurate feedback is provided)*	The feedback includes both wrong/incorrect and outdated information.	The feedback includes correct information but outdated information (e.g. outdated references and/or statistics)	The feedback is book correct and up to date.

Figure 5: rubric belonging to case study 2 to indicate the quality of peer review contributions.

	Element	Insufficient 1-2	Sufficient 3	Good 4-5
1	Balanced with suggestions	The feedback refers to only positive or only negative aspects. It is not constructive, no suggestions for improvement.	The feedback includes both qualities and areas for improvement. But with limited explanation and suggestions for improvement.	The feedback is balanced by giving both qualities and areas for improvement. It explains why and how to improve these areas.
2	Specific & clear formulation	The feedback is very general and ambiguous, it is difficult to understand what is referred to. Formulation is unclear and/or not concise.	The feedback gives some explanations, but not in depth. Example(s) is/are given. Formulation is relatively clear and concise.	The feedback provides in depth explanation. It is immediately clear what it is referring to. Examples given are well explained. Formulation is concise and (very) clear.
3.	Correctness	The feedback is not correctly based on the course theory, and/or has major issues in how it has been interpreted/applied	The feedback is correctly based on the course theory, but has (minor) issues in how it has been interpreted/applied	The feedback is correctly based on the course theory, and has no issues in how it has been interpreted/applied

Figure 6: rubric belonging to case study 2 to indicate the quality of peer review contributions.

Criteria: Score: Characteristics	Incompetent 1-5	Weak 6	Acceptable 7	Good 8-9	Excellent 9-10
General quality	- No understanding demonstrated. - Contribution involves disconnected bits of information.	- Recall /name simple single facts and concepts. - Repeat/summarize text of others in own words.	- Mention relevant ideas and concepts around an issue are, but mainly as isolated, disorganised facts that aren't related together.	- Indicate connections between facts and theory, actions and purposes. - Apply concepts to familiar problems or work situations. - Propose new relevant viewpoints or correctly argue/criticize proposition of others.	- Conceptualises at a level extending beyond what has been dealt with in the actual teaching. - Formulates new hypothesis, create new theories, and critically reflects on theories and concepts thought in course.
Correctness	- Provide incorrect or irrelevant information. - Miss the point.	- Information in contribution is correct but may be irrelevant.	- Contributions are correct, but in depth explanation and argumentation is lacking.	- Explanations are correct and relevant, explanations and argumentation is complete, to the point and internal consistent.	

Figure 7: rubric belonging to case study 4 to indicate the quality of peer review contributions.