# Individual peer assessment of contribution to group work (IPAC): Key points and recommendations

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## ABSTRACT

Individual Peer Assessment of Contribution to group work (IPAC) has been widely reported in the literature as successfully addressing problems that arise when students are asked to perform group work, such as complaints of 'passengers', and staff and student concerns about fairness of the marks. However, there are multiple variations on how to implement it, which makes it difficult for current and potential users to have an in-depth view and understanding of this assessment method or what works best. A working group was created at University College London (UCL) to look into this methodology (IPAC Consortium). This paper reports the key points of the IPAC methodology, as well as guidelines and recommendations for practice, e.g. make it more useful for students by sharing the feedback. These are informed in the review of

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relevant literature, discussion with academics and educators, and own experience. We also introduce the software that is currently in use at UCL to implement this practice easily and time efficiently. This is of interest to anyone organizing and running assessed student group work activities, and that is using or might want to use in the future the IPAC methodology.

## 1   INTRODUCTION

The benefits of incorporating group work activities in Higher Education are well recognized [1], which include giving the opportunity to present students with more relevant projects, as well as providing a good learning experience for students both in terms of knowledge and personal skills. However, problems arise when all members of the team get the same mark, e.g. concerns about the fairness of assessment [2-4], complains of 'passengers' or 'free ridders' and associated poor student experience [5]. A way of addressing these issues is to use the IPAC methodology to assess group work (IPAC stands for Individual Peer Assessment of Contribution to group work), where individual marks are partially based on the contributions and/or work behaviour of the individual as seen by the peers.

The concept of applying IPAC is very simple, and it is presented in *Figure 1*. Students who work 'together' in a group will complete an assignment (a presentation, a report, a prototype, plan of an educational activity, an art work…) which is assessed by the tutor, and given a 'group mark'. The students then assess the level of contribution of each of their peers (including themselves if requested by the tutor) from which an IPAC value is calculated after tutor moderation. The 'group mark' and the 'IPAC value' are then combined such that now every student receives an individual mark. This individual final mark is therefore based on how the group worked together and the participation of that particular student.

This method is welcomed by students [4,6-8] who find the marking approach fairer, encourages them to have better engagement and professional behaviour during the group work [1,5,8,9] and learn towards future teamwork [8]. The marks are also seen fairer by staff [10].

Although the concept of the IPAC assessment methodology is simple, its actual implementation requires consideration and decision making on multiple aspects. These aspects are still unclear despite the broad use of this methodology and literature papers. In fact, the high dimensionality of the practice has resulted in a multitude of variations of IPAC methodology [1,2,5-7,9,10] while in addition, often authors in the literature do not report (or do not consider) some important aspects when running and testing the practice. All of this makes it very difficult to compare between studies and discern which options or features might have made the practice more successful. The focus of this paper is to identify and describe the various key aspects while designing and running IPAC, indicating what works and what can be safely customised, which is highly relevant for the educational community.
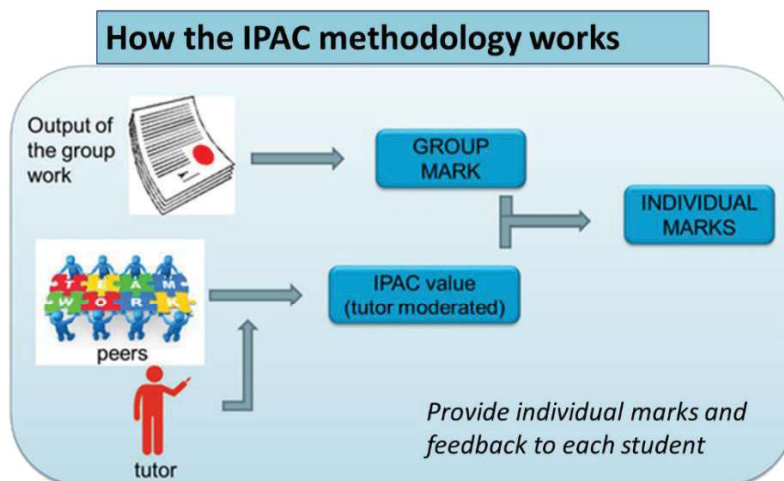
*Fig. 1.* Representation of the IPAC method of assessment.

## 2   UNDERSTANDING THE IPAC METHODOGOLY

In April 2016 the IPAC Consortium, led by Dr Pilar Garcia-Souto, was formed at University College London to look into researching the methodology and identify appropriate tools to run it. The group is formed by academic staff, technologists, experts in education, and students. As a group, we held numerous staff discussions, compare how we implement the IPAC methodology and our experience, run focus groups with students, and searched the literature.

As a result, we identified that the main aspects or points while designing and running IPAC in terms of methodology are (i) how the IPAC value is assessed; (ii) how the IPAC value is applied or combined with the group mark; (iii) information and feedback given to the students; and (iv) tutor involvement and moderation. One should also consider the context in which the methodology is applied.
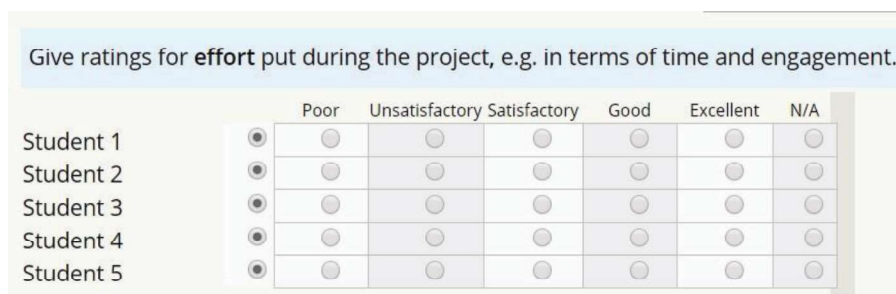
### 2.1 Key elements

#### 2.1.1   *Assessment of the IPAC value*

Assessment of the IPAC value refers to the process and criteria used to ascertain peer evaluations from students and compute them into IPAC values. One of the main questions is 'What do we want to assess by IPAC?'. This can be for instance the actual level of contribution to the group work, their (professional) behaviour, or both. Some examples are *general contribution to delivery of quality work, insightful ideas, solving problems, effort, ability to work in a team, leadership,* etc. Based on what fits better with the objectives of the activity and assessment, the tutor needs to decide which attributes or qualities will be incorporated in the assessment of IPAC, the rating scale, the 'assessment criteria', and if this is defined by the tutor itself or stablished by the students themselves. It is also of value to request students to justify the peer marks given. *Fig. 2* shows an example of a student questionnaire to peer assess with one attribute and associated rating scale. Values given here by the students is what we call the 'raw scores or peer marks'.

Once the "raw peer marks" are collected, these need to be combined into a single IPAC value. The tutor needs to decide (i) which form should this value take, with the main possibilities being *a percentage* or *a normalized value around the average of the team; and* (ii) the calculation to use, e.g. if all attributes are worth the same, if corrections should be applied for instance to mitigate bias.

A final question is 'Who is allowed to assess?'. We would encourage all students to peer assess themselves and their peers in first instance. This is good for reflection and to give a full picture to the tutor of how the team functioned. However, for the calculation of the IPAC value, the tutor can decide which raw scores to use. For instance, the tutor can use/ignore the self-peer marks according to preference. Another popular request among the students is to ignore the marks given by those who themselves have a very low IPAC score, as students claim that *'those who did not contribute to the group work are not in the position to assess others fairly'*.



*Fig. 2.* Example of one attribute and rating scale used to ascertain the IPAC value.

### 2.1.2 *Combining group mark and IPAC value*

Once the tutor has the **group mark** for each team from his/her assessment of the submitted team work, and the **IPAC values** derived from the peer assessment of contribution by the students, these need to be combined to obtain the **individual mark** for each student. There are two main approaches to doing this: (i) adding the group mark and the IPAC value given in percentage using some weighting values of own choice (*Eq. 1*); or (ii) multiplying the group mark by the IPAC value given in its normalized form. Small variations can be seen among practitioners, who take one of these two forms and adapt it to their own preferences, e.g. selecting particular values for *a* and *b* in *Eq. 1*, or applying some sort of cap values.

Each method has their own advantages and limitations. The first method (*Eq. 1*) is easier to understand and has a milder student effect on the marks; however, this method only discerns students who contributed less than the rest, and students tend to be more forgiven on poor effort when rating others, or just give high marks to all to bust marks up. The second method (*Eq. 2*) seem to encourage students to be more honest with their peer evaluations, as their own mark is influenced by the mark of the others. Another advantage is that it discerns students who have contributed more or less to the group work, so *'reward'* or *'penalty'* is applied by the method itself. The limitation is perhaps the staff fear that some students could score more than a 100%, though this is extremely rare and can be easily mitigated by capping values [11].

$$Individual\ mark = a \times group\ mark + b \times IPAC \qquad (1).$$
$$where\ a\ and\ b\ are\ constants;\ a + b = 1;\ IPAC\ is\ given\ in\ percentage$$

$$Individual\ mark = group\ mark \times IPAC \qquad (2).$$
where *IPAC* is normalized and given around 1, this representing the average contribution

Table 1 (adapted from reference 11) presents some experimental results on how the individual marks look like in the case of applying the IPAC methodology as a percentage (N=710 students) or a normalized factor (N=476 students). Examples are given for 3 different typical teams with group marks of 40%, 60% and 80%, and the IPAC values specified as percentiles from the entire IPAC scores set from the combination of case studies.

*Table 1.* Spectrum of the effect of combining IPAC values with group marks [adapted from reference 11]

| Percentile of IPAC scores among all case studies | Final individual mark | | | | | |
| | IPAC value * group mark | | | 0.3*IPAC + 0.7*group mark | | |
| | Baseline group mark | | | Baseline group mark | | |
| | 40% | 60% | 80% | 40% | 60% | 80% |
| 5 | 33.6 | 50.4 | 67.2 | 51.5 | 65.5 | 79.5 |
| 20 | 39.2 | 58.8 | 78.4 | 55.7 | 69.7 | 83.7 |
| 50 | 40.0 | 60.0 | 80.0 | 57.4 | 71.4 | 85.4 |
| 80 | 42.0 | 63.0 | 84.0 | 58.0 | 72.0 | 86.0 |
| 95 | 45.6 | 68.4 | 91.2 | 58.0 | 72.0 | 86.0 |

### 2.1.3   Information and feedback given to students

Besides the normal introduction to the group work activity aim and assignment, tutor can (and should) provide the following initial information and/or preparation to the students: (i) IPAC marking process, (ii) tutor involvement with the assessment process and moderations, (iii) an introductory talk about the purpose of using the IPAC method as well as its benefits, and (iv) training on how to assess their peers' contribution and/or performance, e.g. with a class discussion of expected professional behaviour and work ethics when working in a group, as well as a discussion of the IPAC marking criteria. This is beneficial for the engagement of the students in the process, e.g. providing and receiving feedback, as well as reducing the scepticism that students might have.

After the IPAC process takes place, students can receive various degrees of summative and/or formative feedback. The choices of summative feedback that can be given to the students are (i) their final individual mark only which is the basic

approach; (ii) provide the group mark and the overall IPAC value separated so students can see how the tutor valued the group work, and how her/his peers value her/his individual contribution; (iii) provide their average scores per attribute, so they can see in which areas they might have excelled and in which others they were lacking.

The formative feedback can take different forms. Those mostly recognized as such would be generic (to the entire class or group) or personalized (to each student or group) tutor feedback. However, the students' justifications or comments done for each of their peers can also be used as valuable feedback of how the personal contribution was perceived by others, which students claim would be help them to improve performance and behaviour in the future [8].

### 2.1.4 *Tutor involvement and moderation*

Although the IPAC method is based on peer assessment, the tutor can and should be involved in the process, particularly in critical cases. This reassures student that the marks are fair, deals with complicated cases of team dysfunction (these tend to be very few, much less than what people fear when using this practice! [11]), and it addresses one of the main student requests.

The tutor involvement and moderation can be in different forms, the main ones being (i) keeping tutor (or assistant) observations that can inform later moderations, (ii) check (and moderation of) summative marks, and (iii) check (and moderation of) student comments.

Moderations of the summative marks might be appropriate in dysfunctional or segregated groups, that can be identified by highly uneven peer rate scores for one (or more) individuals within the team, or students with very low/very high IPAC marks. One approach for instance is to disregard the peer scores given by students who, themselves, were mostly absent from the group work.

Moderation of the comments can be done at different levels, and this highly depends on the class size and staff capacity. A basic check is to look for and eliminate profanities which is usually sufficient. Others (more rarely) with the time and staff resources might check and moderate each individual comment before releasing them. A middle ground would be to check the comments related to very low scores to see if the later are justified, perhaps even comparing with tutor observations if existent.

Tutor involvement also includes the traditional approach of setting up alternative assessment for extreme cases, for instance, when a student has disengaged almost entirely from the group work because of genuine reasons.

## 2.2 Context

When implementing the IPAC methodology, ideally we would like to achieve the best student experience using the least staff-time and resources, but this is rarely possible. Instead, we seek to find an 'optimal' or compromise between the two, such that student experience improves while working within the resources and staff-time available.

In this regard, one should consider the context in which the IPAC methodology is applied, as the settings that might be optimal for one class and activity might not be the same for another. Also the staff preferences play an important part here, as different staff will have different ways of compromising. In general, some of the variables to consider are the class size and the available staff and support resources, as this highly influences how much involvement the tutor will have in each team. Others variables refer to the activity itself, e.g. the weight of the assignment within the module and the activity timescale, as this will influence if the IPAC process is use once or more times, for example at several points during long projects perhaps for formative purposes. Finally, understanding the ability of the students to perform peer assessment is also important as it will inform the introduction to IPAC and training activities that might be needed, for example a 3rd year student who has done peer assessment before (IPAC or otherwise) will need less training.

## 3 IMPLEMENTING THE IPAC METHODOLOGY: GUIDELINES AND RECOMMENDATIONS

After a year of conversations with staff and research, it came clear that although we all supported the benefits of incorporating the IPAC assessment into teaching practices, it was going to be impossible to reach a consensus on a strict and rigid 'recipe' on how it should be implemented. Many of the actual details and choices done under the four key points discussed earlier are highly dependent on the context in which the activity takes place, and more significantly, on the preferences of the tutor. However, there are other elements that are identified and acknowledged as requirements for a successful practice.

This section gives the fundamental guidelines of what needs to be done and/or considered when running the IPAC practice, stating also some recommendations that have been found to be successful. Within these guidelines we differentiate between things that all practitioners should incorporate, and those that are open for customization.

### 3.1 Guidelines

The fundamentals of running the IPAC practice are given in *Table 2*, with *Before, During* and *After* sections. Under the section *Your Choice* some elements are given that practitioners can freely choose without compromising the effectiveness and success of the IPAC method, allowing for customization. *Table 1* also includes some recommended practices, although they are optional.

*Table 2.* Guidelines and recommendations to run the IPAC assessment method

| Before | Your choice |
|---|---|
| • Define your IPAC assessment process, i.e. the details of the 4 key elements. Some options of value are:<br> o Include self-assessment to promote reflection and to get full information<br> o Request students for justification of marks<br> o Use few qualities/attributes to keep questionnaire short (N<=6)<br>• Inform students that the IPAC assessment method will be used and benefits of doing so.<br>• Inform students on how the IPAC assessment works, and the tutor involvement. | • How to assess the IPAC value, i.e.:<br> o Attributes (but N<=6)<br> o Rating scale and criteria<br> o Tutor or student led attributes &criteria<br> o Equal or unequal weighting<br> o Calculation used, e.g. bias correction<br> o Output form, e.g. normalized around 1 or % (but normalized is recommended)<br>• Moderation process<br> o Low rate students<br> o Large SD, etc.<br> o Based on observations<br>• Equation used to combine the IPAC value and the group mark<br> o Based on added percentage vs based on a multiplier factor (the latter is recommended). |
| During | After |
| • Ensure students are ready or plan a small activity towards this aim:<br> o Trained to perform peer assessment<br> o Aware of professional behaviour and peer expectations in team work<br> o Define/discuss expectations or meaning of each of the assessment scale levels<br>• (Of value) Keep some tutor observations records. | • Review IPAC scores and apply moderations when relevant<br>• <span style="color:red">Make it valuable not just as a summative assessment but also formative</span><br> o (Of value) Give the anonymized students' feedback back to students. Students need to be informed of this in advance, and use at least the profanity check before releasing the comments.<br> o Give tutor feedback, even if generic. |

## 3.2 Recommendations

### Assessment of the IPAC value

The assessment of the IPAC value is highly customizable, allowing for purpose use with different activity aims and tutor preferences. However, there are some recommendations that have been found to be of value. The number of attributes used to assess the IPAC value should be kept to a maximum of 6, this is to avoid asking students to complete long questionnaires, and there is not much gain on the information collected. In terms of the rating scale, descriptive or categorical (such as in *Fig 2.*) is preferred to numerical, as students relate better to it. But whichever rating

scale is selected, it should remain the same if possible for all attributes used, as it makes it clearer and easier for students. Students should be requested to perform also self-assessment (even if not included in later calculations) and to write a justification for the marks given to each student. These are useful for the tutor to understand the group dynamics, and the later becomes very useful to provide formative feedback to the students at the end.

Tutor involvement and moderation

The tutor is always the ultimate responsible for the marks used for student assessment. In the case of peer-assessed generated marks (even if they are partial marks for an assignment), the tutor needs to take ownership of these marks to be able to use them and present them at the exam boards. Therefore, it is wise for the tutor to check the integrity and validity of the marks (and feedback) and moderate accordingly. Moderation does not need to take long, and it can be in any of the forms discussed in section 2.1.4. The students should be informed at the start of the activity of the main moderation process (regardless of what that is) as it gives them confidence and reassurance with the process.

Combining IPAC value and group mark

Some of the advantages for the two forms of the IPAC value (percentage or normalized) have been given in section 2.1.2. However, the recommended practice is to give the IPAC value as normalized to the group performance. This allows students to easily see if their contribution was perceived to be around, above or below the average of the group without needing to know the values received by other students, and this is useful for the student to reflect on her/his contribution. This therefore leads to the recommendation of using *Eq. 2* as a basis of combining the IPAC value with the group mark.

Information and feedback given to the students

Student training is a very important element towards the success of this methodology. The training should be done before or at the start of the group work activity, and it should include information on: the importance and benefits of engaging with peer assessment in general, how the IPAC methodology works, how to assess themselves and others, importance of giving honest marks, as well as how to provide useful and constructive feedback to peers, and be open to criticism on personal performance and use it to improve. This helps to clarify the methodology to the students, hence preventing 'fears and worries' about how their marks are calculated (specially for high 'achievers'), and engaging all students into contributing to the group work as free-ridders are no longer going unnoticed by the staff. It also engages students with the process of giving honest and more insightful feedback to peers, which is in itself a good skill to have.

The most basic form of training would be to give a presentation to the students covering these points. However, if time permits it, there are other more active ways of

incorporating some training into the activity. One way is to ask students to define the attributes and criteria that should/is to be used for the assessment of the IPAC value. This has also the benefit of helping them to understand what is expected of them while working in a team, and how to rate themselves and peers according to that criteria.

One of the benefits of the IPAC methodology is that it is very valuable not just as a summative assessment but also as formative. It can be used to give feedback to the students on how their contribution and behaviour was **perceived** by others by releasing the peer comments applicable to each individual student. To make this more successful, a good approach is to remind students that their comments will be released to their peers even if in an anonymous way, hence encouraging them (and training them) to write them in a constructive and professional way. In addition, tutors can apply some basic moderation of the student comments such as a simple profanity check just for peace of mind – though it is extremely rare that profanities are included.

There are other pieces of useful feedback for the students that we recommend. One would be to release to each student her/his IPAC value (even better if given per attribute) if in normalized form, so the students can see how they rated in the context of their group. Another is tutor feedback, either customized per individual or group according to their performance, or generic for the entire class.

### 3.3 Software

The main limitation of the IPAC method is that it can be very staff-time consuming to implement due to the need to handle and administer a large amount of data, hence even the keen practitioners are likely to give up if they do not have an appropriate software. Practitioners are recommended to equip themselves with a software that allows them to run the practice in a time-efficient manner, and their own way i.e. with the desired customization level, such that they can focus on understanding the team dynamics, providing meaningful assessment and improving the student experience, rather than on the administrative work.

The IPAC Consortium reviewed some currently available softwares, but these did not fit the requirements. As such, a new software was developed at UCL (depicted in *Fig. 3*) that addresses the identified staff priority requirements, which includes being easy to run, allow for extensive customization, facilitate quick and personalized feedback to students and be staff-time efficiency. This software is widely used at UCL, and it is being expanded to other institutions. The software is further described and reported in the conference paper *"Making assessment of group work fairer and more insightful for students and time-efficient for staff with the new IPAC software"* [12]. Anyone interested on knowing more or potentially using it can contact the corresponding author.
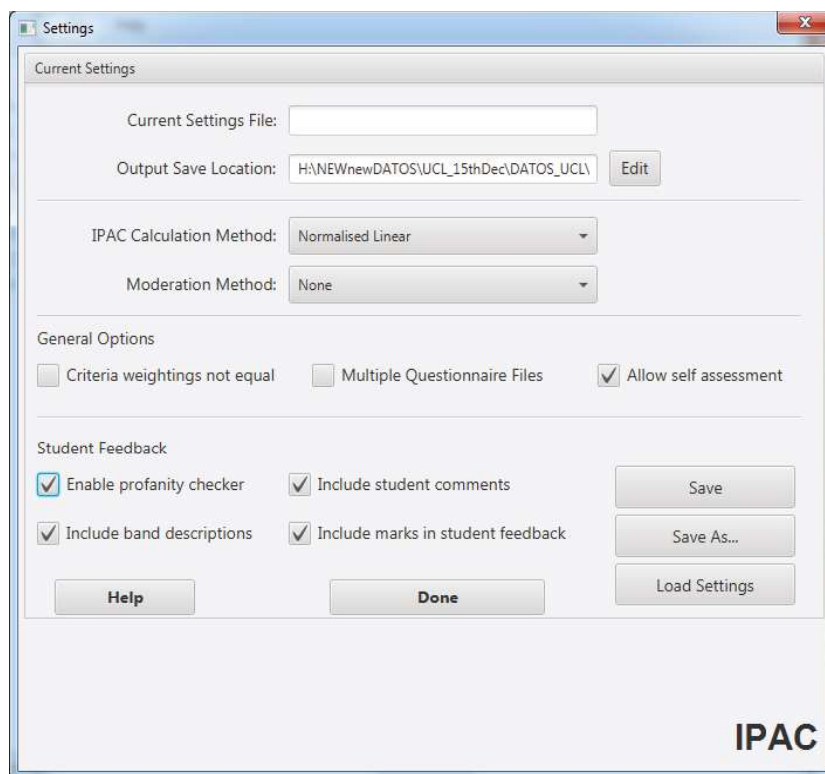
*Fig. 3.* Settings screen of the UCL IPAC software. Copyright © 2018 UCL [12]

## 4    SUMMARY AND ACKNOWLEDGMENTS

In conclusion, this paper explains the IPAC methodology as well as the key aspects that need to be considered for its implementation. It also provides the guidelines and recommendations for any new and current practitioner to make this assessment method successful and insightful for students. Finally, we briefly presented a software developed at UCL that can be used to run the practice easily and efficiently.

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