



How Student Generated Peer-assessment Rubrics use Affective Criteria to Evaluate Teamwork

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ABSTRACT

Student generated rubrics that were designed to peer assess contribution to teamwork mainly use terms that conform to Krathwohl's (1964) affective domain. We have used the affective domain to map the criteria that students use in order to find opportunities to further guide our development and scaffolding of teamwork skills. We are confident that our students are valuing skills within the affective domain as an important contribution to teamwork, but we find that they are making tacit assumptions about the lowest level of the domain – receiving skills. We aim to use this data to support the conscious development of receiving skills, with the aim of promoting team integration.

Conference Key Areas: Engineering Education Research, Engineering Skills, Engineering and Sustainability

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1 INTRODUCTION

The Integrated Engineering Programme (IEP) at UCL brings undergraduates together from seven disciplines, largely through problem-based and project-based learning activities (PBL and PjBL). Its main purpose is to provide authentic learning opportunities that support the development of professional and design skills. The programme is just about to enter its fourth year. Like many of the reforms currently in progress in Engineering Education its most distinctive feature is its high proportion of experiential, problem-based learning (PBL), almost all of which requires students to work in teams.

Working in teams provides students with professional (aka: soft) skills as well as conceptual knowledge by giving them the opportunity to apply their technical knowledge to a problem and to enhance their learning experience through collaboration. Numerous studies have described benefits of the cooperative or collaborative experience, which can boost achievement of grades, depth of learning, retention of information as well as enhancing a range of professional skills [2,3].

These benefits are not guaranteed however. In general, PBL learning outcomes are dependent on careful scaffolding and framing of the learning experience. Some authors have pointed out that knowledge learned through PBL may remain unstructured since learning is largely self-regulated and self-directed [4].

Our specific aim is to support the development of a range of professional skills that are sought after by the engineering professions [5]. In order to do so, we need to provide students with a framework to structure their learning and development of teamwork skills as well as their technical knowledge.

In order to achieve this, we have introduced two structuring components to the curriculum of our first year, first term undergraduate PBL module called 'The Challenges', which takes in 660 students and consists of two five-week PBL elements –

- i) a workshop providing a conceptual framework aimed at enabling students to structure their teamwork experiences and maximise their successes
- ii) a peer-assessment exercise which runs twice at the end of each two five-week problem-based learning activities

Here we present the results of the peer-assessment activity in which members of student-teams assess each other using rubrics that they generated at the beginning of the first of their PBL activities.

One of the issues that students and staff find most troubling when assessing team projects is the potential for team members to avoid contributing their share of the work and taking the grade for free (freeloading) [3]. Yet, team theory tells us that teams need a certain amount of autonomy to set their own rules and manage their own processes in order to function as a team as opposed to a group of individuals [6,7]. In this case, efforts to assess team contribution are better to avoid imposing values or processes on teams because they need to design their own criteria in order to function as a team.

In addition, the criteria by which team members may wish to assess each other are subtle, subjective, interpersonal and hard to define. In these situations, some

authors recommend that students define their own evaluation criteria, because what is most important is that they know, understand and agree what the criteria are [8].

The peer-assessment rubrics that were generated present us with an opportunity for evaluation and analysis that we hope will allow us to develop future learning scaffolds to further support teamwork and enable students to develop these skills, without over-managing the teams.

Teamwork skills are ill defined and include such terms as reliability, positive attitude, responsibility, flexibility, motivation, for example. These are the kinds of competencies and attributes that Krathwohl and Bloom (1964) [1] describe in their affective domain. Their taxonomy provides a hierarchical classification of behaviours and attitudes increasing in complexity, which we employ here to aid the design of learning experiences for team function.

Bloom's cognitive taxonomy [9] is widely utilised in curriculum design and evaluation. The affective domain [1] has not yet gained the same traction. It is becoming ever more important to support the development of values, attitudes and behaviours in higher education not only to support professional skills, but also to produce engineering graduates who are capable of sustainable and socially responsible practice fit for the 21st century [5, 10]. Here we report a novel use of Krathwohl's affective domain [1] which we intend to utilise to provide more student learning opportunities for this purpose.

1.1 The Teamwork Curriculum

The conceptual team framework that we give to our students is designed to encourage the independent development of teamwork processes by providing students with a set of tasks, which if accomplished support the functioning of effective teams. We do not monitor or evaluate students' passage through the tasks, but we do set up opportunities for them to do so through teambuilding and reflection.

The framework consists of the following steps, each of which is explored during a teamwork workshop in weeks one or two of the first PBL element:

- Set a vision and performance goals
- Assign task-based roles and team-based roles
- Create and decide on group processes
- Develop trust in interpersonal relationships
- Develop appropriate inter-group relations

The steps are based on research that highlights how team function can be promoted. The aim is to enable our student teams to make their own decisions, devise their own systems, and develop their own relationships in their teams [6,7, 11, 12]. There is no known formula for successfully passing through these teamwork steps and so we support any student teams who get stuck on a case by case basis.

Krathwohl's (1964) [1] classification of affective skills has potential for developing and furthering our understanding of ways to support and scaffold effective teamwork. In order to pass through the teamwork stages, students require affective competencies in the form of particular "interests, attitudes, values, appreciation and adjustment" [1 p24]. Our aim then, is to utilise Krathwohl's rankings to understand the nature of the criteria that the students think is important to assess in their teams.

In 1964 Krathwohl specifies if “affective objectives and goals are to be realised, they must be defined clearly; learning experiences to help the student develop in the desired direction must be provided; and there must be some systematic method for appraising the extent to which students grow in desired ways” [1 p23]. Our only difference from Krathwohl is that although we need to understand whether our students ‘grow in desired ways’, team theory informs us that such appraisal has to come from within the team and is best not imposed from the outside [6,7]

Congruent with this is a body of research that emphasises the need on the part of students for an excellent understanding of the criteria and standards by which they are evaluated. By allowing students to choose their own criteria and standards for peer-assessment, we hope to ensure that teams can understand and agree on what they are will be judged on [8, 13].

In line with this we designed a peer assessment exercise, which students undertake in the first week of their PBL activity. Student teams are asked to design a rubric for use in assessing one another’s contribution to teamwork at the end of the project. Each team chooses their own four criteria on which to evaluate their peers. Then they write rubrics which have three levels of attainment for each of the criteria. Students write a short description of the standards of behaviours and achievement required for each level in each of the four criteria. Every criterion also has a main heading. Here we report on an analysis of the team rubrics from The Challenges 2016. In total, we have examined 110 rubrics.

2 ANALYSIS AND INTERPRETATION

2.1. Coding Methods

Our initial analysis consisted of in vivo coding of 35 rubrics (5 from each of the 7 disciplines represented on the IEP) using an approach based on an inductive ‘grounded’ theory [14]. Using words that appeared in the rubrics we developed 51 codes. We present results here of the detailed coding of these rubrics, which consisted of 4 criteria at 3 levels each but we observed in this analysis that the lowest level of the affective domain (receiving), appeared to be underrepresented in the data. In order to understand this further we analysed a further 65 rubrics only for the verbs that represent the receiving (lowest) level of the affective domain.

2.2 Interpretation

Table 1 shows the frequencies of codes emerging from detailed coding of 35 rubrics. All elements of criteria and descriptions were categorised with 51 different codes. We used a large number of codes in order to ensure that we retained the meaning intended by the students. Clearly, some of our codes are only subtly different in meaning to each other.

The primary observation emerging from the data in *Table 1* is that students have chosen to assess their contribution to teamwork primarily using affective skills. Some of the codes appear to be strongly task based, such as analytic or research skills. Others, such as attendance or punctuality also seem to be task focused, but are in fact professional skills, which represent a choice and a response to the team.

Table 1

Code	Frequency (%)	Frequency Rubrics (%)	Code	Frequency (%)	Frequency Rubrics (%)
Attendance	9.7	97.1	Accepting of ideas	1.2	28.6
Meeting deadlines	8.8	85.7	Progress reporting	1.2	17.1
Quality of work	6.8	68.6	Builds and maintains relationships	1.1	22.9
Completing assigned tasks	5.5	68.6	Cooperative	1.1	22.9
Active participation	5.2	68.6	Shares findings	0.8	14.3
Contributes ideas	4.7	57.1	Encourages discussion	0.5	14.3
Punctuality	4.5	51.4	Problem-solving	0.5	14.3
Effort and commitment	4.3	48.6	Understanding of team objectives	0.5	14.3
Communicates	3.7	74.3	Tact and diplomacy	0.5	11.4
Contributes to team	3.4	48.6	Work-ethic	0.5	11.4
Contributes to discussion	3.2	54.3	Planning and prioritisation	0.5	8.6
Responds to communications	2.8	31.4	Reliability	0.5	11.4
Respects others	2.6	51.4	Shows initiative	0.4	11.4
Research skills	2.3	28.6	Group motivation	0.4	8.6
Listening skills	2.3	34.3	Can request help	0.3	5.7
Helps and supports others	2.1	31.4	Teamwork	0.3	8.6
Contributes to tasks	2.0	37.1	Analytic skills	0.2	2.9
Gives constructive feedback	2.0	34.3	Responds to feedback	0.2	2.9
Task ownership	1.9	31.4	Written communication skills	0.2	5.7
Professional attitude	1.8	40.0	Flexibility	0.2	2.9
Positivity and negativity	1.6	28.6	Manages team / delegates	0.2	5.7
Notification of lateness / absence	1.5	22.9	Leads by example	0.2	5.7
Expression of opinion	1.5	25.7	Efficiency	0.2	2.9
Self-organisaton	1.5	31.4	Gratitude	0.1	2.9
Empathy and understanding	1.3	22.9	Self-awareness	0.1	2.9
Quality of communication	1.3	17.1			

Table 2

Task Based Codes	Frequency in %
Contributes to tasks	2
Quality of work	6.8
Analytic skills	0.2
Research Skills	2.3
Shares Findings	0.8
Task ownership	1.9
Efficiency	0.2
% of Total Codes	14.20

Task-based professional skills make up the minority of codes, but have a greater concordance between them. Attendance and punctuality are some of the most popular items. Skills at the more affective end of the range, such as respect, empathy, self-awareness are more scattered between a greater range of codes. Major task-based codes are listed in *Table 2* along with their frequencies.

Given that the total frequency of task-based codes only runs at 14.2%, we can be confident that these students are valuing skills in their teammates that lie within the affective domain.

We were forced to use 51 codes to categorise the rubrics, and nearly 86% of those are easily identifiable as affective behaviours or skills. The wide range of adjectives and verbs that define and describe fully affective criteria goes to show how difficult it is to define and to categorise these skills. The difficulty is likely to be inherent in the exercise of defining affective behaviours and not a feature of these students.

In actual fact, *all* of the task-based codes have some element of affect to them. 'Quality of work', for example, implies judgement of the standard of work. 'Research' and 'analytic skills' include the acts of delineation, differentiation and organisation – all affective skills. So, it was possible, to map all of the rubric codes onto the affective domain. The results of this exercise are shown in *Table 3*, which gives the frequency of the codes as a percentage of total codes and the number of rubrics on which they appear.

The low frequency of criteria falling into the bottom (receiving) level of the domain is what interests us here. At this, the lowest level of the affective domain are behaviours involving receiving information, sensing, observing etc. The most common receiving verb to appear in our data was 'to listen', but others included 'pay attention' and 'open to ideas'.

2.3 Receiving

In general, receiving activities are encompassed in the more complex behaviours described in the domain. It is impossible to respond, for example, if one has not received say, a communication to respond to. It is impossible to be punctual, if one has not received the information that specifies the start date of the event.

Receiving is generally characterised by verbs such as to concentrate, to observe, to listen, hear, respect, ask, identify or locate. It is a vital early step in the formation of a new team, especially in teams that are culturally diverse and whose members may be working in a second language for the first time, as ours are. Yet, listening appeared on 34.3% of rubrics, and the whole class of receiving verbs were only present 57.14% of rubrics. These must have been sparsely utilised on the rubrics that they did appear on, since the receiving verbs represent a small fraction 4.10% of the total codes.

It is quite clear that our students can and do function at this level, since they are capable of functioning at the higher levels of the domain, but the fact that most teams have tacitly assumed that receiving happens without note suggests potential for development or improvement of our scaffolding of team function.

The skill of active listening is now taught across a wide range of professions and some view it as a basic professional skill [15]. Yet, unless it is framed as such, it would seem to students like natural activity that can and should go without comment. Our data suggests that all the behaviours generally associated with affective receiving may be subject to the same assumptions. Should we, as educators, frame these behaviours as skills that can be honed and advanced like any others?

Table 3

Affective Domain Criteria	Rubric Codes		% of codes applied by level	% of rubrics level appears on
RECEIVING -Awareness -Willingness to Receive -Selected Attention	Accepting of ideas Understanding of team objectives Listening skills		4.10%	57.14%
RESPONDING -Acquiescence in responding -Willingness to Respond -Comfortable in response	Punctuality Attendance Notification of absence/lateness Communicates Shares findings	Responds to feedback Responds to communications Written communication skills Tact or diplomacy Progress reporting	24.93%	100%
VALUING -Acceptance of a value -Preference for a value -Commitment	Active participation Contributes to team Contributes to discussion Contributes to tasks Quality of work Shows initiative Reliability	Gratitude Professional attitude Meeting deadlines Quality of communication Efficiency Contributes ideas Respects others Encourages discussion	41.50%	100%
ORGANISATION -Conceptualisation of a value set -Organisation of a value system	Empathy/understanding Helps and supports others Gives constructive feedback Effort and commitment Research skills Positivity or negativity Builds and maintains relationships Problem solving	Task ownership Planning and prioritization Self-organisation Teamwork Can request help Completing assigned tasks Cooperative Analytic skills Expression of opinion Manages team/delegates	28.14%	100%
INTERNALISATION -Internalisation of value set -Characterisation by own value complex	Flexibility Self-awareness Work ethic	Leads by example Motivates Group	1.34%	22.86%

Following the detailed coding of rubrics, we searched a further 65 rubrics just for receiving verbs. In the total set of 110 rubrics, each containing 4 criteria at 3 levels (n= 1320 descriptions) we found that 11% of the criteria contained at least one term that fell into the bottom level of the domain.

Each of the four criteria were given headings by the student teams. We found that 60% of rubrics contained one criterion that was headed 'communication' and that this was the most frequently used heading. Yet many of the students did not feel it

necessary to overtly include any receiving verbs under the heading of communication, despite the fact that this seems like an obvious category within which to include receiving words. Communication was usually described as a response phenomenon, and only a third of communication criteria included 'listening' or other 'receiving' verbs. This confirms our commitment to providing further learning opportunities and exercises in which students can develop, or even become conscious of, receiving skills.

3. SUMMARY

We have used Krathwohl's (1964) affective domain in a novel and effective way in this exercise. We aim to use the findings that have emerged from this research to further scaffold teamwork activities for our students by bringing their attention to the need to consciously receive, absorb and listen to team members if a team is to be effective.

While the most popular of the criteria headings is 'communication' at 60%, it was not matched by an equivalent frequency of 'receiving' verbs. This is incongruous given that half of communicating must be 'receiving' and we intend to work with our students on this aspect of affective learning in the coming academic year to support the development of teamwork skills.

This work is also useful in demonstrating that most of the criteria that students describe on these team assessment rubrics are overtly 'affective'. This is itself an interesting result and we aim to understand and work with the affective domain further. We hope that it can both inform the way in which we provide teamwork support for students and help us to probe the potential of the affective domain.

We believe that if we are to support our engineering undergraduates to develop work place skills, such as teamwork, then the affective domain may prove to be a very useful tool.

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