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ABSTRACT

A method for measuring the contribution an individual makes to group work is described, and its use is supported through a study of 57 university students aged from 20 to 46 years working in 8 groups of 4 to 10 members each. The method recognizes that the most valid sources of information on the contribution of each individual to the group work are the group members. The study relied on peer evaluation of the percentage contribution that each member made to the group work. Group members were also asked for a rationale for each evaluation given. The reliability of the individual's mark was indicated by the variance of the marks the group member received from his or her peers. Additional validity was provided by the qualitative agreement of the rationales. The group work was assessed separately using usual appropriate criteria. An individual's mark was calculated as his or her mean percentage of the group's mark, weighted by the number of people in the group. By separating the measurement of process from the assessment criteria for the group work, the method highlighted the cooperative intragroup dynamics. The method also allowed the identification of consistent patterns of correlations within group scores that indicate a problem common to students with low achievement in group work that is independent of the subject assessed. (Contains 2 tables and 18 references.) (SLD)

Reliable and Valid Measurement of Individual's Contributions to Group Work

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Overview

Cooperative groupwork offers pedagogical advantages of social learning, leadership practice, peer guidance and the sharing of knowledge and experience. Teachers who utilize this effective teaching technique also like to assess the contribution of each group member and use it for the purposes of individual assessment. There are various ways of allotting marks to an individual based on the group's work. Each method brings with it its own problems and none has sufficient evidence of reliability and validity. These problems have detracted from the use of this preferred method for high-stakes summative assessment. The method of assessing cooperative groupwork presented in this paper offers improved reliability and validity evidence that increases the attractiveness of this form of assessment for summative decision making.

The simple method presented in this paper has been used successful with university students (n=57) aged from 20 to 46 years working in groups (8 groups) of size from 4 to 10 in Psychology and in Measurement courses. The method recognizes that the most valid source of information on the contribution of each individual to the groupwork is the group members themselves. Hence, the method used peer evaluation of the percentage contribution that each member had made to the group's work. It also asked for a rationale for the evaluations that were given. The reliability of an individual's mark was indicated by the variance of the marks the group member received from his/her peers. Further validity was given by the qualitative agreement of the rationales. The groupwork was assessed separately on usual appropriate criteria. An individual's mark was calculated as his/her mean percentage of the group's mark, weighted by the number of people in the group.

By separating the measurement of process from the assessment criteria of the groupwork, the method highlights the cooperative intra-group dynamics. The method has also allowed the identification of consistent patterns of correlations within group scores that indicates a problem common to low groupwork achievers that is independent of the subject area assessed.

Background

Advantages of cooperative learning

Teachers recognize that cooperative learning is an excellent teaching technique. One of the reasons for this is that teachers consider co-operative learning to be useful for their students' social and psychological development as well as for their academic learning (Khattri, 1991). Research in social learning indicates that students learn thinking strategies from these interactions with their peers (Zimmerman, 1990). Students are energised by cooperative groupwork and see distinct learning advantages in this paradigm (Orsmond, 1996). Student reactions to the cooperative assessment processes are overwhelmingly positive (Griffin, 1994). Groupwork has been shown to improve student involvement and ownership, and to increase student retention and transfer of learning (Petty, P. 1997).

One way in which group learning works is that it:

> ".. forces learners to adjust their thinking to that of others. When students have to think about the alternative viewpoints of group members, they have to elaborate and defend their own ideas and debate the merits of their opinions to others. This promotes a deeper organization and understanding of their own knowledge." (Tombari & Borich, 1999, p.100).

Popularity of cooperative learning

These recognized advantages of groupwork have increased the popularity of this method of teaching so that .. "Classrooms at all levels of education are increasingly emphasizing group-based or cooperative learning strategies." (Airasian, 1994, p.301)

Need to improve reliability and validity of coopative learning

Teachers who use this technique would also like to award each individual in the group a grade that is based on the assessment of the group's work. However, compared to traditional assessment methods, there are many problems with the validity and reliability of assessing group assignments (Falchikov, 1986; Powers & Medena, 1984; Salend & Sonnenschein, 1989). These problems contribute to the difficulties of replacing high-stakes objective tests with these pedagogically preferred 'alternative' assessments.

Problems with attempted solutions to assessing individual contributions to groupwork

Common, yet inadequate solutions, to the group assessment problem are to assume that each student has made an equal contribution and award each student the same grade. This is not popular with students, as the assumption is rarely justified. Conway (1993) reports that students complain that group scores are an inadequate reflection of their individual effort. This solution can also act against collaborative work and cause social loafing (Gibbs, 1993; Rotfeld, 1998). The other extreme is for the teacher to give detailed roles, guidelines and checklists. This is done when a major instructional aim is to teach socialization skills rather than to focus on performance and understanding in the content area. This is because checklist criteria are usually valued social skills such as coaching, function-filling, social facilitation and interaction. Examples of criteria for checklists are 'Reports to group', 'Completes assigned tasks on time', 'considers viewpoints of others', 'encourages other to do well', and 'willing to share materials with others' (Airasian, 1994, p.256; Linn, & Gronlund, 1995, p.276). When this is the intention, checklist criteria for these social skills are given beforehand so that the groupwork will promote socialization by the students working towards these prosocial assessment criteria. Hence, it is necessary to decide on a clear instructional purpose of using groupwork, for example to foster prosocial behaviours or to improve performance and understanding in a content area, and then ensure that collaboration works toward, rather than against, the purposes of the assessment (Webb, 1995). Once these decisions have been made then sensitive professional judgement should temper the degree of teacher intervention, because ".. to push too hard for individual pupil solutions and contributions destroys many of the benefits of cooperative problem solving." (Airasian, 1994, p.301).

Fitting the assessment method to the instructional purpose of collaborative work

If promoting socialization is not an instructional aim then students can use their own criteria. Students can be asked to peer mark their colleagues and to give their own criteria or justification for the mark they have given. The consistency of these reasons can then be used for construct validity of the average mark received by each single group member. This was the method used in the research reported in this paper.

Methodology

Subjects, data and methodology

Students taking an undergraduate assessment course and students taking a Masters course in psychology were given group work assignments as part of their summative course assessments. The students chose their own groups (sizes 2 to 10) for their own practical and personal bonding reasons. Only the results for the students who chose groups of size 4 to 10 are included in this report, because these group sizes are appropriate to the statistics used in the analysis. There were eight such groups which included 57 students, males and females, whose ages ranged from 20 to 46 years.

Separation of process and product assessment

The measurement method used in this research was to separate the assessment of the final group product from the assessment of students' individual contributions to the group product. The products were assessed according to content standards set at the beginning of the groupwork. The contributions of individual group members was confidentially peer assessed at the end of the groupwork. Results of other studies have shown that students think peer assessment is an important part of the group grading process (Keaten & Richardson, 1993), and attitude surveys have shown that students perceive this separation of assessment as fair and effective (Beard, 1989).

Fail-safe validation for administrative accountability

Students were advised, right at the start, to be sure that other group members knew how they were contributing to the group's work. Each member was asked to keep a log of everyone's contributions. Students were told that at the end of the course they would award each other marks for their contributions to the group's work. These logs were to be used to supply the confidential justifications for the marks students would award. The purpose of this design was to moderate any personality or popularity effects that might have influenced students' peer assessments, as have been reported by Brown and Knight (1994). The logs, which were also collected, were to be used as a failsafe source of validation, in conjunction with post-assessment interviews, if that should be necessary. The instructions for the confidential feedback forms were as follows:

Peer assessment instructions

Share Certificate

Private and Confidential - do not show this information to any other group member. When it has been completed, fold it and staple it. Put it in an envelope with the other share certificates from your group and submit the envelope with the group work.

Please print your name and ID no. _____

Please *Sign* _____

Below are the names of the people in your group. Put a star * by your name. In the box by each name write the percentage you think that person deserves - including yourself. Then, for each person, give your reasons why you decided that person deserved the percentage you gave - including yourself. When you have finished check that the total is 100%

Validity of peer assessed contributions and expert assessed content

These peer assessments could be expected to have a higher content validity than those of an external assessor. This is because the group members could be expected to know the exact content of each member's contribution to the group's work better than an external assessor, such as the teacher. However, the students may not be so expert as an external assessor in the criterion assessment of the content standard. Hence, the content standard of the product was assessed in the traditional manner against the criteria that had been given at the start of the course.

Table 1 illustrates how the product assessment was weighted by the number of students in the group and combined with their confidential peer assessments to arrive at each individual's mark.

Table 1: Weighting product assessment by group size and sharing total marks according to the average peer assessment for each member.

Calculation of individual marks from the product assessment, weighted by the group size, and shared according to the average peer assessment of each individual's contribution

Group 2 Assessment				Percentages given by group members					Average received	Std. Dev received	Raw Individual mark received	Individual mark
Group Number	Marks available	395										
Subject area	Group % for assignment	79										
10 Maths	Number in group	5										
st/id	disc-id	name	st/id	21	22	23	60	62				
21	95-(	Confidential Names and IDs	Nicola	25.0	25.0	24.0	25.0	24.0	24.6	0.55	97.2	97
22	95-(		na	21.0	19.0	18.0	19.0	20.0	19.4	1.14	76.6	77
23	95-(		elix	14.0	15.0	17.0	17.0	15.0	15.6	1.34	61.6	62
60	97-(		ndre	24.0	23.0	23.0	22.0	22.0	22.8	0.84	90.1	90
62	97-(		nna	16.0	18.0	18.0	17.0	19.0	17.6	1.14	69.5	70
		% total check = 100%		100	100	100	100	100	100			
Corr sd of given		Means of marks given		20.0	20.0	20.0	20.0	20.0	20.0	1.0	79.0	79.2
with received =	0.74	St.devs of marks given		4.8	4.0	3.2	3.5	3.4	3.7	0.3	14.6	14.3

Table 1 shows the results from a group of size five and how the five students' assessments from their confidential forms have been processed. For example, column 21 has the five marks given by student No.21 these are 25.0, 21.0, 14.0, 24.0 and 16.0 and the '% total check' is 100 as required. When the marks have been entered for all five columns, in the same row order, then each row holds the marks received by each student. So in this example the first row is for student 21 and the marks received for that student are respectively 25.0 (self-assessed), 25.0 (from student 22), 24.0 (from student 23), 25.0 (from student 60) and 24.0 (from student 62). The average of this row, 24.6%, is the percentage of the total mark that the group has allotted to student 21. To find the final mark for this student we find the number of marks that have been made available from the assessment of the performance and the number of group members. In our example it is 5x79=395. That is the quality of the finished work was independently assessed at 79%. The 79 is multiplied by the number of members in the group, 5 in this case, and each student gets their share e.g. student 21 gets 29.4% of 5 x 79 which is 97% as shown in the last column of the table.

Internal reliability and construct validity of the individual's mark

The variation in the marks received by a group member are used as a measure of the reliability of that member's mark. The reasons given for each of these marks is used as an indication of the construct validity of the group member's mark.

Method reveals a discrimination problem with cooperative learning

Findings from the analysis of the marks given and received by the group members showed a consistent pattern across all eight groups and content areas. The variation in the marks that were given by a group member to the other members of the group was positively correlated with the total mark that was received by that group member from the rest of the group. It must be remembered that the two confidential processes, (i) giving a mark to others and (ii) the average of the marks received, are independent processes that are now shown to be statistically correlated.

Table 2, lists the findings from all eight groups to illustrate the consistency of this finding. These groups are not 'samples' and so it is the effect-size of the correlation that is of interest. The significances are given only for completeness.

Table 2: Showing a consistent positive correlation across groups and subjects of 'marks received' with 'variation in marks given'

Table illustrating the consistancy of the discrimination problem

	Group 1	Group 2	Group 3	Group 4
Corr	.7650	.7418	.9690	1.0000
n	(10)	(5)	(5)	(5)
Sig	P= .010	P= .151	P= .007	P= .000

	Group 5	Group 6	Group 7	Group 8
Corr	.7317	.9061	.5598	.3389
n	(4)	(5)	(10)	(13)
Sig	P= .268	P= .034	P= .092	P= .257

This correlation means that the less a group member is able to distinguish between the value of the contributions of group members then the lower is the mark independently awarded to that group member by the other students.

Conclusion

Educators have a clear pedagogic preference for co-operative performance assessments over traditional high-stakes forms of objective tests. However, problems of reliability and validity associated with the assessment of co-operative performances make it difficult to support these educationally preferred forms of assessment for high-stake gate-keeping decisions. The method of assessing an individual's contribution to co-operative groupwork detailed in this paper may make these 'alternative' assessments more widely acceptable for such important summative evaluations. The method detailed here offers (a) evidence of reliability which is based on the variation of peer assessed marks received, (b) evidence of construct validity which is based on the reasons given for group members' marks, and (c) content validity which is based on group members' insiders' knowledge of each individual's contribution to the product content. The logs of individual's contributions, and the availability of post-assessment interviews, offers the failsafe rigour necessary to support the use of groupwork for high-stakes summative assessment. In addition, the method indicates that students' low discrimination between components of the group's performance might be a fundamental factor preventing higher level attainment in cooperative learning assignments.

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