
Original Article

Validity of Rubrics for Team-Based Learning in Dental Hygienist Education in Japan

Keisuke NISHIGAWA¹⁾, Toshiko MORITA²⁾, Isako UETA²⁾, Masanori NAKANO¹⁾

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Abstract : Purpose: This study aimed to determine the validity of rubrics for team-based learning (TBL) classes in dental hygienist education. Rubrics are learning achievement evaluation criteria that provide a learning support system with high equity, equality and objectivity. In this study, we adopted rubrics for grading students in TBL classes instead of peer evaluation, and evaluated its validity and effectiveness.

Methods: Subjects were 25 second-year dental hygienist students in a medical ethics course. Eight classes were held during the semester: two classes with a traditional face-to-face teaching style, and five classes with a TBL style. In the last class, the students wrote a term paper about what they learned in the class and evaluated their learning achievement according to the criteria in a rubric table. During the TBL classes, students were graded using an individual readiness assurance test (IRAT), group readiness assurance test (GRAT), and self-evaluation of their level of contribution to group discussion and preparatory study. The term paper was also scored. Correlations of these scores and the results of the rubric evaluation were analyzed.

Results: The rubric scores showed a significant positive correlation with all other scores excepts for the GRAT. Multiple regression analysis using the rubric scores as the criterion variable and the other scores as the explanatory variables showed a significant association between the rubric scores and the other scores.

Conclusion: These results indicate the effectiveness of the evaluation points and criteria in the rubric table and the validity of the rubric scores for this course.

INTRODUCTION

Quality management is an important issue in medical education. Skills in communication, judgement, problem solving, and team cooperation are becoming central topics in this field. The passive learning style of previous courses is being replaced with active learning classes. Team-based-learning (TBL) is an instructional strategy of active learning that is showing great promise in current medical education^{1,2)}.

Many studies undertaken in different education sites have reported its effectiveness³⁻⁹⁾.

Students attending TBL classes are commonly evaluated according to the results of an individual readiness assurance test (IRAT) at the start of the class, a group readiness assurance test (GRAT) following group discussions, and peer evaluation consisting of mutual evaluation of the group members' contribution level during group discussions.

¹⁾ Department of Oral Health Sciences, Faculty of Health and Welfare, Tokushima Bunri University

²⁾ Graduate School of Nursing, Tokushima Bunri University

Table 1 Questions to record self-evaluation of student levels of preparation and contribution in the TBL class

Question	Point
How many points do you rate out of 10 points for your preparation study in this class?	() / 10
How many points do you rate out of 10 points for your contribution to group discussion in the TBL class?	() / 10

Because peer evaluation requires students to grade their colleagues, group members might experience psychological stress, and it may be difficult to achieve impartial and adequate scoring. Some studies have reported such difficulties in peer evaluation in TBL classes¹⁰⁻¹³. Rubrics are learning achievement evaluation criteria that provide a learning support system with high equity, equality and objectivity¹⁴⁻¹⁵. Therefore, the purpose of this study was to determine the validity of the rubrics that have been adopted for grading TBL students instead of peer evaluation.

METHODS AND MATERIALS

Twenty-five second-year dental hygienist students at the Department of Oral Health Sciences at Tokushima Bunri University, and who took a medical ethics course in the first semester of 2018, participated in this study. The medical ethics course consisted of eight classes. The first two classes took the form of standard face-to-face lectures and the following five classes were held in a TBL style. In the last class, the students wrote a term paper about what they had learned in the medical ethics classes. Self-evaluations of their learning achievements according to a rubric table were also recorded at the last class.

One week before each TBL class, students were provided with study materials for preparation and homework. At the beginning of the TBL class, all students took an IRAT with five multiple-choice questions that covered the preparatory material. Then, the class was divided into small groups of five, and students were instructed to participate in active group discussion and to answer the GRAT, which had the same questions as the IRAT. Group members were fixed during five TBL classes, so members in the same group had the same GRAT score. After groups received feedback from the instructor about these questions, all students recorded self-evaluations of their levels of preparation and contribution to group discussion in the TBL class with a ten-grade system (Table 1). Details of these TBL classes can be found in our previous report⁷⁻⁹.

Generally, TBL classes adopt peer evaluation in which the students make mutual evaluations of other group members' contributions to group work. Because most of the students are not trained to grade their colleagues, this may cause psychological stress and conflicts among the students. Additionally, previous studies have reported that the scores in peer evaluations tend to be unified because students are reluctant to give their peers excessively high or low scores¹⁰⁻¹³.

In this study, we used self-evaluation of learning achievement with a rubric table instead of peer evaluation. Seven categories (knowledge and understanding, thinking ability and judgment, skill and presentation, concern and motivation, preparatory study, practice use of TBL, and term paper) were evaluated with a three-grade rubric table (Table 2). The sum of scores in the seven categories were counted as the rubric score. The term paper written at the last class was also evaluated with a five-grade system by one trained instructor. The criteria for grading included knowledge and opinion about medical ethics and TBL classes, readiness to become a dental hygienist, and the consistency of the paper.

To verify the validity of the rubric scores, the following analysis was performed. The average scores for IRAT, GRAT, self-evaluation of the level of contribution to group discussion (group contribution score) and preparatory study (preparation score) through the five TBL classes were standardized, together with the term paper score and the rubric score, by converting them into percentage values according to the maximum numbers. The Spearman's rank correlation coefficient was adopted to evaluate the correlation between all combinations of the six scores. Multiple regression analysis using the rubric score as the criterion variable and the other five scores as the explanatory variables was also performed. In the statistical analysis, 5% was adopted as the level of significance.

All students participated in this research of their own free will. The medical ethics course did not involve a term-end

Table 2 Rubric table for students to self-evaluate their learning achievements in a medical ethics course

Criteria Category	Level 3 (3 point)	Level 2 (2 point)	Level 1 (1 point)
1 Knowledge and understanding	Can explain the subject in the syllabus completely	Can explain the subject in the syllabus mostly	Can explain the subject in the syllabus partly
2 Thinking ability and judgment	Have ability to think and judge the subject in the syllabus exactly	Have ability to think and judge the subject in the syllabus mostly	Have not enough ability to think and judge the subject in the syllabus
3 Skill and presentation,	Have complete skill of communication to make cooperative discussion with clear evidence	Have enough skill of communication to make cooperative discussion	Have not enough skill of communication to make cooperative discussion
4 Concern and motivation	Developed high ethics level as dental hygienist sufficiently	Developed average ethics level as dental hygienist	Developed a few ethics level as dental hygienist
5 Preparatory study	Always readied for the study subject with enough preparation	Mostly readied for the study subject with enough preparation	Sometimes readied for the study subject with enough preparation
6 Practice use of TBL	Always made use of TBL classes practically and efficiently	Mostly made use of TBL classes practically	Sometimes made use of TBL classes practically
7 Term paper	Wrote the best term paper with full of study outcomes from classes	Wrote good term paper with some study outcomes from classes	Wrote average level term paper with few study outcomes from classes

examination, and the final results for the class were decided from the above scores. The scores were calculated by the class instructor. After the students were graded, statistical analysis was undertaken by a research collaborator who did not attend any of the medical ethics classes. Personal information of the students was hidden from the collaborator during analysis. This study was approved by the Research Ethics Committee of Tokushima Bunri University (Permission No. H30-3).

RESULTS

Correlation between scores

Average scores after standardization were as follows (average \pm standard deviation): IRAT $66.8 \pm 12.7\%$, GRAT $81.8 \pm 3.7\%$, preparation score $61.6 \pm 21.0\%$, group contribution score $79.6 \pm 12.1\%$, term paper score $79.2 \pm 12.2\%$ and rubric score $74.3 \pm 9.0\%$. Table 3 shows the correlations between all six scores (Spearman's rank correlation coefficients).

The rubric score exhibited significant positive correlations

Table 3 Correlation of total scores in a TBL course, term paper and rubric score (n = 25, Spearman's rank correlation)

p-value \ Correlation Coefficient	IRAT	GRAT	Preparation score	Group contribution score	Term paper score	Rubrics evaluation score
IRAT	—	-0.064	0.479	0.207	0.416	0.558
GRAT	p=0.762	—	0.173	0.367	0.146	0.128
Preparation score	p=0.015*	p=0.408	—	0.570	0.382	0.701
Group contribution score	p=0.322	p=0.071	p=0.003*	—	0.150	0.495
Term paper score	p=0.039*	p=0.487	p=0.060	p=0.474	—	0.479
Rubrics evaluation score	p=0.004*	p=0.543	p<0.001*	p=0.012*	p=0.016*	—

Table 4 Multiple regression analysis for rubric score

Explanatory Variable	Regression Coefficients	Standard Error	p-value
IRAT	0.148	0.132	0.274
GRAT	0.013	0.401	0.975
Preparation score	0.178	0.088	0.058
Group contribution score	0.115	0.138	0.412
Term paper score	0.166	0.129	0.213

n=25, Multiple $R^2=0.571$, $p=0.004^*$

with all other scores except for GRAT. GRAT exhibited no significant correlations with any of the other scores. Other positive correlations were found between IRAT and the preparation score, IRAT and the term paper score, and the preparation score and the group contribution score.

Table 4 shows the result of multiple regression analysis that

adopted the rubric score as the criterion variable. The other five explanatory variables in the table could significantly predict the rubric score ($p = 0.004^*$), but none of these scores showed a significant independent association with the rubric score.

DISCUSSION

Correlation of class scores

The rubric score exhibited significant positive correlations with all other scores except for GRAT. Because the evaluation categories of the rubric table included preparatory study and level of contribution to group discussion, this score should naturally be associated with the self-evaluation of preparatory study and group contribution during TBL classes. Given that IRAT (an objective score measured by a written test) and the term paper score (marked by the instructor anonymously) also showed a significant correlation with the rubric score, self-evaluation of the students with a rubric table seems to have a certain validity in exhibiting learning achievements. However, there were no correlations between GRAT and any of the other scores. Because members in the same group have the same GRAT score as a matter of course, this score was not associated with other scores in which individual learning performance was independently assessed¹³⁾.

The results of the multiple regression analysis revealed significant associations between the rubric score and the other five scores. This model predicts the criterion variable (rubric score) from the explanatory variables (IRAT, GRAT, preparation score, group contribution score and term paper score). Since none of the explanatory variables showed a significant association with the rubric score separately, self-evaluation with the rubric table, with seven categories and a three-grade scoring system, seems to comprehensively demonstrate the learning achievements of individual students.

Rubrics evaluation

The rubrics evaluation assessed the learning achievements of students using a rubric table with several evaluation categories and evaluation criteria for each category^{14,15)}. The overall object of the medical ethics course was that all students develop a medical ethical manner that is indispensable for a dental hygienist. If this course had been for the basic medical sciences, such as anatomy, more objective evaluation such as a written examination would be appropriate. Because the aim of the rubrics evaluation is to assess learning achievements that are generally difficult to evaluate numerically, we believe that this style of assessment is appropriate for this course. In this course, because the students self-evaluated, inappropriately excessive or underestimated scores could be recorded. However, the self-evaluation scores of the students were significantly correlated with the IRAR from the written test and the term paper score from the instructor, suggesting that the evaluation categories and criteria in the rubric table were valid and effective.

A previous study reported that peer evaluation scores in general TBL classes tend to be similar¹³⁾. To avoid such

inappropriate scores, definite evaluation criteria are required. However, such criteria may precipitate psychological stress for students when grading colleagues, thus preventing proper scoring. Since self-evaluation with the rubric table does not cause such mental conflict during scoring, students might find this method easier to accept.

CONCLUSION

We verified the validity of the rubrics evaluation adopted for the TBL medical ethics course for dental hygiene students. The self-evaluated scores of the students using the evaluation categories and criteria of the rubric table correlated significantly with the written examination in the TBL class and the term paper scores graded by an instructor. The rubric score was also significantly associated with the other scores recorded throughout the classes. These findings demonstrate the effectiveness of the rubric table and the validity of the rubric score in this course.

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