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Comparison of Student Performance, Self-mutual and Tutor Teaching Assessments in PBL Tutorial Process Between 1st and 4th Year Dental Undergraduates

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Abstract: Objectives: Evaluate the effectiveness of PBL teaching and analyze potential influencing factors between senior and junior from the perspectives of student performance, student self-mutual and tutor teaching evaluations.Materials and methods: 81 Grade 1 and 83 Grade 4 students of dental school, Kunming Medical University participated in PBL teaching, the scores collected from the above three evaluations mentioned were analyzed.Results: study found the overall three comparative assessments scores of Grade 4 were significantly higher than those of Grade 1($P < 0.01$). Further analysis revealed no significant difference of student performance score between Grade 4 and Grade 1 in the 1st unit ($P > 0.05$), but it was improved and maintained significantly since 2nd time ($P < 0.01$).Moreover, each self-mutual evaluation of 4th year students was significantly higher than that of 1st year students, especially in the second half of the course ($P < 0.01$).And, all the evaluations of tutor teaching from seniors were significantly higher than those from juniors ($P < 0.01$). Finally, no significant correlation between student self-mutual scores and those given by tutors no matter high or lower grade ($P > 0.05$).Conclusions: Even being supported strongly in both 2 grades, self-awareness of senior was more prominent because of more favorable timing. It can be inferred that student performance could be stimulated by superior integration of problem scenarios and appropriate tutor's skills. High acceptances of tutor's role were received both from 2 grades, the medical background of tutors may be detrimental to the group process of 1st grade. Self and mutual evaluation were not accurate but irreplaceable measurement tools. It is necessary to combine qualitative analysis to adjust the existing evaluation strategies.

Keywords: PBL; Dental undergraduates; Student performance evaluation; Self and mutual evaluation; Tutor teaching evaluation

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1. Introduction

PBL (Problem-based Learning) has quickly become a continuous hot issue of medical education reform [1-3] due to its unique advantages in concepts, models, and ability training effects [4] since being introduced into the medical education field of China. As a student-centered and problem-oriented group discussion mode of learning [5], the attribute of this provides an encouraging way of learning because students can deal with challenging and observed problems in real life [6], as promoting them to realize the value of solving and understanding problems [7]. Therefore, an integrated PBL course aimed at improving students' ability of combining clinical thinking with practice was developed for the 4th year undergraduates in school of Stomatology, Kunming Medical University since 2015, and a good teaching outcome was obtained [8]. In succession, a pilot PBL teaching was also conducted among the Grade 1 students.

Sufficient literatures showed that PBL was very effective for dental education [6,9,10], the critical thinking, analysis and problem-solving skills of dental students were improved through PBL. However, using effective and reliable strategies to evaluate the overall performance of students is one of the main challenges of PBL teaching [11,12]. And, it also has own shortcomings such as the role

of tutors is difficult to act, a large amount of human resources need to be invested, limited teaching resources, and the overloading information for students, and so on [6,13]. These realities should not be ignored, which are the main reasons why still the small-scale exploration of PBL despite more than 30 years of development in higher medical education of China [14]. Furthermore, as far as our current knowledge is concerned, some well-known dental colleges of China, such as dental school of Wuhan University, which was the first dental school to carry out PBL innovation in Chinese mainland, only set up PBL course before students enter the clinic practice, which account for 20% of the total hours [15].

The study intended to evaluate the effectiveness of PBL teaching and analyze potential influencing factors between high and low grades from the perspectives of student performance, student self and mutual evaluation and tutor teaching evaluation.

2. Materials and methods

2.1 General information

81 Grade 1 and 83 Grade 4 students of dental school, Kunming Medical University participated in PBL teaching at Spring and Fall semester in the year2018, respectively.

2.2 Implementation of PBL teaching

The standard PBL process were adopted both in 2 grades.

2.3 Evaluation methods and calculation

The scales originated from PBL teaching of dental school, Wuhan University were applied at the 3rd time discussion of each unit, including student performance evaluation,student self and mutual evaluation, tutor teaching evaluation.

● Student Performance Evaluation: Tutors score students; PBL student self-evaluation and mutual evaluation: students score themselves and their peers; Tutor teaching evaluation: Students score tutors.

● In the comparison of self- mutual evaluation between two grades, the scores compared were the initial scores of students evaluating themselves and their peers; When correlation between student self -mutual evaluation and student performance evaluation was tested, the individual score was calculated and applied.

● The Tutor teaching evaluation of Grade 4 only counted the scores of same 8 tutors with Grade 1.

2.4 Statistics

A commercially available software program (SPSSAU) were performed for analysis. P-value <0.05 was considered significant statistically. Descriptive data, including mean ± standard deviation and (median) were used for expression of each evaluated scores. Kolmogorov-Smirnov test was used to detect whether the quantitative data were normally distributed.

● Mann-Whitney U test was used for the overall comparison of three evaluation scores between two grades.

● Kruskal-Wallis test and Dunn test were used for the comparison of assessments in different grades and times.l

● Spearman correlation was tested between student self-mutual evaluation (Individual score after calculation) and student performance evaluation

3. Results

3.1 Comparison of three evaluation scores between two grades

All the three comparative assessments of Grade 4 obtained significantly higher scores (table 1).

Table 1 Overall comparison of student performance, student self and mutual evaluation, tutor teaching evaluation scores (Grade 1 vs Grade 4)

	1st year	4th year	P value
Student performance evaluation	n=81	n=415	0.002**
	39.16±4.12(40.000)	41.18±2.61 (41.700)	
Student self and mutual evaluation	n=81	n=406	0.000**
	91.93±3.52(91.550)	98.62±0.67 (98.600)	
Tutor teaching evaluation	n=81	n=182	0.000**
	97.20±2.64（98.0）	99.05±1.6（100.0）	

Note: ** P < 0.01

3.2 Comparison of assessments in different grades and times

Firstly, no significant difference of student performance score between 1st unit of Grade 4 (39.55±3.82) and Grade 1 (39.16±4.12), but the scores were improved significantly and maintained since 2nd time PBL of Grade 4 (table 2).

Table 2 Comparison of three assessments based on different times of evaluation (Grade 1 vs Grade 4)

	Student performance evaluation	Student self and mutual evaluation	Tutor teaching evaluation
Grade 1(T1)	n=81	n=81	n=81
	39.16±4.12 (40.000)	91.93±3.52 (91.550)	97.20±2.64 (98.000)
Grade 4			
1st time (T4-1）	n=83	n=83	n=47
	39.55±3.82 (40.000）	97.93±0.87 (97.890)	98.72±1.87 (99.000)
2nd time（T4-2）	n=83	n=83	n=36
	42.00±3.24 (42.000）	98.52±0.79(98.330)	98.67±2.04 (100.000)
3rd time（T4-3）	n=83	n=83	n=27
	41.69±4.98 (43.000）	98.81±0.68 (98.890)	99.26±1.51 (100.000)
4th time（T4-4）	n=83	n=83	n=38
	41.36±2.88（42.000）	99.00±0.73 (99.000)	99.37±1.00 (100.000)
5th time（T4-5）	n=83	n=74	n=34
	41.33±4.41（42.000）	98.84±0.64 (98.750)	99.41±1.42 (100.0000)
P value	0.000**	0.000**	0.000**
	T4-2,T4-3,T4-4,T4-5 > T1 (P=0.000**,0.000**,0.003**,0.000**, respectively) T4-2,T4-3,T4-4,T4-5 > T4-1(P=0.000**,0.000**,0.009**,0.001**, respectively)	T4-1,T4-2,T4-3,T4-4,T4-5 > T1 (P=0.000**,0.000**,0.000**,0.000**,0.000** respectively);T4-2,T4-3,T4-4,T4-5 > T4-1(P=0.002**,0.000**,0.000**,0.000** respectively);T4-3,T4-4,T4-5, > T4-2(P=0.036*, 0.001**,0.031* respectively)	T4-1,T4-2,T4-3,T4-4,T4-5 > T1 (P=0.000**,0.001**,0.000**,0.000**,0.000**,respectively) T4-5 > T4-1(P=0.026*)

Note: *P < 0.05 ** P < 0.01

Secondly, any student self-mutual evaluation result of 4th year students was significantly higher than that of 1st year students, and the scores of last 3 times were significantly higher than those of first 2 times (table 2).

Finally, all the evaluations of tutor teaching from seniors were significantly higher than those of fresh students. Except for the 5th evaluation was higher than the 1st time, no significant difference was found among the other evaluations in 4th year students (table 2).

3.3 Correlation between student self-mutual and student performance

Low correlation coefficient were found in a total of 6 times evaluations of two grades, no significant correlation between student self-mutual and student performance scores from tutors (table 3, figure 1).

Table 3 Spearman correlation between student self-mutual evaluation (Individual score after calculation) and student performance evaluation

	Student performance evaluation from tutors					
Student self and mutual evaluation (Individual score after calculation)	Grade 1	Grade 4				
		1st unit	2nd unit	3rd unit	4th unit	5th unit
	0.164	0.020	0.048	0.121	0.060	-0.193
P value	0.144	0.854	0.669	0.276	0.589	0.100

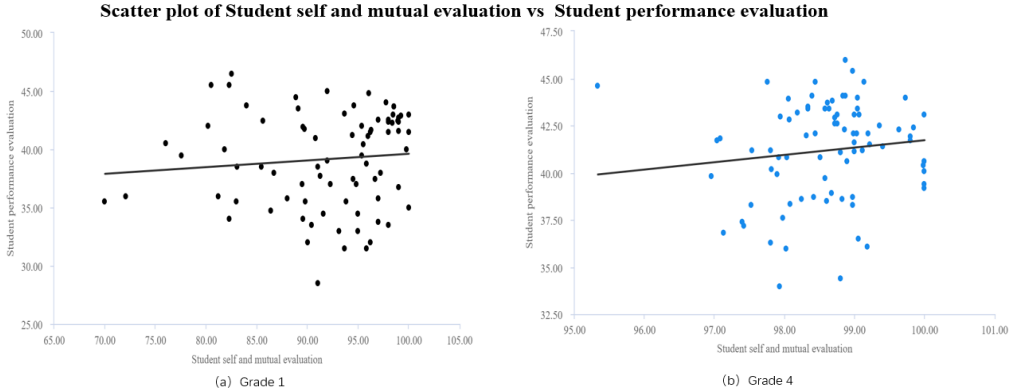

Figure 1 Scatter plot of student self and mutual evaluation vs student performance evaluation (Grade 1 and Grade 4)

4. Discussion

The assessment of PBL is challenging, as students are given autonomy of learning goals setting that may or may not meet expectation of tutors [6]. Evaluation plans and strategies consistent with the purpose of the PBL curriculum were strongly advocated [16,17]. The assessment was driven by the demand for constructive adjustment between intentions and evaluations of PBL, the conventional summative assessment model was not really fit well to PBL [18]. Hence, the formative assessment protocols including student performance, student self-mutual evaluation and tutor teaching evaluation were adopted in this study, which provide unique opportunity to judge each other's work between tutors and students wherefore making them develop the ability to reflect on own strengths and weaknesses as these are central elements of self-directed learning [19].

PBL was assumed to promote other abilities than knowledge and skills, such as collaboration, communication and regulated learning ability and professionalism [18].

The result of exceeding average 2 points, equivalent to 4 points in a hundred marks system, showed Grade 4 students received higher overall student performance ratings, it was learned from tutor's feedback that senior students have demonstrated obviously improved self-directed learning (SDL)capabilities, which was manifested as more adequate preparation, more eye-catching communication and expression in the discussion process. Elzubeir MA's research [20] found that senior students had statistically significantly higher mean scores on 11 of 14 self-assessed SDL competencies ($p<0.05$) in comparison to junior students. Yet it was noted that no difference between points of 39.16±4.12(40.000) from Grade 1 and 39.55±3.82(40.000）from Grade 4 in the first unit of PBL. Under the conditions of first attempt, this is very likely related to the writing of the problem scenarios and the teacher's guidance. Undoubtedly, the preparation of problem scenarios is the focus of learning and the framework of discussion [21]. In our study, all the problem scenarios were compiled after collective discussion by all tutors instead of the existing cases of other schools. Therefore, it was mainly focus on humanistic education and common oral problems in life for 1st year students but emphasizing the integration of "etiology-mechanism-clinical manifestations-diagnosis-treatment" of common dental clinical diseases for Grade 4. Taking into consideration of characteristics of teaching subjects to set more targeted problem scenarios may weaken the difference in knowledge and skill discrepancy between the higher and lower grade to a certain extent. In addition, all tutors who serve as the first grade were selected from last round of PBL teaching and that their own experienced skills may also play a positive role in guiding first year students. For example, tutors can strengthen the interaction of tutor and student by asking questions so as to facilitate students to express themselves more actively [22]. The above two keys were also positively affirmed by the interviews with students when course finished.

A basic part of the PBL process is that students are responsible for being active members of a group of learners. This may include the practice of collaboration and self-assessment, which may enhance reflection and self-awareness [23]. More than 90 scores of self-mutual evaluation were observed both in 2 grades, especially the fourth year students, all scores were above 95 points. Compared with Grade 1, the senior students gave themselves and their peers significantly higher self-mutual scores from the beginning of PBL, and this reached peaks at the middle and late stages of the course (Table 2), this may mainly depend on the following factors: first of all, the time point of PBL course for 4th year students was set after completion of all basic and clinical courses of Dentistry and before students entering the clinical practice. On the one hand, senior students have mastered a certain professional knowledge after 3-year studying, the implementation of PBL just cater to the demands for combination of theory into practice, which was likely to more attractive to students. On the other hand, the systematic nature and integrity of knowledge were guaranteed due to 4th year students have accepted theoretical curriculum designed from the shallower to the deeper in the past 3 years, and the lab experiments matched with the curriculum cultivate students' basic skills; therefore, PBL was more conducive to the cultivation and embodiment of students' clinical thinking transformation ability at this moment, all above were the foundations and conditions that 1st students can't possess. Hagi SK's research [24] revealed that a positive and higher mean score was found in all statements of the questionnaire about students' perception of PBL in the new curriculum among fourth year medical students than those of second year students.

The tutor's framing of active student learning and building on knowledge is an decisive factors of successful implementation of PBL [6]. However, the repositioning of the role of tutor remains challenges all the time due to it occupies a central and unique role in influencing students' learning [25]. Student assessment information speaks to the outcomes of the educational process, and often serve as benchmarks for comparison and formative assessment for teachers [26]. The same 8 tutors received higher ratings from Grade 4 students, this showed that the acceptance of the new role of teachers in PBL teaching by the students in the first grade was lower than that of fourth grade students. Yet, it was not difficult to find that the average score of teacher evaluation was 97.20±2.64 (98.000) but 91.93±3.52(91.550) for themselves and their peers in Grade 1, indicating that the recognition of tutors by Grade 1 students was still

very high. Therefore, in addition to the consciousness of students, the potential influencing factor may depend on the expertise of tutors. Indeed, there is no doubt about the ability of the medical teaching team in terms of professional quality, but the comprehensive ability of multidisciplinary knowledge and the integration of medical science with other social sciences such as the Humanities was not enough, the study observed the existence of differences between medical tutors and non-medical tutors in facilitating the group process [22]. Tutors with expertise tended to serve as a more directive role, spoke more often and for longer, provided more direct answers and suggested more discussion topics in the tutorial [27], which may play a positive but negative role of promoting the group process in 4th and 1st year students, respectively.

In our study, regardless of high or low grade, students scored themselves and peers generously, always above their tutor's marks , which were similar with Machado JL's study [28], the authors found that scores of students from tutors were consistently lower than the scores students awarded themselves and their peers from a cohort of seven semesters. Other studies [23,29,30] have shown that the Peer- and self-assessment marks might not be an accurate measure, as well as correlation between tutor ratings and peer ratings were relatively low. The correlation coefficient for Grade 1 was 0.164, and those of 5 assessments for Grade 4 was 0.020,0.048,0.121,0.060, -0.193, respectively (table 3). There was no significant correlation between student self-mutual evaluation and scores from tutors (Fig.1), this may be caused by inconsistent evaluation standards and lack of transparency in procedures [28] between students and tutors. Nevertheless, the high grade of self- mutual evaluation also reflects the efforts of students in the teaching process, because it still plays an important role in supporting reflection and self-awareness skills development [23].

5. Conclusion

The limitation of this study was only pilot PBL teaching being carried out for first year students, that evaluation based on one unit (12 hours) may cause biased results. Moreover, the results reflected the differences in scores, but didn't reveal the specific crux of the differences. With the limitation of this study, the following conclusions were drawn:

- The self-awareness of students were reflected clearly and strongly in PBL teaching both 1st and 4th year students, and this was more prominent in the senior students due to more favorable conditions of them.
- The self-direct learning ability of senior students was more powerful, but it can be inferred that student performance was more motivated by superior integration of problem scenarios and appropriate tutor's skills instead of knowledge and skills reserve.
- High level acceptances of tutor's role both from 2 grades, in-depth research combined with qualitative analysis on the role of tutor is needed.
- Self-evaluation and mutual evaluation were not accurate but irreplaceable measurement tools.
- The current assessment protocols are effective, yet a construction of evaluation strategies combining with qualitative analysis is needed in subsequent work.

Conflicts of Interest

The authors declare no conflict of interest.

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Running title

Comparison of PBL assessment between Grade1 and 4

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