

A Pilot Study of Team-based Learning in Pediatric Clerkship

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Abstract

Background

Team-based learning (TBL) is widely used in health professions education. However, TBL implanted in pediatric clerkship is rare. Here we explore the efficacy and feasibility of TBL in pediatric clerkship.

Methods

We retrospectively reviewed the TBL course in pediatric clerkship in between August and October in 2019, at Children's Hospital, Zhejiang University School of Medicine, Hangzhou, China. TBL group (with 107 students) compared to students from the prior year with case-based discussion (Control group, with 222 students). The learning outcomes were measured as theoretical exams when pediatric clerkship ended. The satisfaction of TBL was evaluated by an anonymous questionnaire in the TBL group.

Results

The grade point average before pediatric clerkship in the TBL group (3.58, 3.04–3.96) was similar to in Control group (3.62, 3.16–4.00). However theoretical exams in the TBL group (76, 67–82) were significantly higher than the control group (72, 64–78) ($P = 0.002$). Besides, 92.5% of students in the TBL group responded to the questionnaire with a satisfaction higher than 90%.

Conclusions

Our study demonstrated that TBL in pediatric clerkship was effective and feasible with a better learning outcome.

Background

Clerkship is one of the core components in undergraduate medical education(1). During clerkship in various specialties, the medical students would be immersive learning in different departments, including pediatrics. Pediatric teaching and learning have their features. But some studies showed that students showed lower interest in pediatrics(2). Comparing with the clerkship in other medical schools (1, 3, 4) the period of our pediatric clerkship was much shorter -only three weeks. Learning and teaching is a challenge for both students and teachers. As we are known, active learning improves the learning effect(5): improving knowledge gaining and evoking the memory. We are trying to change the students' learning methods by changing our teaching methodologies.

TBL (team-based learning) was popular in health professions education in recent years(6, 7), including different specialties in medicine. TBL is a unique and powerful form of small-group learning(8). "It

harnesses the power of teams and social learning combined with accountability structures and systematic instructional sequences to let you achieve powerful results”(8). TBL had 4 stages: preparation before class, individual and group readiness assurance tests, application activities which required students to apply the knowledge from readiness stage into a “real world”(7). All these promoted the teams working on the same problem, provoking the students to learn actively and maximally participate in group discussion. Although this systemic review(7) showed 47% of 118 studies exploring the TBL practicing in undergraduate, only 2 articles focus on pediatrics.

According to the positive findings of TBL in the literature(9-13)and our colleagues’ experience, we hypothesis implementing TBL in pediatric clerkship could improve the effectiveness of learning pediatrics in undergraduate students. Here, we retrospectively reviewed our students who participated in a pediatric clerkship with TBL in 2019, compared with students in the prior year with case-based discussion, which we used previously. We aimed to prove that TBL was effective in a pediatric clerkship with learners’ satisfaction.

Methods

This study was approved by The Ethics Committee of Children’s Hospital Zhejiang University School of Medicine.

We organized TBL in pediatric clerkship for students who were major in clinical medicine from August to October in 2019 at Children’s Hospital Zhejiang University School of Medicine.

Subjects

The students were from Zhejiang University School of Medicine who had 5-year undergraduate programs. They had clerkship in many specialties in the third year, including 3 weeks in pediatrics. We retrospectively reviewed the students’ teaching methods and their performance before and after a pediatric clerkship. The student cohort with TBL-planted pediatric clerkship (TBL group) was compared with the student cohort from the prior year (Control group) which was using case-based discussion as the teaching method. The students’ grade point averages (GPA) of major courses before pediatric clerkship were reviewed.

Control Group

The pediatric clerkship for students from the control group contained 4-6 case-based discussions in 3 weeks (Table 1). The cases used in the discussion were chosen by students themselves during the clerkship and mainly covered core pediatric topics (e.g. pneumonia, acute gastroenteritis). In each case-based discussion, one student in one group was voluntary to do the preparing work including presenting the case to the group and organizing the discussion. The students would domain the discussion, including presenting a typical case, asking questions to other group members, and explaining the possible rational. One teacher would be assigned to a group as an instructor. Teachers’ work was mainly

about previewing the student's preparing work (including the slides), observing the discussion, and facilitating if necessary. The group held their discussion separately.

TBL Group

The pediatric clerkship for students from the TBL group contained 4 modules. The 4 modules were fixed which covered those pediatric topics: acute gastroenteritis with fluid therapy, neonatal hyperbilirubinemia, pneumonia, glomerulonephritis/nephritic syndrome (Table 1).

The faculties had attended a TBL fellowship training or a TBL workshop before TBL beginning. Finally, 4 teachers participated in the TBL group in total. 3 of those 4 teachers were the same as in control group, including one teacher who had more than 10 years of teaching experience in pediatrics. Each TBL module was mainly conducted by one pediatric faculty member, and another faculty would help with the readiness assurance test part.

When pediatric clerkship started, the students would receive a brief introduction of TBL methods, including how this worked and what they should do in each component. The preparing materials were assigned 2 days before classes, usually from certain chapters in the textbook or articles. TBL modules were designed in the "4 Ss" framework (Significant problem, Same problem, Specific choice, Simultaneous reporting). Learning objectives were set to meet the pediatric requirements in the national examination of practicing doctor's qualifications.

A TBL module began with an individual readiness assurance test (iRAT) containing 12 multiple-choice questions (MCQs) in closed-book. iRAT was going to be finished in 12 minutes. Those MCQs were based on clinical problems. Students were doing iRAT using a mini-program in the App of Wechat. When teachers logged in the mini program, they could see the results of iRAT for each student or each MCQ. During iRAT, the students didn't get feedback on knowing the right answers. Then the students started the discussion in teams and finished team readiness assurance test (tRAT) which were the same questions as iRAT also in closed-book. tRAT was conducted using Immediate Feedback Assessment Technique (IF-AT) (such as scratch cards) or voting cards. Scratch cards were made by our faculties. Scratch cards eventually would reveal the correct answers to the students and also would record the students' confusion. Voting cards revealed the students' opinions for the first time and could provoke the discussion immediately. After tRAT with discussion, there was a short time for the mini-lecture conducted by teachers. The teachers would give feedback and clarification to ensure that the key principles were understood by all the students. The application began with another clinical case. The questions set as clinical problems. And questions in application were not only covered the key principles discussed in tRAT but also need applying other knowledge. After the groups demonstrated their ideas simultaneously, gallery walks started which allowed groups to cross-exam others, leaving their comments. The discussion was guided by facilitators; the groups expressed their thinking. Peer reviews were done by mobile phone after class, including using the Fink method(8) to reassess members' contribution to their team's success and using the UT Austin method(8) to obtain descriptive feedback of the performance during TBL

module. That feedback would give to the students after each TBL module. When each module ended, the teacher would assign some reading material related to the topics.

Outcome Measure

During the TBL practicing, the iRAT and tRAT scores would be recorded.

At the end of the pediatric clerkship, all students would be evaluated by a theoretical exam which consisted of 100 MCQs in closed-book within a certain time. Those MCQs should cover most of the topics that the national examination of practicing doctor's qualifications required in pediatrics, not just core topics. Repeating MCQs as used in readiness assurance test wasn't allowed.

The satisfaction of students who enrolled in the TBL group was assessed with an anonymous questionnaire when pediatric clerkship ended. The questionnaire was answered by a five-point scale: strongly agree, agree, neutral, disagree, strongly disagree, and an open-ended question for a further suggestion about TBL.

Statistical Analysis

Statistical analyses were conducted by SPSS version 25.0(IBM, Armonk, New York).

Continuous data were presented as mean \pm standard deviation which showed with normal distribution or median with interquartile range (IQR) which showed with non-normal distribution.

A Chi-square test was used for categorical variables. Mann-Whitney test or Kruskal-Wallis test were used for non-normal distribution data and *t* test was used for normal distribution data. Significance was considered as a *P* value <0.05.

Results

In the 2017-2018 academic year, 222 third-year students (Control group) participated the pediatric clerkship with the teaching method of case-based discussions in Children's Hospital Zhejiang University School of Medicine. In the 2019-2020 academic year, 107 third-year students (TBL group) participated the pediatric clerkship with TBL in the same hospital. The students in the TBL group were all not familiar with TBL before. The demographics and the theoretical exam score of the two groups were showed in Table 2. The GPA of major courses before pediatric clerkship were similar in two groups ($P=0.839$). But the theoretical test scores at the end of pediatric clerkship in the TBL group were higher than the control group($P=0.002$).

Learning Process in TBL Group

During the 3-week clerkship in pediatrics, the students in the TBL group went through 4 modules of TBL. Their performance would be recorded as the accuracy in iRAT and tRAT (Table3). Comparing the accuracy of iRAT to tRAT in each module, tRATs were all higher than iRATs in each module ($P<0.05$).

Students' Satisfaction

99% (92.5%) students in the TBL group responded to the anonymous questionnaire. Overall, more than 90% of the students gave positive feedback on TBL. 97.0% (96/99) students agreed that TBL made them learn better and improve their enthusiasm for learning. 98.0% (97/99) students felt their abilities of self-directed learning improved. 95.0% (94/99) students' collaboration improved and 97.0% (96/99) students' data analysis got better than before. 93.0% (92/99) expressed and communicated better through TBL. 97% (96/99) students could get feedback and help in time. 94.9% (94/99) students got fun during TBL and 98.0% (97/99) of them thought TBL was effective. 90.9% (90/99) students would prefer the TBL way than the traditional way of learning (Table 4).

The students gave a lot of suggestions for TBL. Some students proposed more TBL modules or the arrangement covered more core topics. Some students suggested that it would be better if the teacher gave a summary after the discussion. A few students desired more opportunities to express themselves. 2 students thought it was a bit rush to set 4 modules in 3-week. 1 Student complained that one team member wasn't devoted during the class.

Discussion

This study is one implanted TBL in pediatric clerkship in medical undergraduate students. Our research demonstrated that using TBL, medical students could obtain theoretical knowledge better than they did with case-based discussion. TBL's component was able to quantify the learning process. Students were satisfied with TBL although they never used that before.

Why TBL worked in our 3-week pediatric clerkship? In our opinion, this was contributed by teachers, students, and TBL itself. Looking at other TBL characteristics of facilitators(7), only a small part of the literature mentioned the training of facilitators or the experienced of facilitators before implementing. But we had faculties well trained before TBL implemented. The training included participating in TBL fellowship in an experienced center and TBL workshop which allowed the trainees immersed themselves in TBL. Meanwhile, we had one of four teachers who were experienced in pediatric teaching. Those made our faculties well prepared for TBL. Our experience in TBL practicing showed that the number of faculties was not the most important but the training experience was.

Students were another impact factor in our TBL activities. Before pediatric clerkship started, the students in the control group showed the same as the TBL group in GPA of major courses and they shared the same textbooks. Although the students' domain the discussion in both groups and they were provoked to learn actively, the results showed differently. In the TBL group, every student should do the pre-up work. During the discussion, students in the TBL group showed more interesting because they were working on the same question with a similar knowledge level. In contrast, in the control group, the students who were voluntary to do the preparation work, usually did the most pre-up work while the others' pre-up work was unable to measure. The discussion was in a hurry while other members didn't have their own opinion or questions. The control group covered more topics but less depth. In the end, the TBL group did much

better than the control group in the theoretical exam with a higher score. This indicated the students could learn more in theoretical knowledge with TBL even they didn't meet TBL before. Our finding here consisted of other TBL practices in pediatric(9, 13) and non-pediatric fields(14, 15).

And looked back to TBL itself-the only change in control and TBL group. As we've known, TBL is a structural method of learning. IRAT, tRAT made the students' readiness accountable. RAT results were not just only score, but let the teachers knew where the "weak point" or the "confusing part" was, that made the discussions between groups more powerful and effective. And working in a smaller sized group (5-7 persons, comparing 8-10 persons in the control group) and working on the same question, the students had more opportunities to share their thoughts. When teams debated with each other, they might clarify and get a deeper understanding. This learning process might be more effective because it was learning from peers. This consisted of another study(16).

Besides, we found the TBL group required fewer classrooms than the control group. The teachers liked TBL more because they could shorten the time of teaching.

Still, we had limitations. As the learning and teaching methods changed, the learning outcome measures remained the same. The theoretical test score might only show how the knowledge remembered or applied. Other abilities which might get improved in TBL, such as team-working, communication, couldn't be properly assessed in our study. As for learning, theoretical exams when pediatric clerkship ended just tested for the short-term outcome. We didn't explore the long-term effect. So far, recent studies brought the opposite results(9, 13). More studies on the long-term outcome with TBL would be needed. Meanwhile, the purpose of a clerkship should not only focus on theoretical knowledge but also focus on clinical competency. Some more objective indexes would be needed in clerkship to evaluate the students' performance. Thus, we might see how TBL influenced clerkship in pediatrics.

Conclusion

In this study, we showed the efficacy and feasibility of TBL in pediatric clerkship, even within a quite short time. Students could master the knowledge and improve self-learning with team cooperation. The quantified learning process was not only immediate feedback for students but also improved the efficacy of discussion which was facilitated by the teachers.

Abbreviations

TBL: team-based learning

GPA: grade point averages

iRAT: individual readiness assurance test

MCQs: multiple-choice questions

tRAT: team readiness assurance test

IF-AT: Immediate Feedback Assessment Technique

Declarations

Ethics approval: This study was approved by The Ethics Committee of Children's Hospital Zhejiang University School of Medicine (No.2019-IRB-153). All procedures performed in this study involving human participants were following the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent is not required.

Consent for publication: Not applicable

Availability of data and materials: All data generated or analysed during this study are included in this published article and available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: LX, YZ, ZC, and QS designed the research. LX, YC, YX, and JW conducted the research; LX and YZ collected the data. LX analyzed the data. YZ checked all of the data. LX was a major contributor in writing the manuscript. ZC and QS had primary responsibility for the final content. All authors offered critical comments, read and approved the final manuscript.

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Tables

Table 1 Comparison the setting of the control group and the team-based learning group in a pediatric clerkship

	Control group	TBL group
Duration	3 weeks	3 weeks
Number of students (persons)	35-37	35-37
Groups setting	Divided into 4 groups with 8-10 students in each group	Divided into 6 groups with 5-7 students in each group
Time for students' preparing before class	Not measured	2 hours
Activities in class	1 group contained 8-10 students held discussion every time	6 groups were in class together, in TBL ways
Class hours for each student	4-9 hours for 4-6 cases	12 hours
Occupied time of classrooms	16-36 hours	12 hours
Number of teachers (persons)	4	4
Time for each teacher facilitating work in class	4-9 hours	4.5 hours

TBL: Team-based learning

Table 2 Demographics for students enrolled in the cohorts

	Control group	TBL group	<i>P</i> value
Number of students	222	107	
Male (%)	124 (55.9)	71 (66.4)	0.069
GPA [#]			0.839
Median	3.62	3.58	
IQR	3.16-4.00	3.04-3.96	
Test scores at end of pediatric clerkship			0.002
Median	72	76	
IQR	64-78	67-82	

TBL: Team-based learning; GPA: grade point average; IQR: Interquartile range

#. GPA here was counted from major courses before pediatric clerkship

Table 3 Accuracy of readiness assurance test in each module

	iRAT	tRAT	P value
Module 1	0.50 (0.33-0.58)	0.83 (0.83-0.92)	0.000
Module 2	0.50 (0.42-0.67)	0.79 (0.67-0.83)	0.000
Module 3	0.58 (0.42-0.67)	0.83 (0.75-0.92)	0.000
Module 4	0.58 (0.72-0.75)	0.92 (0.83-1.00)	0.000

iRAT: individual readiness assurance test; tRAT: team readiness assurance test.

Table 4 Questionnaire results of students' satisfaction (n=99)

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
learning better with TBL	63 (63.6%)	33 (33.3%)	3 (3.0%)	0	0
Increasing my motivation for learning	61 (61.6%)	35 (35.4%)	3 (3.0%)	0	0
TBL enhanced my ability of self-directed learning	63 (63.6%)	34 (34.3%)	2 (2.0%)	0	0
Promoting collaboration	55 (55.6%)	39 (39.4%)	4 (4.0%)	1 (1.0%)	0
Developing the ability to analysis and sum up the data	53 (53.5%)	43 (43.4%)	3 (3.0%)	0	0
Expressing and communicating better	45 (45.5%)	47 (47.5%)	7 (7.1%)	0	0
Getting feedback and help in time	55 (55.6%)	41 (41.4%)	3 (3.0%)	0	0
Having fun in TBL	56 (56.6%)	38 (38.4%)	4 (4.0%)	1 (1.0%)	0
TBL was effective	60 (60.6%)	37 (37.4%)	2 (2.0%)	0	0
Preferring TBL more than traditional way	54 (54.5%)	36 (36.4%)	8 (8.1%)	1 (1.0%)	0

