

Effect of team-based learning in interprofessional education at a health university

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Abstract

Objective: This study aimed to examine the effects of interprofessional education (IPE) using team-based learning (TBL).

Methods: We analyzed the results of a scale to measure IPE among 449 fourth-year students from seven faculties of a health university in Japan. The students took the Assembly Special Lesson as part of IPE using TBL. Before and after the lesson, the participants completed a questionnaire, which consisted of the IPE Tsukuba Model, to which we added two items. The scale was divided into five domains. We compared the scores using the Wilcoxon signed-rank test.

Results: The overall scores of four of the five domains of the IPE evaluation were significantly higher after the lesson than before ($P < 0.05$): "Understanding the role of each profession's specialization"; "Regarding participation in group work"; "Thoughts regarding the team in healthcare and welfare"; and "Feelings about cooperation among different professions."

Conclusions: It was evident that the lesson enhanced the students' understanding of the role of other professionals, enabled them to participate in group work, and allowed them to understand the responsibilities of each profession within a team, thereby leading to greater cooperation and better health care. This TBL for IPE was found to be effective by producing valuable changes in perceptions and attitudes toward professional cooperation among students.

Keywords: Interprofessional education, Team-based learning, Medical and health care

Introduction

At present, it would be extremely difficult for a single health-care professional to undertake all aspects of the medical treatment and care of patients with complex problems; the importance of interprofessional work has increased.^{1,2} For that reason, the practice of interprofessional education (IPE) is necessary in undergraduate curricula.^{3,4} The Centre for the Advancement of Interprofessional Education offers the following definition for IPE: "IPE occurs when two or more professions learn with, from and about each other to improve collaboration and the quality of care."⁵ Student health professionals have been found to benefit from interdisciplinary education, with the outcome effects being primarily related to changes in knowledge, skills, attitudes, and beliefs.⁶

Fujita Health University (FHU) is a general health university in Toyoake, Japan; it comprises two departments—the School of Medicine and the School of Health Science—and seven faculties.⁷ The School of Health Science consists of the following faculties: Medical Technology; Nursing; Radiological Technology; Rehabilitation; Clinical Engineering; and Medical Management and Information Science. At that university, an original educational approach termed "assembly" has been

adopted since the institution's founding in 1971. With assembly, all first- and second-grade students of the two departments and seven faculties are reassigned to classes across departmental boundaries. The purpose of assembly is to provide basic knowledge about health-care teams to lower-grade students. However, no such classes were held for upper-grade students, who had already acquired sufficient ability in patient medical care. Therefore, a new class—Assembly Special Lesson—was created as part of IPE to promote teamwork within health care.

With the Assembly Special Lesson, we focused on the techniques of team-based learning (TBL) within IPE. TBL offers a number of advantages, such as collaboration and active participation by the learners in the educational process; those qualities are essential in team medical care.^{8,9} This educational technique was developed by Michaelsen in the late 1970s, when he advocated expanding classes of small numbers of students to larger classes. Owing to its effectiveness, TBL has spread rapidly in medical education in recent years.^{10,11} TBL involves preparation processes, an individual readiness test, a team readiness test, application exercises, and peer evaluation as an active learning process. These steps lead to enhanced judgment and a sense of responsibility at both the individual and team level; in this way, cooperation within the team gradually develops. TBL is an effective tool for building cooperation and mutual trust in work groups. Accordingly, it is very appropriate in practicing IPE.

The TBL program is generally adopted for fewer than 200 students in colleges or minority departments in schools.^{12,14}

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However, team medical care is actually practiced by multidisciplinary professionals. We therefore considered it necessary to study a TBL program using a large number of students from various health-care departments. With over 500 students studying at the same site, FHU offers an ideal environment for implementing IPE. Taking advantage of this situation, we introduced the Assembly Special Lesson using TBL.¹⁵ Through this methodology, students from different faculties aimed to learn and collaborate interdependently with common health goals toward providing the best health care for patients with complex problems that cannot be solved only from the perspective of a single profession.

The focus of this study was to confirm the effects of IPE using TBL at a health university. We examined questionnaire responses from before and after the Assembly Special Lesson.

Methods

Study subjects

Among 550 fourth-year students from seven faculties (one faculty of the School of Medicine and six faculties of the School of Health Sciences) at FHU, we selected 502 students. We excluded 48 students who did not participate in the Assembly Special Lesson.

TBL program

For 3 hours each day on October 31 and November 1, 2013, the Assembly Special Lesson was held at FHU as a type of IPE; the lesson was conducted on a large scale, with TBL adopted as the teaching method. We divided the students into 92 fixed-member teams of five or six individuals prior to the first TBL session such that the teams incorporated multidisciplinary mixtures from the two schools and seven faculties. The teams were clustered into five classrooms. Two or three instructors conducted the TBL sessions in each classroom; as course material, they used "Home Health Care of Stroke Patients," which was carefully selected by the Subject Selection Committee. The members of that committee were instructors from all faculties who were responsible for the Assembly Special Lesson. The instructors assigned to present the TBL sessions had participated in a series of faculty development seminars on TBL and IPE. Since almost all the students had no previous experience of TBL, they received orientation from each faculty. The students received prepared materials about 1 week before the lesson was held, and they were encouraged to study the materials so as to take responsibility for their learning.

On both days the lesson was held, TBL was undertaken using individual readiness assurance tests, team readiness assurance tests, appeals, instructor feedback, and application activities. When different opinions were voiced within a team during the application activities, each member clarified their reasons until the team was able to reach a unanimous opinion. After the final application activity on day 2, students were requested to provide peer feedback through formative written feedback and summative evaluations of performance. The feedback sheets, containing gradings by the teams and anonymized comments from team members, were presented to all the students for use as reference materials for self-reflection.

Questionnaire survey

We employed a new version of the Interprofessional Education Tsukuba Model (IPET) scale, which originally consisted of

five domains (38 items).¹⁶ We added two items related to professions that were not included in domain 2 of the original version of IPET: "Understanding the role of each profession's specialization." The two items were "I think I understand the role of a clinical engineer" and "I think I understand the role of a medical information management officer" with respect to professions related to FHU. So the total number of items was 40. The five domains were as follows: (1) feelings about the profession I am training for (eight items); (2) understanding the role of each profession's specialization (12 items); (3) regarding participation in group work (six items); (4) thoughts regarding the team in healthcare and welfare (10 items); and (5) feelings about cooperation among different professions (four items). Each item was measured using a Likert scale with six levels: 1 (strongly disagree); 2 (disagree); 3 (somewhat disagree); 4 (somewhat agree); 5 (agree); and 6 (strongly agree).

We performed forward translation from Japanese to English of the five domains and 40 items. A native English speaker who was proficient in Japanese collaborated with the developer of the IPET scale in translating the survey domains and items for the purposes of this manuscript.

The self-administered survey was conducted before day 1 and at the end of day 2 of the Assembly Special Lesson.

Statistical analysis

Using the Wilcoxon signed-rank test, we compared the scores for each item and overall for the five domains before and after the Assembly Special Lesson. We performed all statistical analyses using SPSS software, version 22.0 (SPSS IBM Co.). The significance level was set to 5%.

Ethical considerations

We clarified the purpose, method, and content of the study in a document sent to the participants. We explained to the subjects that a questionnaire survey would be performed as part of the study. We also stated that participation in the research was voluntary, that refusal had no disadvantages, and that it was possible for the participants to withdraw at any time—even after having agreed to cooperate. This study was conducted with the approval of the medical research ethics review committee of FHU (approval no. 13-209).

Table 1. Characteristics of study subjects

		N (%)
Sex	Male	175 (39.0)
	Female	274 (61.0)
Faculty	Medicine	95 (21.2)
	Medical Technology	79 (17.6)
	Nursing	100 (22.3)
	Radiological Technology	44 (9.8)
	Rehabilitation	87 (19.4)
	Clinical Engineering	25 (5.6)
	Medical Management and Information Science	19 (4.2)
		Mean ± SD
Age (years)		22.2 ± 1.8

Results

Among the 502 students selected, 457 answered the questionnaire (response rate, 91.0%); after excluding eight students whose responses were incomplete, we analyzed the data of 449 students (valid response rate, 98.2%). Table 1 presents the characteristics of the study subjects. There were 175 male (39.0%) and 274 female students (61.0%); 95 students were from the Faculty of Medicine, 79 from Medical Technology, 100 from Nursing, 44 from Radiological Technology, 87 from Rehabilitation, 25 from Clinical Engineering, and 19 from Medical Management and Information Science. The average age of the subjects was 22.2 ± 1.8 years.

The results of the analysis of the IPET questionnaire for the five domains appear below.

Domain 1. Feelings about the profession I am training for

Table 2 presents the results for the domain "Feelings about the profession I am training for." In this domain, the mean overall score was 4.37 ± 0.91 before the lesson and 4.39 ± 0.95 after the lesson; we did not observe a significant difference. However, after the Assembly Special Lesson, some items showed significantly higher scores than before the lesson ($P < 0.05$). These items were as follows: "I think that I am suitable for the profession I am training for"; "If I am consulted by one of my juniors who says that he or she wants to become a professional, I would recommend the profession I myself wish to do"; and "I have confidence I will work in my chosen profession in the future." However, the score for "If I go back in time to the start of university, I would choose the same field of study" was significantly lower after the Assembly Special Lesson than before ($P < 0.05$).

Table 2. Comparison of the scores before and after IPE in domain 1

Domain 1: Feelings about the profession I am training for Items 1–8	N	Before IPE	After IPE	P value
		score	score	
		Mean \pm SD	Mean \pm SD	
1. I'd like to continue working in the profession I am training for for a long time in the future.	449	4.95 ± 1.08	4.91 ± 1.10	0.380
2. I think that I am suitable for the profession I am training for.	449	4.07 ± 1.03	4.16 ± 1.06	0.022
3. If I go back in time to the start of university, I would choose the same field of study.	449	4.24 ± 1.50	4.14 ± 1.45	0.024
4. If I am consulted by one of my juniors who says that he or she wants to become a professional, I would recommend the profession I myself wish to do.	449	3.71 ± 1.24	3.87 ± 1.26	0.002
5. I have pride in the profession I am training for.	449	4.68 ± 1.08	4.63 ± 1.09	0.263
6. I'd like to learn more about the profession I am training for.	449	4.79 ± 1.02	4.80 ± 1.11	0.438
7. I'm satisfied with my choice of profession.	449	4.56 ± 1.15	4.57 ± 1.16	0.847
8. I have confidence I will work in my chosen profession in the future.	449	3.96 ± 1.21	4.06 ± 1.18	0.025
Overall	449	4.37 ± 0.91	4.39 ± 0.95	0.181

Table 3. Comparison of the scores before and after IPE in domain 2

Domain 2: Understanding the role of each profession's specialization Items 1–12	N	Before IPE	After IPE	P value
		score	score	
		Mean \pm SD	Mean \pm SD	
1. I think I understand the role of a doctor.	449	3.78 ± 1.06	4.19 ± 1.00	<0.001
2. I think I understand the role of a nurse.	449	3.93 ± 1.17	4.31 ± 1.09	<0.001
3. I think I understand the role of a clinical laboratory technologist.	449	3.46 ± 1.18	3.92 ± 1.18	<0.001
4. I think I understand the role of a pharmacist.	449	3.49 ± 1.02	3.75 ± 1.10	<0.001
5. I think I understand the role of a physical therapist.	449	3.62 ± 1.18	4.07 ± 1.12	<0.001
6. I think I understand the role of an occupational therapist.	449	3.57 ± 1.17	4.02 ± 1.11	<0.001
7. I think I understand the role of a speech therapist.	449	3.25 ± 1.18	3.67 ± 1.16	<0.001
8. I think I understand the role of a radiological technologist.	449	3.45 ± 1.15	3.87 ± 1.11	<0.001
9. I think I understand the role of a nutritionist.	449	3.26 ± 1.03	3.59 ± 1.06	<0.001
10. I think I understand the role of a social worker.	449	2.94 ± 1.15	3.33 ± 1.18	<0.001
11. I think I understand the role of a clinical engineer.	449	3.14 ± 1.17	3.59 ± 1.18	<0.001
12. I think I understand the role of a medical information management officer.	449	2.76 ± 1.15	3.33 ± 1.19	<0.001
Overall	449	3.39 ± 0.83	3.80 ± 0.87	<0.001

Domain 2. Understanding the role of each profession's specialization

Table 3 shows the results of the domain "Understanding the role of each profession's specialization." The scores for all items were significantly higher after the Assembly Special Lesson than before ($P<0.05$).

Domain 3. Regarding participation in group work

The scores for the domain "Regarding participation in group work" appear in Table 4. The overall score for the domain was 4.21 ± 0.82 before the lesson and 4.48 ± 0.81 after; the score after the lesson was significantly higher than before ($P<0.001$). The scores for the following items were significantly higher after the Assembly Special Lesson than before ($P<0.01$): "I speak to convey my thoughts to the other members"; "I strive to listen to the opinions of other members"; "I take a flexible attitude when presented with opinions differing from my

own"; "I actively participate in group work as a member of the group"; and "I strive to advance the group work by cooperating with other members."

Domain 4. Thoughts regarding the team in healthcare and welfare

As shown in Table 5, the overall score of the domain "Thoughts Regarding the team in healthcare and welfare" was significantly higher after the Assembly Special Lesson than before ($P<0.001$). It was evident that the score of each item was significantly higher after the lesson than before ($P<0.05$) with the following exceptions: "Team members should treat all team members as equals"; and "Team members should mutually support each other."

Domain 5. Feelings about cooperation among different professions

Table 6 presents the results of the domain "Feelings

Table 4. Comparison of the scores before and after IPE in domain 3

Domain 3: Regarding participation in group work Items 1-6	N	Before IPE	After IPE	P value
		score	score	
1. I speak to convey my thoughts to the other members.	449	3.76 ± 1.49	4.27 ± 0.97	<0.001
2. I strive to listen to the opinions of other members.	449	4.23 ± 1.70	4.86 ± 0.88	0.001
3. I take a flexible attitude when presented with opinions differing from my own.	449	4.49 ± 0.89	4.63 ± 0.90	0.001
4. I actively participate in group work as a member of the group.	449	4.13 ± 0.98	4.41 ± 1.06	<0.001
5. I strive to advance the group work by cooperating with other members.	449	4.45 ± 0.93	4.59 ± 0.95	0.009
6. I strive to demonstrate the specialization of my particular profession.	449	4.22 ± 0.92	4.12 ± 1.15	0.071
Overall	449	4.21 ± 0.82	4.48 ± 0.81	<0.001

Table 5. Comparison of the scores before and after IPE in domain 4

Domain 4: Thoughts regarding the team in healthcare and welfare Items 1-10	N	Before IPE	After IPE	P value
		score	score	
1. I think it is important that each team member tries to understand the opinions of other members.	449	5.06 ± 0.92	5.16 ± 0.86	0.025
2. It is important that each team member recognizes and accepts the differences between themselves and other members.	449	4.98 ± 0.87	5.08 ± 0.91	0.027
3. It is important that each participating member shares each patient's problems when making care policies.	449	5.06 ± 0.90	5.17 ± 0.88	0.008
4. It is important to keep the patient's desires central when considering a patient's care policy.	449	5.01 ± 0.93	5.16 ± 0.86	0.001
5. It is important that each team member understands the team's goal, has an awareness of their role in meeting that goal, and works responsibly toward that goal.	449	5.06 ± 0.87	5.20 ± 0.86	0.001
6. It is important that all team members participate in the discussion.	449	4.95 ± 0.96	5.14 ± 0.90	<0.001
7. Deeper understanding of the patient is made possible by the discussion of team members.	449	4.92 ± 0.94	5.09 ± 0.90	<0.001
8. It is possible to provide better care for patients by having team discussions.	449	4.97 ± 0.93	5.15 ± 0.89	<0.001
9. Team members should treat all team members as equals.	449	4.96 ± 1.07	5.05 ± 1.01	0.117
10. Team members should mutually support each other.	449	5.17 ± 0.91	5.23 ± 0.89	0.172
Overall	449	5.01 ± 0.79	5.14 ± 0.79	<0.001

Table 6. Comparison of the scores before and after IPE in domain 5

Domain 5: Feelings about cooperation among different professions Items 1-4	N	Before IPE	After IPE	P value
		score	score	
		Mean ± SD	Mean ± SD	
1. I think that cooperation among many professions leads to better care for both patients and families.	449	5.02 ± 0.96	5.09 ± 0.94	0.088
2. I think that cooperation among many professions leads to better health care by each profession.	449	4.98 ± 0.95	5.10 ± 0.92	0.011
3. I think there are common areas which any health, medical, and welfare professional would be able to perform.	449	4.63 ± 0.98	4.92 ± 0.96	<0.001
4. I feel that by sharing goals as part of a professional team, each specialization gains better awareness of its place and role.	449	4.77 ± 0.97	4.78 ± 1.10	0.700
Overall	449	4.85 ± 0.88	4.97 ± 0.89	0.002

about cooperation among different professions.” The overall score for the domain was significantly higher after the lesson than before ($P<0.01$). The scores of the following items were significantly higher after the lesson than before ($P<0.05$): “I think that cooperation among many professions leads to better health care by each profession”; and “I think there are common areas which any health, medical, and welfare professional would be able to perform.”

Discussion

The overall scores with four of the five domains in the IPE evaluation were significantly higher after the Assembly Special Lesson than before. We concluded that the effect of IPE on each of the five domains of the IPET questionnaire were as follows.

The mean overall scores in domain 1 (“Feelings about the profession I am training for”) did not differ significantly before and after the lesson. However, the mean scores for the following items were significantly higher after the lesson than before: “I think that I am suitable for the profession I am training for”; “If I am consulted by one of my juniors who says that he or she wants to become a professional, I would recommend the profession I myself wish to do”; and “I have confidence I will work in my chosen profession in the future.” Students working in teams trust both their own knowledge and one another’s ability to apply that knowledge effectively.¹⁰ We believe these results indicate students’ increased confidence in their profession as their goal and that they had greater hope for the future as a result of the Special Assembly Lesson using TBL. However, the score for “If I go back in time to the start of university, I would choose the same field of study” was significantly lower after the Assembly Special Lesson than before. This result demonstrates that students may also have learned the merits of other professions through the classes using TBL. Students’ perspective of the medical profession may be expanded through the use of TBL.

With the results for domain 2 (“Understanding the role of each profession’s specialization”), the overall scores for all items were significantly higher after the Assembly Special Lesson than before. We believed that the students may have obtained a sense of the role of other occupations as a result of the lesson through solving the complex problems of patients in multidisciplinary groups. By means of IPE, students develop teamwork abilities and can learn from one another.³ Thus,

through IPE at a health university, students may be able to understand the role of different professional specializations. At the participating faculties, the various professions toward which the students were directing their studies were as follows: doctors, nurses, clinical laboratory technologists, physical therapists, occupational therapists, radiological technologists, clinical engineers, and medical information management officers. By being able to relate these professions to one another, the proper function of each presumably became clearer to the participating students. We did not include faculties for pharmacy, speech therapy, nutrition, and medical social work in the present study, but we supposed that the Special Assembly Lesson could also be applied to deepen students’ understanding of the professional roles in those areas.

With domain 3 (“Regarding participation in group work”), when conducting a discussion as a team, students listened to the various opinions of other members and they explained their own opinions. Accordingly, their ways of thinking were deepened through the two-way communication. TBL typically provides opportunities for team discussions, such as during team readiness assurance tests and application exercises. TBL frequently offers the chance for peers to enhance their learning as teammates talk and listen to one another before arriving at consensus decisions.¹⁷ Thus, with the domain “Regarding participation in group work,” the scores for the following were higher after the Assembly Special Lesson than before: “I speak to convey my thoughts to the other members”; “I strive to listen to the opinions of other members”; and “I take a flexible attitude when presented with opinions differing from my own.” In a study using the Readiness for Interprofessional Learning Scale (RIPLS)-a measure for evaluating IPE-it was reported that the scores for teamwork and collaboration significantly increased after IPE compared with before¹⁸; accordingly, IPE appears to have the effect of encouraging participation in group work. In TBL teaching methods, high cognitive ability is required to make multiple comparisons and discriminations through analyzing complex information.¹⁰ Participation is encouraged in active discussions to achieve cooperation among group members. Therefore, the scores for “I actively participate in group work as a member of the group” and “I strive to advance the group work by cooperating with other members” were higher after the Assembly Special Lesson than before.

In domain 4 (“Thoughts regarding the team in healthcare

and welfare”), the overall score was higher after the Assembly Special Lesson. We inferred this meant that students were able to learn that each profession has a particular responsibility in healthcare and welfare and that students were also able to grasp the importance of functioning as a team. The effective use of learning groups clearly requires that individual students are made accountable for class preparation¹⁹; it also means that teams are able to accomplish more than the sum of the individual members’ contributions.¹⁰ In the Assembly Special Lesson, each student had such responsibility, and students cooperated with other students from different faculties. Thus, we considered that through TBL, the students developed a deeper sense of the importance of working together in a medical and health team.

With domain 5 (“Feelings about cooperation among different professions”), the scores of the following items were significantly higher after the Assembly Special Lesson than before: “I think that cooperation among many professions leads to better health care by each profession”; and “I think there are common areas which any health, medical, and welfare professional would be able to perform.” Our results suggest that patient problems are better considered from many professional viewpoints, thereby leading to better care. Efforts to improve the quality of care are one of the most effective aspects of IPE.²⁰ We believe better patient care at a health university to be the goal of IPE. Health practitioners need to be able to use the knowledge they have personally acquired and also be able to solve problems by working effectively within a diverse team of health-care professionals and accessing the team’s combined knowledge.²¹ True team cohesion develops when learners begin to trust one another.¹⁰ When teams conduct problem-solving dialogues, they develop a synergy that maximizes the likelihood of producing the correct decision.^{10,22} In the present study, the student participants cooperated in teams through TBL when solving patient problems. TBL helped raise the students’ consciousness about the importance of cooperation in professional occupations, and we inferred that TBL led to students feeling that it allowed them to make a better contribution to health care.

From the above findings, we conclude that IPE with TBL enhanced the students’ understanding of the role of other professionals and encouraged active participation by the students in their group work. IPE with TBL also allowed the students to understand different professions with a sense of responsibility and cooperation, leading to better health care at the health university.

The correlation coefficient between the IPET scale and the total RIPLS score was 0.55; thus, criterion-related validity was secured. Cronbach’s alpha of each domain was 0.84–0.92, and so reliability was maintained.¹⁶ In our survey, using 40 items it was added 2 items to the IPET scale, we confirmed the correlation between the score before and after IPE in the same subjects. Spearman’s rank correlation coefficient was 0.318–0.658 ($P < 0.01$); thus, we confirmed the reproducibility. With the 40 items it was added 2 items to the IPET, Cronbach’s alpha of each domain was 0.78–0.96; therefore, reliability was maintained. Moreover, there was a significant correlation between the scores for the original 38-item IPET scale and our 40-item scale in domain 2 and the total score ($P < 0.001$); thus, criterion-related validity was secured.

The present study has some limitations. Since the study was based on self-assessment, there is the problem of objectivity.

However, except for missing values, the evaluation before and after the lesson was with the same students; therefore, we believe that there was no bias in the comparison before and after the lesson. There was no control group in this study, which we acknowledge to be an area of weakness and may affect the conclusions we have drawn.

In conclusion, it was suggested that medical and health students cooperating in teams and using TBL to solve patient problems enhanced the students’ understanding of the roles of other professionals and encouraged participation in group work. Furthermore, it was suggested that the Assembly Special Lesson underlined the importance of working together as a team and reinforced feelings of cooperation among the students. We conclude, therefore, that the health university students underwent valuable changes in their perceptions and attitudes toward professional cooperation as a result of IPE using TBL.

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Conflict of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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