《 Original Article 》

Educational Effects of Community-Participatory On-Site Training Underpinned by Multidisciplinary Collaboration

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Even before its integration with Hokkaido University of Science, Hokkaido College of Pharmacy (hereinafter, HCP) had, for a long time, aimed to nurture human resources capable of contributing to the local community. To this end, a three-day, community-participatory on-site training was conducted in Yubari City, Hokkaido, involving six departments of three educational institutions, including HCP Department of Pharmacy, Hokkaido University of Science Departments of Nursing, Physical Therapy, and Clinical Engineering, and Tenshi College Departments of Nursing and Nutrition, for the purpose of learning the importance of multidisciplinary collaboration in the context of community healthcare.

Participating students were organized into four groups and on-site training to acquire work experience in visiting medical care, visiting nursing care, and visiting pharmacy care was conducted. Before and after the on-site training, the degree of understanding and the degree of awareness of the need for the work of each profession were surveyed. In addition, each student was asked to come up with keywords related to community healthcare before and after the on-site training, and the number of keywords that matched those prepared in advance by faculty members was counted.

With regard to the degree of understanding and the degree of awareness of the need for the work of each profession, significant increases in almost all survey items were observed after the on-site training relative to before. Moreover, after the on-site training, there was a significant increase in the number of keywords provided by each student that matched those prepared by faculty members relative to before the training. These results objectively supported the educational effects that the on-site training aimed to provide. Promoting multidisciplinary collaborative education that transcends the boundaries of universities, academic disciplines, and departments is very useful in terms of understanding the necessity and importance of multidisciplinary collaboration, as well as understanding the role of each individual in the context of multidisciplinary collaboration.

Key words; multidisciplinary collaborative education, on-site training, community healthcare, home-care

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1. Introduction

As a result of the aging of society, medical care has become far more complex, and the Ministry of Health, Labour and Welfare of Japan has been promoting the development of a comprehensive community care system[1]. This phenomenon has also increased the need for home-care in the community as well as for pharmacists to become involved in home-care in collaboration with physicians and nurses[2]. Six-year undergraduate pharmacy education was implemented in FY2006, the aim of which was to train pharmacists who are able to work as a member of team-based healthcare and contribute to patient medical care and treatment as a specialist of pharmaceuticals. In FY2015, the Model Core Curriculum for Pharmacy Education was revised[3] to include an "outcome-based education" system as a requirement for pharmacy education. Among the 10 "Professional Core Competencies for Pharmacists" specified in this Core Curriculum are "inter-professional team care" and "community health and medical care", and these have become essential for future education.

Hokkaido College of Pharmacy (HCP; presently Hokkaido University of Science Faculty of Pharmaceutical Sciences) had, for a long time, offered education aimed at nurturing human resources capable of contributing to the local community. Even after its integration with Hokkaido University of Science (which, at that time, was composed of the Faculty of Health Sciences, the Faculty of Engineering, and the Faculty of Future Design) in April 2018, this educational policy has been upheld.

Previously, we reported the effects of providing students opportunities for actual experiences at multiple medical institutions, nursing care and welfare facilities, and home-care sites in medically underserved areas. This endeavor has been initiated as part of the Good Practice Project of the Ministry of Education, Culture, Sports, Science and Technology, with the full cooperation of Yubari Municipal Clinic in Yubari City, Hokkaido, since 2007[4].

In addition, in our on-site training entitled, "Learn with multidisciplinary students! – Hands-on community healthcare," which has been conducted since 2009 in the same city (Yubari City), student volunteers experienced home-care during spring vacation for the purpose of learning the importance of multidisciplinary collaboration in the community healthcare setting.

Previously, HCP also jointly offered on-site training with the Department of Nursing and the Department of Nutrition, Faculty of Nursing and Nutrition at Tenshi College (Sapporo City; hereinafter, Tenshi College Departments of Nursing and Nutrition), which has concluded an inter-institutional collaborative education and research agreement with HCP. The contents of the on-site training as well as its educational effects have been reported elsewhere[5].

This time, a total of six departments at three educational institutions, including HCP Department of Pharmacy, Tenshi College Departments of Nursing and Nutrition, and new participants, namely, the Department of Nursing, the Department of Physical Therapy, and the Department of Clinical Engineering of the Faculty of Health Sciences at Hokkaido University of Science (hereinafter, Hokkaido University of Science Departments of Nursing, Physical Therapy, and Clinical

Engineering), jointly conducted a three-day on-site training targeting the students of these departments, in collaboration with Yubari Municipal Clinic and AIN Pharmaciez, Inc., both of which have concluded a community-based collaboration agreement (the agreement has been continued even after the integration) with HCP. Herein we report the implementation of this community-participatory on-site training.

2. Methods

1. On-site training

1) Participants

The participants were 28 first- to third-year students (11 males and 17 females) from six departments at three educational institutions (i.e., HCP Department of Pharmacy; Hokkaido University of Science Departments of Nursing, Physical Therapy, and Clinical Engineering; and Tenshi College Departments of Nursing and Nutrition), who wished to attend the present training.

The participants included 14 second-year students from HCP Department of Pharmacy; six first- and second-year students, three first-year students, and one first-year student from Hokkaido University of Science Department of Nursing, Department of Physical Therapy, and Department of Clinical Engineering, respectively; and two second-year students and two third-year students from Tenshi College Department of Nursing and Department of Nutrition, respectively.

2) Implementation period

The on-site training was performed for a three-day period spanning March 3 through 5, 2018.

3) Implementation site

The on-site training was conducted at Yubari Municipal Clinic, a long-term healthcare facility located in Yubari, and patients' homes, and consisted of the following items: visiting medical care, visiting nursing care, and physical and occupational therapy (Yubari Municipal Clinic); watching nutritionists perform food intake observation (long-term healthcare facility); visiting pharmacy care (AIN Pharmaciez, Inc.); and clinical engineering work.

4) Implementation method

Prior to the on-site training period, a 60-minute introductory lecture was given at each educational institution. On the first day of the on-site training, a 60-minute guidance was provided at Yubari Municipal Clinic. The students were organized into four groups of seven students each, in a manner that ensured an even distribution of students from different departments/years to the extent possible, and the training was conducted.

The outline of the on-site training is shown in Figure 1.

The contents of the on-site training included the following: accompanying staff during visiting medical care/visiting nursing care/visiting pharmacy care; experiencing the work of physical or occupational therapists; watching nutritionists perform food intake observation; and experiencing the work of clinical engineers (Table 1).

As for "accompanying staff during visiting medical care/visiting nursing care/visiting pharmacy care" and "experiencing the work of physical or occupational therapists", each of these was a three-hour on-site training and students participated by rotation. Regarding "watching nutritionists perform food intake observation", this was carried out during lunchtime over the course of the three-day training period.

	5th (Mon)				6th (Tue)				7th (Wed)		
	am 9:00–12:00	Lunch break	pm 13:00–16:00	Other	am 9:00–12:00	Lunch break	pm 13:00–16:00	Other	am 9:00–12:00	Lunch break	pm 13:00–15:30
Visiting medical care	Travel from Sapporo to Yubari Guidance Questionnaire survey	Watch nutritionists perform food intake observation at the long-term healthcare facility (Group 1) (15 minutes)	C	16:00–17:00 Watch "conference video" (30 minutes) Supplementary lectures: - Visiting nurse - Physician 19:00–20: 00 Discussion / Preparation for presentation (60 minutes)	B	Watch nutritionists perform food intake observation at the long-term healthcare facility (Group 2) (15 minutes)	A	16:00–17:15 Supplementary lectures: -Clinical engineer -Hospital pharmacist -Community pharmacist -Dentist 19:00–20:00 Discussion/ Preparation for presentation (60 minutes)	D	Watch nutritionists perform food intake observation at the long-term healthcare facility (Group 3) (15 minutes)	Presentation/ Discussion/ Summary (60 minutes) Questionnaire survey 15:30– Travel from Yubari to Sapporo
Visiting nursing care			B		A		D		C		
Visiting pharmacy care					D		C		A・B		
Occupational therapy/ Experiencing home-based oxygen therapy			(Occupational therapy) A Visit patient at home D Rehabilitation room		(Occupational therapy) C Rehabilitation room		(Experiencing home-based oxygen therapy) B				

Figure 1　Outline of on-site training

Lecture contents:
Visiting nurse: Content of work in visiting nursing care setting, multidisciplinary collaboration (15 minutes)
Physician: Content of work in visiting medical care setting, multidisciplinary collaboration (15 minutes)
Clinical Engineer: Content of work in community healthcare setting (30 minutes)
Hospital pharmacist: Content of work in community healthcare setting, pharmacist-pharmacist collaboration (15 minutes)
Community pharmacist: Content of work in visiting pharmacy care setting, multidisciplinary collaboration, inter-facility collaboration (15 minutes)
Dentist: Content of work in visiting dental care setting (15 minutes)
Groups: Group A, n = 7; Group B, n = 7; Group C, n = 7; Group D, n = 7

(watch nutritionists perform food intake observation at long-term healthcare facility: Group 1, n = 9; Group 2, n = 9; Group 3, n = 10)

Table 1　Items and contents of on-site training

Item	Content
Visiting medical care	Accompanying staff during visiting medical care in home-care setting
Visiting nursing care	Accompanying staff during visiting nursing care in home-care setting
Visiting pharmacy care	Accompanying staff during visiting pharmacy care in home-care setting
Physical and occupational therapy	Experiencing the work of physical or occupational therapists in home-care or rehabilitation room setting
Work of nutritionists	Watching nutritionists perform food intake observation at a long-term healthcare facility
Clinical engineering work	Experiencing the work of clinical engineers in home-care setting (experience home-based oxygen therapy)

As regards “experiencing the work of clinical engineers”, only one group was able to participate; thus, a lecture and hands-on equipment experience were provided to all students after completing the work experience on the 2nd day. After completing the work experience on the 1st and 2nd days, a roughly 60-minute-long supplementary lecture of the above contents was held, followed by a discussion. In the supplementary lecture, the work content of each profession was explained from the perspective of each department/unit involved in community healthcare and visiting care. After that, the students participated in a question and answer session and discussion to address questions arising from their experiences and share their experiences.

Furthermore, after completing the work experience and the supplementary lecture on the 1st and 2nd days, each of the members of the four groups discussed what they had experienced by group, and summarized their discussions at the accommodation facility in Yubari City. Then, after completing their on-site training on the 3rd day, in front of all participants, the students made a presentation of the results of their group discussion as well as their future academic goals and aspirations when they become members of the society in their respective professions.

Due to scheduling conflicts, it was difficult for all of the students to participate in the on-site training held at Yubari Municipal Clinic. Accordingly, students watched the conference video.

2. Questionnaire survey

1) Methods

Questionnaire surveys were conducted before and after the on-site training (after guidance in the morning of the 1st day, and after the presentation in the afternoon of the 3rd day), regarding the degree of understanding and the degree of awareness of the need for each content on a 7-point scale (I don't think so at all → I strongly think so). In addition, the questionnaire also had a free comment section regarding community healthcare and home-care.

Moreover, each student was asked to come up with keywords regarding community healthcare before and after the on-site training, and points were calculated for each student in the following manner: when a keyword the student came up with matched one of those prepared in advance by two faculty members, one point was given. With regards to the keywords, their validity was examined after they were presented by faculty members. The faculty members referred to the literature when they found it difficult to determine the validity of the keywords. These points were used as a measure of educational effects.

The questionnaire used before the on-site training comprised seven questions pertaining to the degree of understanding and the degree of awareness of need; four questions pertaining only to the degree of understanding, and 13 other questions; the questionnaire also contained a free comment section for three items and an entry column for keywords.

The questionnaire used after the on-site training comprised seven questions pertaining to the degree of understanding and the degree of awareness of need; four questions pertaining only to the degree of understanding, and 15 other questions, with a free comment section for seven items and an entry column for keywords.

The main items in the questionnaire were as follows:

- About community healthcare and home-care
- The role of each profession (physician, nurse,

pharmacist, occupational (physical) therapist, clinical engineer) in the community and home-care settings

- Multidisciplinary collaboration (physician - nurse - nutritionist - pharmacist - occupational (physical) therapist - clinical engineer)

A portion of the questionnaire used before the on-site training is shown in Figure 2.

2) Collection of questionnaires

All students answered the items in the questionnaires for both before and after the on-site training.

About "Practicing Community Healthcare" (before on-site training)

Please describe or rate your response on a 7-point scale
(1: I don't think so at all → 7: I strongly think so)

1. What motivated you to participate in this on-site training?

2. What is your idea of "community healthcare"?

3. What do you want to learn through this on-site training?

4. About community healthcare

I understand.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I think it is necessary.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

5. About home-care

- Visiting medical care (physician): **I understand.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I think it is necessary.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
- Visiting nursing care (nurse): **I understand.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I think it is necessary.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
- Visiting pharmacy care (pharmacist): **I understand.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I think it is necessary.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

6. About each profession in community healthcare

- Role of each profession (physician, nurse, pharmacist, occupational (physical) therapist, clinical engineer) in home-care setting:

I understand.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

7. About intention to contribute

- I would like to contribute to community healthcare.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
- I would like to contribute to home-care.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Figure 2 Example of questionnaire used before on-site training

3) Data analysis

Questionnaire scores are presented as means ± standard error (S.E.). Comparisons of scores before and after the on-site training were performed using the paired t-test, and $p < 0.05$ was considered statistically significant.

It should be noted that because some departments had a small number of students, when performing data analyses by department, the total number of students from the Department of Nursing and the Department of Nutrition was used for Tenshi College, and the Department of Clinical Engineering at Hokkaido University of Science was excluded.

4) Ethical considerations

This study was conducted after receiving approval that no application to the Ethics Committee of Yubari Municipal Clinic was necessary.

With regard to informed consent, the purpose, methods, consent by free will, and privacy protection were explained, and the study was conducted after obtaining informed consent.

3. Results

1. Work of each profession in home-care setting

Before the on-site training, the scores for the degree of understanding of "visiting medical care", "visiting nursing care", and "visiting pharmacy care" were low at 3.82 ± 1.19, 3.89 ± 1.20, and 3.93 ± 1.33, respectively. On the other hand, the scores for the awareness of the need for each of those were high at 6.18 ± 1.02, 6.29 ± 1.05, and 6.07 ± 1.12, respectively.

After the on-site training, the scores for the degree of understanding of each of the above items significantly increased (5.46 ± 0.84, 5.61 ± 0.99, and 5.71 ± 1.08, respectively). Similarly, the scores for the degree of awareness of the need for each of the above items also increased (6.75 ± 0.59, 6.75 ± 0.59, and 6.71 ± 0.60, respectively) (Table 2).

Table 2 Changes in degree of understanding and degree of awareness of need before and after on-site training

Survey item (Question contents in the questionnaire)	I understand.			I think it is necessary.		
	Before on-site training	After on-site training	Significant difference	Before on-site training	After on-site training	Significant difference
Visiting medical care	3.82 ± 1.19	5.46 ± 0.84	*	6.18 ± 1.02	6.75 ± 0.59	*
Visiting nursing care	3.89 ± 1.20	5.61 ± 0.99	*	6.29 ± 1.05	6.75 ± 0.59	*
Visiting pharmacy care	3.93 ± 1.33	5.71 ± 1.08	*	6.07 ± 1.12	6.71 ± 0.60	*
Role of each profession (physician, nurse, pharmacist, occupational (physical) therapist, clinical engineer) in home-care setting	3.89 ± 1.34	5.64 ± 0.95	*	—	—	
Multidisciplinary collaboration (physician - nurse - nutritionist - pharmacist - occupational (physical) therapist - clinical engineer)	4.46 ± 1.32	5.82 ± 0.86	*	6.54 ± 0.79	6.64 ± 0.73	N.S.
Information sharing in multidisciplinary collaboration (e.g., conferences)	4.29 ± 1.18	5.68 ± 1.02	*	6.50 ± 0.79	6.82 ± 0.61	*
Community healthcare	4.14 ± 1.15	5.46 ± 0.88	*	6.39 ± 1.07	6.75 ± 0.52	*
Home-care (as a whole)	4.36 ± 1.16	5.32 ± 1.06	*	6.43 ± 0.92	6.64 ± 0.73	N.S.

Mean ± S.E., n = 28,*: $p < 0.05$ (before on-site training vs. after on-site training), N.S.: not significant

With respect to "visiting pharmacy care", we plotted the degree of understanding against the degree of awareness of the need for such care. Before the on-site training, the degree of understanding was low, whereas the degree of awareness of need was high. After the on-site training, both the degree of understanding and the degree of awareness of need increased (Figure 3). Although data are not shown, similar trends were observed for "visiting medical care" and "visiting nursing care."

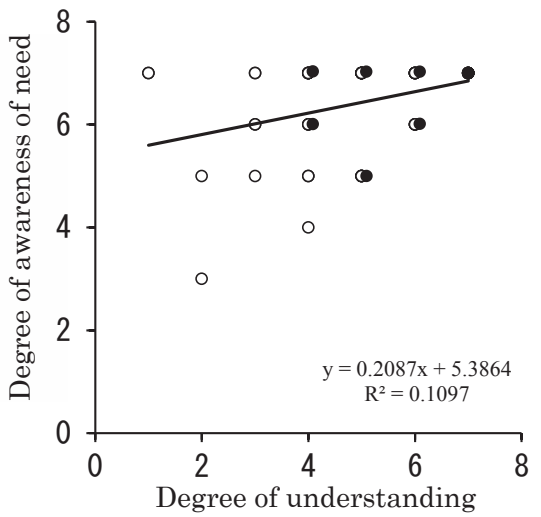

Figure 3 Degree of understanding vs. degree of awareness of need for visiting pharmacy care

○before on-site training, ●after on-site training, n = 28
Each point may contain duplicates

2. Role of each profession in home-care setting

The score for the degree of understanding of the "role of each profession in home-care setting (physician, nurse, pharmacist, occupational (physical) therapist, clinical engineer)" was significantly increased after the on-site training relative to before, from 3.89 ± 1.34 to 5.64 ± 0.95 (Table 2).

3. Multidisciplinary collaboration and information sharing among various professions

With respect to "multidisciplinary collaboration (physician - nurse - nutritionist - pharmacist - occupational (physical) therapist - clinical engineer)" among various professions, before the on-site training, the score for the degree of understanding was low (4.46 ± 1.32) compared with the score for the degree of awareness of need (6.54 ± 0.79), but after the on-site training, the score for the degree of understanding was significantly increased (5.82 ± 0.86). However, there was no significant difference in scores for the degree of awareness of need before and after the on-site training (6.54 ± 0.79 and 6.64 ± 0.73, respectively) (Table 2).

With respect to "information sharing in multidisciplinary collaboration (e.g., conferences)", before the on-site training, the score for the degree of understanding was low (4.29 ± 1.18) compared with the score for the degree of awareness of need (6.50 ± 0.79), but after the on-site training, the scores for both were significantly increased (5.68 ± 1.02 and 6.82 ± 0.61, respectively) (Table 2).

We also analyzed by department the scores for the degree of understanding of "multidisciplinary collaboration (physician - nurse - nutritionist - pharmacist - occupational (physical) therapist - clinical engineer)" among various professions. Significant increases were observed after the on-site training relative to before for all departments except Hokkaido University of Science Department of Nursing (Figure 4).

4. Regarding community healthcare and home-care

With respect to "community healthcare", before the on-site training, the score for the degree of

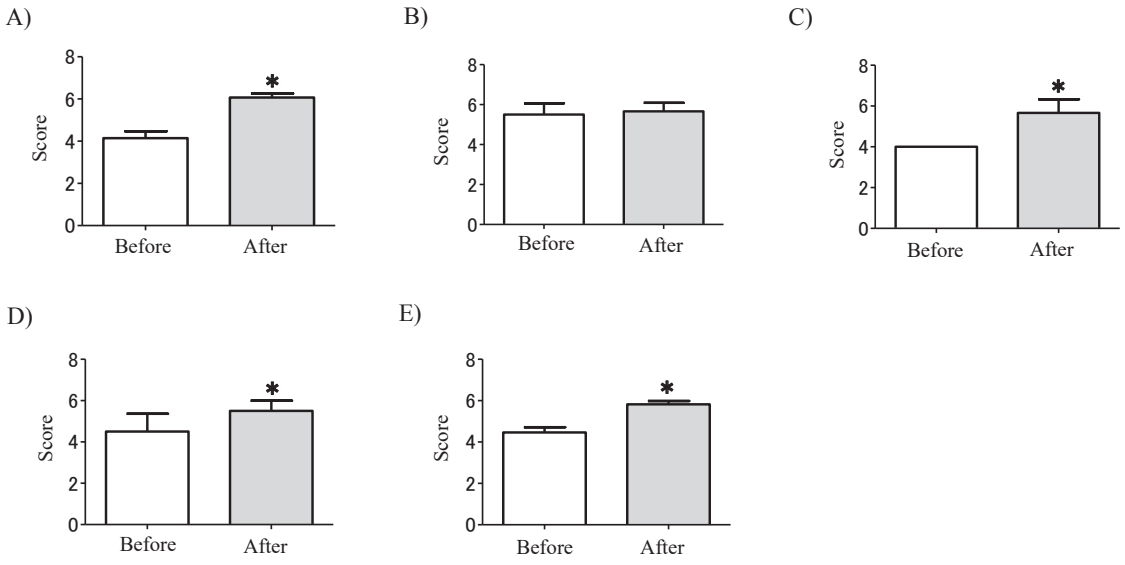

Figure 4 Changes in degree of understanding of multidisciplinary collaboration before and after on-site training

A: Hokkaido College of Pharmacy (before integration) (Department of Pharmacy), n = 14;
B: Hokkaido University of Science (Department of Nursing), n = 6;
C: Hokkaido University of Science (Department of Physical Therapy), n = 3;
D: Tenshi College (Departments of Nursing and Nutrition), n = 4;
E: three educational institutions/six departments (include one student at Hokkaido University of Science Department of Clinical Engineering), overall, n = 28;
Mean ± S.E., n = 28, *: $p < 0.05$ (before on-site training vs. after on-site training)

Table 3 Changes before and after on-site training

Survey item (Question contents in the questionnaire)		Before on-site training	After on-site training	Significant difference
About intention to contribute	I would like to contribute to community healthcare.	5.46 ± 1.29	6.11 ± 1.17	*
	I would like to contribute to home-care.	5.39 ± 1.37	5.96 ± 1.20	*
It is meaningful to learn with students other than pharmacy students (or nursing/nutrition students, or health sciences students).		5.89 ± 1.20	6.64 ± 0.78	*
I think it will be useful in the future (when I become a pharmacist, nurse, nutritionist, physical therapist, or clinical engineer).		6.14 ± 1.04	6.64 ± 0.78	*
Hands-on, on-site training is meaningful as it offers an opportunity to learn things that are otherwise not available through university classes.		6.18 ± 0.90	6.68 ± 0.72	*
It increases motivation for future study.		5.96 ± 1.10	6.43 ± 0.84	*

Mean ± S.E., n = 28,*: $p < 0.05$ (before on-site training vs. after on-site training)

awareness of the need was originally high at 6.39 ± 1.07, whereas the score for the degree of understanding was low at 4.14 ± 1.15. However, the scores for both were significantly increased after the on-site training (6.75 ± 0.52 and 5.46 ± 0.88, respectively) (Table 2).

With respect to "home-care", before the on-site training, the score for the degree of understanding was low (4.36 ± 1.16) compared with the score for the degree of awareness of need (6.43 ± 0.92), but after the on-site training, the score for the degree of understanding was significantly increased (5.32 ± 1.06). However, there was no significant difference in scores for the degree of awareness of need before and after the on-site training (6.43 ± 0.92 and 6.64 ± 0.73, respectively) (Table 2).

Moreover, with respect to "I would like to contribute to community healthcare" and "I would like to contribute to home-care", significant increases were observed after the on-site training relative to before (from 5.46 ± 1.29 to 6.11 ± 1.17, and from 5.39 ± 1.37 to 5.96 ± 1.20, respectively) (Table 3).

Analysis of scores for the degree of understanding of "community healthcare" by department revealed that except Hokkaido University of Science Department of Nursing, all departments showed a significant increase after the on-site training relative to before (Figure 5).

Analysis of scores for the degree of understanding of "home-care" by department revealed that except Hokkaido University of Science Department of Nursing and Physical Therapy, all departments showed a significant increase after the on-site training relative to before (Figure 6).

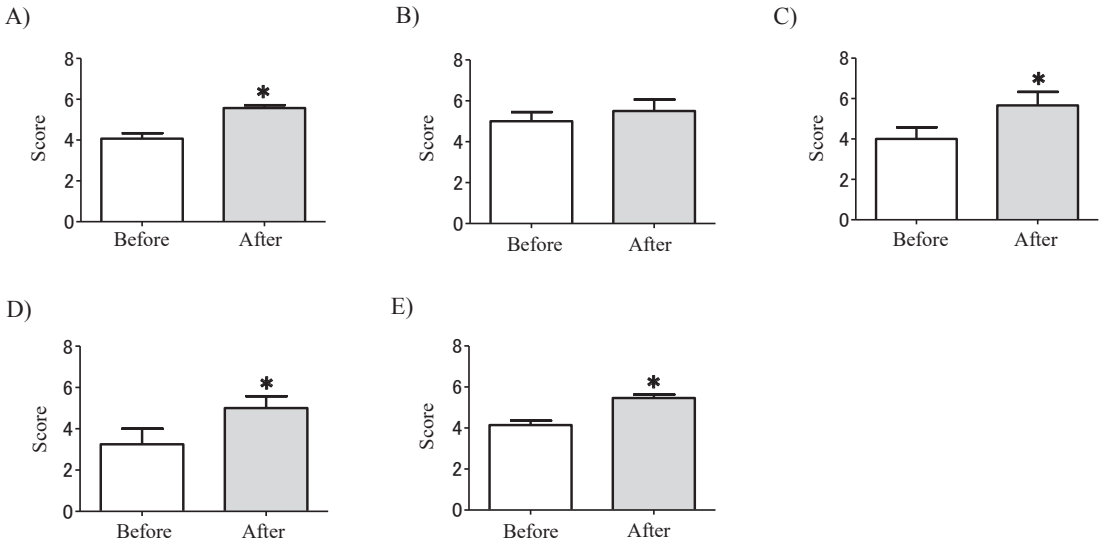

Figure 5 Changes in degree of understanding of community healthcare before and after on-site training

A: Hokkaido College of Pharmacy (before integration) (Department of Pharmacy), n = 14;
B: Hokkaido University of Science (Department of Nursing), n = 6;
C: Hokkaido University of Science (Department of Physical Therapy), n = 3;
D: Tenshi College (Departments of Nursing and Nutrition), n = 4;
E: three educational institutions/six departments (include one student at Hokkaido University of Science Department of Clinical Engineering), overall, n = 28;
Mean ± S.E., n = 28, *: $p < 0.05$ (before on-site training vs. after on-site training)

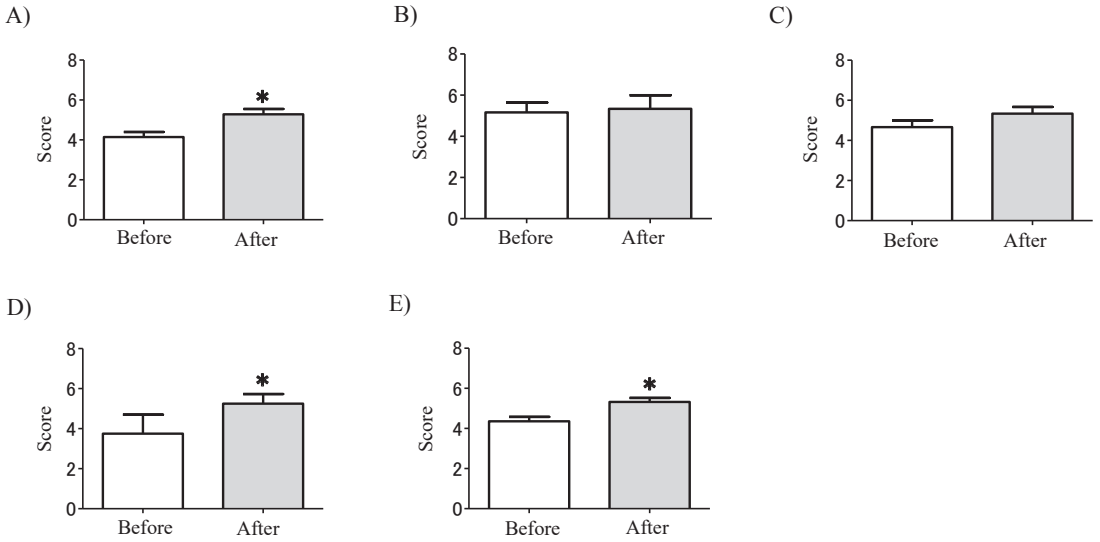

Figure 6　Changes in degree of understanding of home-care before and after on-site training

A: Hokkaido College of Pharmacy (before integration) (Department of Pharmacy), n = 14;
B: Hokkaido University of Science (Department of Nursing), n = 6;
C: Hokkaido University of Science (Department of Physical Therapy), n = 3;
D: Tenshi College (Departments of Nursing and Nutrition), n = 4;
E: three educational institutions/six departments (include one student at Hokkaido University of Science Department of Clinical Engineering), overall, n = 28;
Mean ± S.E., n = 28, *: $p < 0.05$ (before on-site training vs. after on-site training)

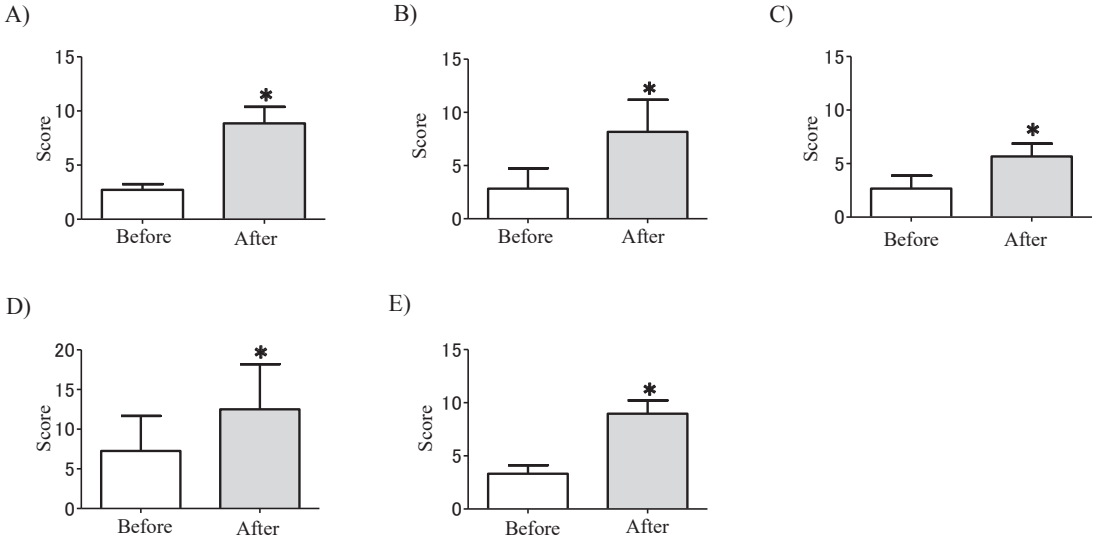

Figure 7　Educational effects before and after on-site training by keyword presentation

A: Hokkaido College of Pharmacy (before integration) (Department of Pharmacy), n = 14;
B: Hokkaido University of Science (Department of Nursing), n = 6;
C: Hokkaido University of Science (Department of Physical Therapy), n = 3;
D: Tenshi College (Departments of Nursing and Nutrition), n = 4;
E: three educational institutions/six departments (include one student at Hokkaido University of Science Department of Clinical Engineering), overall, n = 28;
Mean ± S.E., n = 28, *: $p < 0.05$ (before on-site training vs. after on-site training)

5. About on-site training with students from different academic disciplines

With regard to "It is meaningful to learn with students other than pharmacy students (or nursing/nutrition students, or health sciences students)", a significant increase in score was observed after the on-site training relative to before, from 5.89 ± 1.20 to 6.64 ± 0.78 (Table 3).

Moreover, with regard to "It increases motivation for future study", a significant increase in score was observed after the on-site training relative to before, from 5.96 ± 1.10 to 6.43 ± 0.84 (Table 3).

6. Keywords related to community healthcare

In terms of the number of keywords that students came up with as relating to community healthcare, significant increases were observed after the on-site training relative to before in HCP Department of Pharmacy, Hokkaido University of Science Departments of Nursing and Physical Therapy, and Tenshi College Departments of Nursing and Nutrition. Among the six departments of the three educational institutions, overall, the score was 3.32 ± 0.80 before the on-site training and 8.96 ± 1.25 after, showing a significant increase (Figure 7).

4. Discussion

The results of the questionnaire survey of the work of each profession in the home-care setting indicated significant increases in scores for the degree of understanding as well as the degree of awareness of the need for "visiting medical care", "visiting nursing care", and "visiting pharmacy care" after the on-site training. When the relationship between the degree of understanding and the degree of awareness of the need for "visiting pharmacy care" was plotted, a characteristic trend was observed, namely, whereas the scores for the degree of awareness of need were high even before the on-site training, those for the degree of understanding were low. On the other hand, after the on-site training, both scores for the degree of understanding and the degree of awareness of need were high. Moreover, given that there was a further increase in score for the awareness of need, which was originally high, relative to before the on-site training, we presumed that the degree of awareness of need increased even more after the on-site training because of the increase in the degree of understanding relative to before. Similar trends were noted in the scores for "visiting medical care" and "visiting nursing care", suggesting that similar factors to those related to "visiting pharmacy care" might have been involved.

With regard to the role of each profession, the score for the degree of understanding of the "role of each profession (physician, nurse, pharmacist, occupational (physical) therapist, clinical engineer) in the home-care setting" showed a significant increase after the on-site training relative to before. In addition to experiencing the work of each profession, supplementary lectures were provided afterwards, and in some cases, discussions evolved into those related to the importance within communities. This likely helped students better understand the role of each profession.

After the on-site training, the score for the awareness of the need for "multidisciplinary collaboration (physician - nurse - nutritionist - pharmacist - occupational (physical) therapist - clinical engineer)" was 6.64 ± 0.73, and that for "information sharing in multidisciplinary collaboration (e.g., conferences)" was 6.82 ± 0.61,

which was the highest of all scores in the on-site training. In the on-site training, the multidisciplinary work experience contributed to an increased understanding of multidisciplinary collaboration. This likely resulted in the increased scores after the on-site training, suggesting that the training is useful for learning hands-on the necessity of multidisciplinary collaboration.

In the present study, whereas a significant difference was observed with respect to "information sharing in multidisciplinary collaboration (e.g., conferences)", no significant difference was observed with respect to the awareness of the need for "multidisciplinary collaboration (physician - nurse - nutritionist - pharmacist - occupational (physical) therapist - clinical engineer)". As a related factor, we noted that the original score (i.e., before the on-site training) for "multidisciplinary collaboration" was 6.54 ± 0.79, which was the highest of all scores; this might explain why there was no significant difference. Another possibility was that because it was rare to have people of other professions present during work experience particularly in a patient's home, significant differences might not have been detected.

As for the items "it is meaningful to learn with students other than pharmacy students (or nursing/nutrition students, or health sciences students)" and "it increases motivation for future study", the scores were significantly increased after the on-site training relative to before. In addition, during the on-site training, students from different departments acted together in groups, and at the time of discussion as well, they were able to carry out discussions from their respective knowledge bases and perspectives. As such, learning and discussions with students from different academic disciplines might have further increased their understanding of different professions as well as their awareness of the need for multidisciplinary collaboration.

With regard to "community healthcare", which includes the present on-site training, there were significant increases in scores for the degree of understanding and the degree of awareness of need. Significant increases in scores were also observed for the degree of understanding of "home-care", "I would like to contribute to home-care", and "I would like to contribute to community healthcare" after the on-site training. However, there was no significant difference in the degree of awareness of the need for "home-care". This may be because a high score of 6.43 ± 0.92 was originally noted before the on-site training and the difference was not statistically significant even though the score increased to 6.64 ± 0.73 after.

When the analyses were performed by department (Figures 4 to 6), Hokkaido University of Science Department of Nursing showed no significant differences in scores for the degree of understanding of "multidisciplinary collaboration (physician - nurse - nutritionist - pharmacist - occupational (physical) therapist - clinical engineer, Figure 4B)", "community healthcare (Figure 5B)", and "home-care (Figure 6B)", after the on-site training relative to before. This might be because four of the six students had participated in the same on-site training in the previous school year, and also, their scores before the on-site training were high.

Hokkaido University of Science Department of Physical Therapy also showed no significant difference when scores for the degree of understanding of "home-care" before and after the

on-site training were compared. Hokkaido University of Science Department of Physical Therapy offers a requisite lecture course entitled "Theory of team medical care" in the first semester of the first year, where students learn about team-based healthcare as well as the roles of other professions. It was thus likely that because all students of this Department who participated in the present on-site training were first-year students and had taken the above-mentioned course, their scores were high before the on-site training. This might explain the observed trend.

The results of the questionnaire surveys revealed that many students felt the need for most items, even though their levels of understanding of those items were low before participating in the on-site training. As for the cause, we presumed that because the students have learned about community healthcare and contents related to home-care in other lectures and courses, they might have felt that community healthcare and home-care were necessary; meanwhile, they have not yet acquired a sufficient understanding of the contents due to lack of experience.

Teshima *et al.* reported that among the three educational institutions, a survey targeting students who had taken inter-university credit-exchangeable courses in fields related to home-care and community healthcare revealed that the educational effects of each specialized education were significantly increased in the "lecture plus exercise or practical training group" compared with the "lecture-only group"[6].

We presumed that through participation in the on-site training, the students were able to gain awareness of the need accompanied by understanding.

This was also reflected in the presentation of keywords related to community healthcare, namely, the mean value for all students before the on-site training was 3.32 ± 0.80, whereas that after was 8.96 ± 1.25. That a significant increase was observed in scores across all the three institutions suggested that objective evaluation was feasible.

In addition, the number of keywords presented before and after the on-site training by students of Tenshi College was larger than that by students of the other institutions. This could be attributed to the fact that one of the four students of Tenshi College had a deep interest in community healthcare and did self-study prior to the training. The fact that this student's scores before and after the on-site training were extremely high at 20 and 29, respectively, was considered one of the factors contributing to the large number of keywords. The scores before and after the on-site training for only the other three students were 3.00 ± 3.00 and 7.00 ± 3.61, respectively, and were almost the same as the average scores for all students of 3.32 ± 0.80 and 8.96 ± 1.25, respectively. The above-mentioned possibility was further inferred on the basis of these findings.

Currently, multidisciplinary collaborative education has been introduced as part of undergraduate education in many medical universities, as well as in universities that have a faculty of pharmaceutical sciences[7–10]. There are several learning methods for multidisciplinary collaborative education and in many cases, problem-based learning (PBL)[11–13], case study[9], and role play[14] are used; however, on-site training is rarely offered[10]. Moreover, there are few instances in which multidisciplinary collaborative education is offered with the Faculty of Pharmaceutical Sciences at the core, and only a few

cases have examined its educational effects[9, 11, 14].

Ogura *et al*. showed that in first-year professional collaborative education using the PBL style, organizing groups among students from four faculties (Faculties of Medicine, Dentistry, Pharmaceutical Sciences, and Health Sciences) and six departments was effective in promoting mutual understanding among students[13].

In our present study as well, we showed that conducting hands-on practical training of students from six departments by organizing them into groups had valid educational effects.

We think that a comprehensive understanding of community healthcare was gained through the following approaches. First, in order to deepen understanding of the local community, on-site training was conducted with focus on home-care, which involved visiting various homes rather than limiting training to only a single facility. Second, students not only learned the contents of work of respective professions but also experienced multidisciplinary collaboration. Third, in addition to on-site training, a pre-training lecture, post-experience supplementary lectures, and discussions were carried out, which might have enabled students to learn while retaining knowledge they have acquired.

The results of the on-site training and questionnaire surveys suggested that students were able to understand the importance of multidisciplinary collaboration through comprehensive experience of community healthcare involving multiple departments in Yubari City, where community healthcare has been proactively implemented.

It is considered that by conducting the on-site training, it may be possible to develop professionals who are capable of playing a key role in collaboration with society, through comprehensive learning of team-based healthcare centered on home-care. In terms of contribution to community healthcare, we would like to enhance the awareness of the need in future learning.

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