

The Evolution of Occupational Therapy Profession in Korea

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Abstract: In Korea, the first national occupational therapy licensing examination was administered by the National Institute of Health in 1965 since it was introduced in the early 1950's. Although it has been a half century from its beginning, the actual commencement of occupational therapy in Korean society was not until 1993 when the Korean Association of Occupational Therapists (KAOT) was founded. It became a full member of WFOT (World Federation of Occupational Therapists) in 1998. The conventional educational program began in 1979 at Yonsei University. Within the last four years, twenty-three new occupational therapy programs have launched nationwide, and there are total of twenty-four occupational therapy programs as of December 2002. From year 2006, nine hundred new graduates are expected to be licensed every year. The KAOT is working on five projects to achieve a qualitative growth of the occupational therapy profession.

Key words: Korea, Occupational therapy, History, KAOT

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Introduction

Occupational therapy was introduced in Korea by Americans at the end of the Korean War (1950–1953). Although it has been a half century from its beginning, the actual commencement of occupational therapy in Korean society was not until 1993 when the Korean Association of Occupational Therapists (KAOT) was founded (Lee, 1998). This article briefly describes the development and the current status of the

occupational therapy profession in Korea.

The Beginning Stage

According to Dunton (1954), the first occupational therapy service was provided for the Korean War veterans at the National Rehabilitation Center in Busan, which was funded by AKF (American Korean Foundation) and UNKRA (United Nations Korean Reconstruction Agency). In 1957, Esther Park, a Korean-American occupational therapist, educated medical ancillaries of the US Navy, and they provided occupational therapy at the military hospital. By 1968, three occupational therapy clinics had opened and foreign occupational therapists were providing services. Since most

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Table 1. Occupational therapy training institutions

Training institutions	The year of inauguration	Number of trainee (s)
Catholic University Yeoido Hospital	1980	2
Catholic University Gangnam Hospital	1975	3
Korea University Guro Hospital	1985	3
Korea University Ahnam Hospital	1975	2
Busan Merinol Hospital	1975	1
Seoul National University Hospital	1975	2
Yonsei University Hospital	1975	3
Jeonju Jesus Hospital	1975	3
Hanyang University Hospital	1975	1

Table 2. National occupational therapy licensing examination pass rates

Year	Count	# Passing	% Passing	Total
1965	3	0	0	0
1969	1	1	100	1
1974	3	3	100	4
1976	1	1	100	5
1977	1	1	100	6
1978	2	2	100	8
1979	1	1	100	9
1980	5	5	100	14
1982	3	3	100	17
1983	9	9	100	26
1984	11	10	100	36
1985	10	10	100	46
1986	18	12	66.6	58
1987	24	23	95.8	81
1988	25	20	80.8	101
1989	23	21	91.3	122
1990	18	18	100	140
1991	39	39	100	179
1992	35	35	100	214
1993	32	31	96.9	245
1994	21	21	100	266
1995	25	23	92.0	289
1996	33	30	90.9	319
1997	29	28	96.5	347
1998	27	25	92.6	372
1999	25	25	100	397
2000	22	20	90.9	417
2001	83	65	78.3	482
2002	177	117	66.1	599

occupational therapy evaluation and treatment tools were not available at that time, the therapists had the clients make the tools and experience the real works such as making stove pipes or water

pipes. They also tried to integrate traditional Korean games into occupational therapy intervention and even performed activity analysis of Je-Gih-Cha-Gih (a kind of shuttlecock game

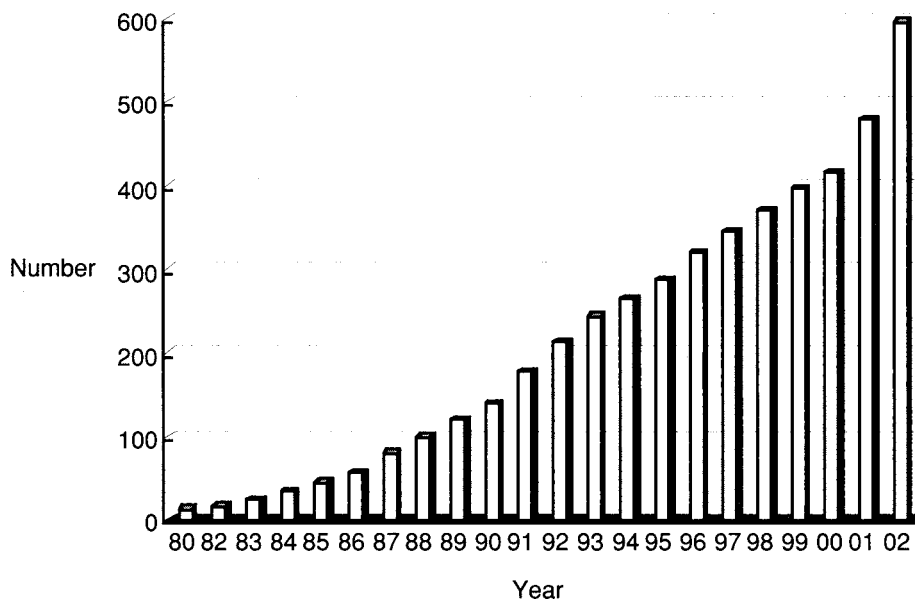


Fig. 1. Accumulated number of occupational therapists

played with the feet) reflecting the root philosophy of “occupation work” (O, 1994; Reed, 1993).

The Developing Stage

The first national occupational therapy licensing examination was administered by the National Institute of Health in 1965, but no one had passed the examination until 1969 (Lee, 1998). In 1969, Gui-Ja Choi, who was educated by Esther Park, became the first Korean occupational therapist. Back then, the target trainees for occupational therapy education were physical therapists, and they became occupational therapists by going through a one-year training program and taking the national board examination (Table 1). The conventional educational program began in 1979 at Yonsei University. By then, only nine Korean occupational therapists had been licensed (Jeong, Choi, & Lee, 2000). By year 2000, four hundred seventeen occupational therapists had been licensed, and about half of them were actively practicing (Table 2, Fig. 1).

The Korean Association of Occupational

Therapists (KAOT) was founded in 1993, and it joined the Asia-Pacific Occupational Therapy Congress (APOTC) in 1995 and became a full member of World Federation of Occupational Therapists (WFOT) in 1998. Within the last four years, twenty-three new occupational therapy programs have been launched nationwide, and there are total of twenty-four occupational therapy programs (seven four-year programs and seventeen three-year programs) as of December 2002 (Table 3 & 4). From year 2006, approximately nine hundred new graduates are expected to take the national occupational therapy licensing examination every year (Fig. 2). Also, the post-professional graduate programs (Table 5) are currently offered by four universities (Lee & Kang, 2002).

The Current Stage

As mentioned before, occupational therapy was introduced to Korea in the early 1950's. This period coincided with the time that the biomedical perspective was dominating the health care system worldwide (Kielhofner & Burke, 1977). Consequently, Korean occupational therapists

Table 3. The four-year occupational therapy programs

University	Established year	Admitted student number per year
Yonsei University	1979	40
Konyang University	2000	25
Inje University	2000	30
Hanseo University	2000	40
Woosong University	2001	40
Gaya University	2002	30
Daebul University	2002	30

Table 4. The Three-year occupational therapy programs

College	Established year	Admitted student number per year
Gwanyang College	1998	80
Kyungbok Collge	1999	80
Dongnam Health College	1999	80
Kyungbuk Science College	2000	40
Daegu Health College	2000	40
Jeju Halla College	2000	40
Daejeon Health College	2001	40
Kyungbuk Foreign Language Technology College	2002	30
Gunjang College	2002	30
Seorabul College	2002	30
Sungduk College	2002	30
Sunghwa College	2002	30
Sooncheon First College	2002	30
Hanyeong College	2002	30
Jeonnam Science College	2002	30
Joosung College	2002	30
Pohahng First College	2002	30

have been mainly focusing on physical disabilities under the atmosphere of scientific reductionism until recent days. These days the paradigm of occupation, stemmed from the early occupational therapy philosophy, is vastly accepted in the international occupational therapy society. In Korea, occupational therapy is being recognized more and more nationally as an integral part of the rehabilitation process. We are in the middle of the emerging paradigm, and it is the right time for us to refine the direction of our profession. In order to ensure the qualitative as well as quantitative growth of occupational therapy in Korea, the KAOT (Korean Association of Occupational Therapists) is working on the following five

projects.

First, the KAOT is restructuring the association responding to a sudden increase of occupational therapy programs. The first national occupational therapy licensing examination was administered by the National Institute of Health in 1965. In 1998, the National Health Personnel Licensing Examination Board assumed responsibilities for the development, administration, and implementation of the licensing process based on current and valid standards for occupational therapy practice. The purpose of awarding license is to identify for the public those persons who have demonstrated both the knowledge and the skills necessary to provide

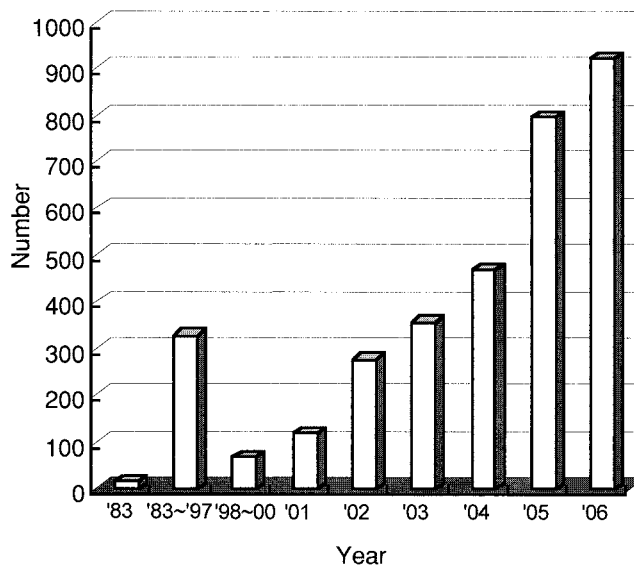


Fig. 2. The number of entry level occupational therapy program graduates

Table 5. The graduate occupational therapy programs

University	Program(s)	Entry level offered
Yonsei University	Master, Doctorate	Yes
Hanseong University	Master	Yes
Daegu University	Maste	No
Dankook University	Master	No

occupational therapy service. In the effort to develop, maintain, and defend the content validity of practice-based occupational therapy licensing examination, the National Health Personnel Licensing Examination Board sponsored and authorized the occupational therapy practice analysis study in 2000. Based on the occupational therapy practice analysis study, Minimum Standards for the Education of Occupational Therapists By World Federation of Occupational Therapists (WFOT, 1993), and The National Occupational Therapy Practice Analysis in the USA (Dunn & Cada, 1998), the Korean National Board Examination Development Committee met to review the content of the national board examination for occupational therapists in July 2001. The test items were carefully reviewed and

updated. The significant change made at this meeting was the “addition” of new test items focusing on occupation-based practice since the occupational therapy license examination was instituted in 1967. A new task force composed of experienced clinicians and educators is working on establishing a standard guideline for the approval of an occupational therapy program and clinical fieldwork based on the WFOT minimum standard.

Second, the KAOT is exploring diverse occupational therapy areas such as hand therapy and ergonomics with emphasis on occupation-based practice. In reality, occupational therapy service is mainly focusing on ADLs (Activities of Daily Living) training at most of the institutions in Korea. The use of hands has been a symbol of the

occupational therapy profession, which is well reflected in Mary Reilly's famous Eleanor Clark Slagle lecture in 1962.

"Man, through the use of his hands as they are energized by mind and will, can influence the state of his own health" (Reilly, 1962, p. 2)

For attainment of optimal function (health), according to Cynkin and Robinson (1990), it is imperative that every human being be "involved consciously in problem-solving and creative activity" (p. 5). Problem-solving and creative activity are also linked with the use of hands. Practically all activities devoted to self-care and the care of one's environment require involvement of the hands. Therefore, the hand therapists are encouraged to integrate occupation-based interventions into clinical practice to emphasize the unique contributions of occupational therapy. In order to accomplish this objective, a wide spectrum of continuing education programs such as hand therapy, ergonomics, assistive technology, and mental health need to be generated.

Third, the KAOT is trying to integrate the unique aspects of Korean culture into establishing the concept of occupational therapy. Even though the occupational therapy profession sprouted in western culture, it values meaningful occupation in the real environmental context. In general, maximizing independence in daily life is a priority of occupational therapy. However, this principle does not apply to every single case. Some Korean culture highly values caring for the elderly (i.e. domestic chores or basic self-care) rather than having them be independent in all areas. Therefore, the Korean occupational therapists are being encouraged to be sensitive to the changing health care systems and reflect the social value in their practice while maintaining the core construct of occupational therapy.

Fourth, the KAOT is striving to develop community-based occupational therapy programs. Currently, most occupational therapy programs concentrate on metropolitan areas and local health needs that can be addressed by occupational therapy are relatively ignored. The KAOT is confident that a regionally balanced development of occupational therapy will ensure both

qualitative and quantitative growth of this promising profession in Korea.

Fifth, the KAOT is making strenuous efforts to establish a closer partnership with the international occupational therapy community to ensure the high quality of service that is consistent with international thinking about health and educational practice. The World Health Organization's International Classification of Functioning, Disability and Health (ICF) addresses both the components of health and the environmental context of health (WHO, 2001). Accordingly, the KAOT is taking an active role in speaking for international factors such as the Disability Rights movement and the rights of indigenous people.

Conclusion

The Korean occupational therapy society has worked strenuously to expand its professional domain and has achieved incredible quantitative growth. Now, it is focusing on the qualitative growth of occupational therapy. The Korean Association of Occupational Therapists (KAOT) is placing high priority on establishing accreditation standards for the occupational therapy program to assure the quality of the program and to assist in the development of the program. To guarantee the quality of occupational therapists, and to make circumstances better for them, and to predict a promising future in the field of occupational therapy, basic regulations and minimum standards for educational institutions and practice institutions are being established by a special task force sponsored by the KAOT. This process will enhance the reputation of an accredited program because of public regard for accreditation while the KAOT is developing a concrete system to proactively advocate the roles and effectiveness of occupational therapy to the public. At the same time, the KAOT is seeking strong and ongoing links to the international occupational therapy community. Through these efforts, the profession of occupational therapy in Korea will be strengthened by contributing to the unity of the professions in an activity directed at improving professional preparation and professional practice.

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Using Problem-Based Learning (PBL) with Hong Kong Occupational Therapy Students: Opportunities and Challenges

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Abstract: This action learning project aimed at exploring the feasibility, values and limitations of implementing problem-based learning (PBL) with Hong Kong occupational therapy (OT) students. The PBL methodology was implemented in a year-one subject in the undergraduate occupational therapy curriculum, entitled 'Sensation and Perception'. During a 14-week period, 90 OT students, working in small teams of 6, studied three PBL cases. Both quantitative and qualitative methods were used to examine the effects of this PBL implementation. The Inventory of Learning Preferences (ILP) and Study Process Questionnaire (SPQ) gauged the change in the students' learning approach before and after PBL implementation. Focus group interviews and non-graded reflective journals were used to examine students' perceptions of the PBL experience. Although their learning approaches and preferences did not differ significantly after the PBL experience, the majority of students (84%) favored this learning method. The qualitative data indicated that the students developed basic study skills such as the ability to brainstorm and perform a literature search, and the experience of which they valued. The major challenges identified were the heavy workload, insufficient learning resources to support the new learning experience, and poor transfer of the acquired study skills to other learning situations. It is recommended that the PBL methodology be refined based on the opportunities and challenges identified, and that its application be extended to other subjects in the teaching curriculum.

Key words: Hong Kong students, problem-based learning, study skills, undergraduate occupational therapy program

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Introduction

As with all healthcare professionals, occupational therapists must possess good clinical reasoning skills to solve clients' individual problems. Problem-based learning (PBL), since its introduction to the McMaster Medical School in the mid-1960s, has been documented for its

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values in promoting critical thinking (Biggs, 1991; Boud & Feletti, 1991), problem-solving (Dolmans & Schmidt, 1994) and independent learning (Norman & Schmidt, 1992). Depending on how the problem is structured and the extent of teacher direction, some PBL methodologies adopt a more structured format, while others are less structured (Barrows, 1986). Despite the format differences, all PBL approaches share a common characteristic, namely that learning should begin with a problem that students wish to solve (Boud, 1985). Through the processes of understanding and formulating strategies to solve the problem, students acquire knowledge and content-related skills, and develop skills of clinical reasoning and self-directed learning (Barrows, 1986; Biggs, 1999).

There has been a growing interest in adopting PBL as an innovative teaching-learning strategy in occupational therapy curriculums, notably in North America and Western Europe. Some Asian countries, such as Singapore, Japan and Hong Kong, are also keen to reform the education system and encourage their students to develop a more active learning attitude, because it is often commented that their students are rote learners. For instance, Hong Kong students are criticized for relying too much on teachers' inputs and seldom assume an active learning role (Biggs, cited in Watkins, Reghi, & Astilla, 1991). The Confucian beliefs held by many Chinese people can partly explain the shaping of rote-learning behaviors, because Confucianism teaches students to respect knowledge and teachers (Chan, 1999). Hence, Chinese students are largely obedient and seldom express personal opinions in classes. In fact, a majority of the teaching curricula in primary, secondary, and tertiary education adopts a didactic teaching-learning mode in which active questioning and creativity are not encouraged. Moreover, Chinese parents tend to have high hopes concerning their children's academic achievements. In order not to disappoint their parents, most Hong Kong students use an 'achieving' learning strategy, in which their primary study objective is to obtain good grades rather than search for knowledge (Stevenson & Lee, 1996).

With few exceptions, the undergraduate occupational therapy curriculum of Hong Kong is largely characterized by a conventional teaching-learning methodology that consists of lectures, seminars and tutorials. Sometimes, when case studies are used in tutorials to stimulate student discussion on case management, the majority of students are found to be passive in learning and expect much input from their teachers (Chung, 2001). Realizing that occupational therapists need to be reflective and creative in formulating strategies to solve clinical problems, the authors therefore initiated an action learning project to explore the opportunities and challenges of implementing a PBL methodology with Hong Kong occupational therapy (OT) undergraduate students who have long been exposed to the conventional type of teaching-learning methodology.

The Action Learning Project

Preparation phase

A subject in the undergraduate occupational therapy curriculum of The Hong Kong Polytechnic University, entitled 'Performance Component: Sensation and Perception', was chosen to pilot test PBL implementation with Hong Kong OT students. Implemented in the second semester of the year-one curriculum, it is a supporting subject that aims at developing students' basic understanding of the nature, development and functions of sensation and perception in normal people, and their appreciation of how to apply the basic knowledge in clinical case management. It is a three-credit subject, consisting of 10 lecture hours, 10 seminar hours, and 22 tutorial hours.

The authors experienced two constraints during the preparation stage. Firstly, typical PBL sessions are run in small groups to promote maximum student interaction and participation (Davis, 1995), but limited human resources (two faculty members) and a large class size (90 students) made such small-group sessions impossible. Secondly, PBL was only introduced to one one-semester subject in the three-year curriculum, because the department was not ready

for a complete change.

To address the issue of limited manpower, the PBL methodology was structured so as to be implemented in three large-sized tutorial groups (30 students per group), in which students were asked to study in small teams. Instead of working with 30 individuals in a tutorial group, the tutor facilitated student learning in five small teams. As the PBL methodology was implemented in only one subject in the whole curriculum, it was felt important to prepare and orientate students to this new teaching-learning methodology in order to minimize learning anxiety and uncertainty. After consulting educators who are experienced in PBL, the authors drafted the philosophy, objectives and learning modes of PBL, and the roles of students and tutors in PBL sessions (refer to Appendix for details). All this information was introduced and explained to students in the first class.

Problems are central to the PBL approach and must be carefully designed to meet both the learning objectives and the educational objectives of the study subject. Good problems are usually ill defined, to incorporate the learning objectives, capitalize on students' interests, promote the use of problem-solving skills and critical thinking, and reflect real-life scenarios. Three clinical cases were solicited and written as study cases based on the occupational therapy process: initial interview and assessment, problem identification, and treatment planning and implementation. The OT process was used because it would allow students to analyze the case and identify learning issues in a systematic manner. After the first study case was developed, five former students were invited to pilot test its ability to promote study skills such as problem-solving, integration, and critical analysis of information. The problem was also checked against the learning objectives and students' interest. Modifications were made according to the first case, which then became the basis of formulating the other two study cases.

Implementation phase

The PBL methodology was introduced in the selected subject, in which 90 OT students enrolled during the academic year of 2000/01. In the first session, they were introduced to the PBL

methodology and the action learning project, and all gave their consent to participate. The gender divide was as follows: 35.6% were males and 64.4% were females. Their mean age was 20.6 (SD=6.32).

The PBL subject, consisting of both large-group (lecture) and small-group (tutorial/seminar) meetings, spanned over 14 weeks. The 90 students were divided into working teams of 6, and each team worked on three open-ended problems. Three tutorial groups, each comprising five working teams, met weekly with their tutor, who guided them through the essential stages of PBL such as brainstorming, identification of learning issues, study planning, and independent study. Each working team presented their chosen learning issues to their peers during the seminar sessions. The lectures were used to consolidate the key concepts that students learned through addressing the problems. An electronic discussion board was established to encourage students to communicate with tutors, share information, and discuss related issues with their classmates outside the scheduled class contact hours.

Evaluation phase

Both quantitative and qualitative methods were used to examine the learning outcomes, values and limitations of using PBL methodology with Hong Kong occupational therapy students. In terms of the quantitative evaluation, all students completed the Study Process Questionnaire (SPQ) and the Inventory of Learning Preference (ILP) prior to and again after the PBL experience. The SPQ, based on motive-strategy congruence theory, was used to examine students' predisposition towards learning (Biggs, 1993). Students independently rated each of the 42 SPQ statements on a 5-point scale- for example, "I have a strong desire to excel in all my studies", from 1 "never or rarely true of me" to 5 "always or almost always true of me". Three levels of learning (surface, deep, and achieving) can be identified from the analysis of the statements. The 34-item ILP probed into the student's preferred learning mode, which ranges from strongly favorable to not favorable to PBL (Moore & Fitch, cited in Stokes, Mackinnon, & Whitehill, 1997). Students were

asked to select 10 statements that best described their ideal learning environment.

As for qualitative evaluation, all students were requested to submit a non-graded reflective journal at the end of the subject. They were encouraged to reflect upon their learning experiences by discussing the impacts of the PBL methodology on their learning. In addition, two focus group interviews were arranged to further explore students' perception of PBL as a teaching-learning strategy. Areas examined in the interviews included students' conception of university teaching and learning, their perception of PBL as a learning strategy, the positive and negative aspects of PBL, and suggestions for improvement. Fourteen students (15%) were randomly selected and allocated to the interview groups. One student was ill and could not attend the interview, and therefore one interview group consisted of 6 students and the other had 7 students. Both focus group interviews lasted for about 1.5 hours, and were audio-taped.

Data analysis

The SPQ was scored according to Biggs (1993). One-way ANOVA was used to investigate whether the students' learning approach changed after the PBL experience. MANOVA was used to further analyze whether post-PBL changes occurred in any of the students' SPQ scores in terms of the three levels (surface, deep, achieving), two scales (motive, strategy), and six sub-scales (surface motive, deep motive, achieving motive, surface strategy, deep strategy and achieving strategy). The percentage of students selecting a particular learning environment, as illustrated by ILP, was compared before and after the PBL experience (Stokes, Mackinnon, & Whitehill, 1997).

Qualitative analysis of the interviews and reflective journals was based on a Model of Human Occupation (MOHO; Kielhofner, 1995), which is a theoretical model developed for occupational therapy practice to understand the occurrence and formation of human behaviors (one of which is study behaviors). The MOHO consists of an input system (task and environment), human subsystems (performance,

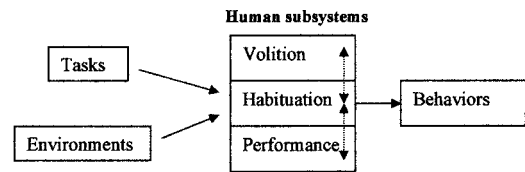


Fig. 1. Model of human occupation (Kielhofner, 1995)

habituation, and volition), and an output system (behaviors) (Fig. 1). An independent rater, who is experienced in the area of student learning, coded the scripts and journals, and the first author performed a reliability check with a sub-sample of seven reflective journals and two interview scripts. The percentage agreement was between 82% and 88%.

Results

SPQ and ILP

Only 51 pairs of pre- and post-test data were analyzed, because 39 students did not return the SPQ and ILP in the post-test phase. Prior to the PBL experience, the students' preferences for study processes varied among the three learning approaches: deep, surface and achieving ($F=7.40$, $p<.001$). Post hoc analysis based on the Scheffé Test revealed a difference only between the deep and achieving approaches. The preferences for a deep approach ($M=3.32$, $SD=0.55$) were significantly higher than those for an achieving approach ($M=2.97$, $SD=0.38$), but not those for a surface approach ($M=3.12$, $SD=0.42$). When comparing pre- and post-PBL implementation, the MANOVA results showed that none of the SPQ scores differed significantly at the .05 level. Table 1 presents the means, SD and F values of the MANOVA analysis.

Of the 34 statements in the ILP, there was a change of more than 10% in seven items (See Fig. 2). Students showed an increased preference for independent learning according to two items: "valuing classmates as sources of information" and "allowing peers to have their own opinion". Similarly, students' preferences for a surface approach decreased according to one item:

Table 1. Mean, SD and MANOVA results of Study Process Questionnaire (SPQ; Biggs, 1993)

	Pre-test		Post-test		F	p
	Mean	SD	Mean	SD		
Surface approach	3.12	.42	3.12	.52	.001	.98
Deep approach	3.32	.55	3.35	.47	.10	.75
Achieving approach	2.97	.38	2.96	.47	.02	.90
Motive	3.23	.34	3.22	.37	.01	.91
Strategy	3.05	.31	3.07	.32	.10	.75
Surface motive	3.26	.51	3.25	.62	.01	.91
Deep motive	3.27	.62	3.25	.62	.14	.71
Achievement motive	3.15	.53	3.18	.59	.09	.76
Surface strategy	2.98	.50	2.99	.51	.004	.95
Deep strategy	3.37	.58	3.47	.51	1.03	.31
Achieving strategy	2.80	.52	2.74	.56	.27	.61

N=51.

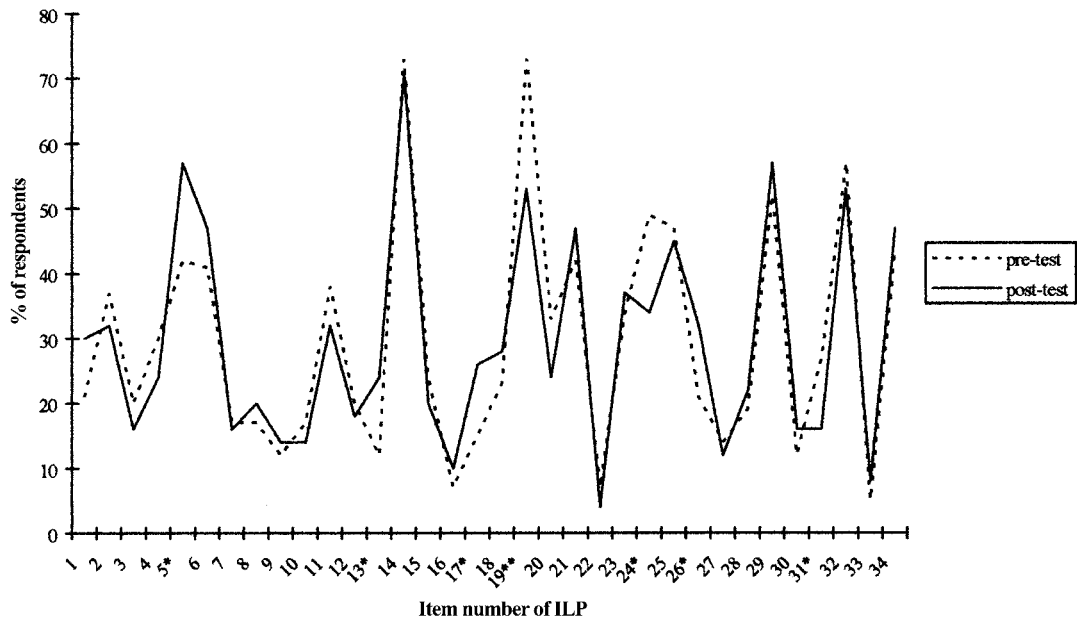


Fig. 2. Percent change in inventory of learning preference prior to and after the PBL implementation (ILP; Moore & Fitch, cited in Stokes, Mackinnon, & Whitehill, 1997). Note: * >10% difference, ** >20% difference.

“professor provides clear directions and guidance for all course activities and assignments”. On the other hand, according to two other items there was a decreased preference for independent learning: “classroom atmosphere of exploring and debating new ideas” and “workshop or seminar atmosphere

to exchange ideas and evaluate own perspectives”. There was also an increase in a surface approach in two other instances: “while emphasizing class discussion, the professor tells us the right answer” and “the professor is an expert who knows all the answers”.

Reflective journals and interviews

In the reflective journals, 76 students (84.4%) gave positive comments on their PBL experience. The greatest number of positive comments was related to students' preference for a more independent learning mode (n=179¹). One student expressed her joy at being a university student, "I am given the opportunity to study independently. ...Though it is not easy, I am motivated to search, select and read according to my chosen learning issues." However, the PBL methodology was unsettling for some students. One student said that he paid the tuition fee but obtained few learning materials from the tutors.

The following sections present the qualitative data based on the MOHO framework (refer to Fig. 1).

Human subsystems

Performance: Students reported on developing basic study skills from the PBL experience (n=146). As one student commented, "I only read the recommended textbooks and journal articles in other subjects, but I read more extensively in this PBL subject. Moreover, I have developed literature search strategies and extended my search to the Internet." About half of the students claimed that the PBL methodology provided them with structured opportunities to practice brainstorming of ideas, exchanging and discussing opinions, and performing a systematic literature search (n=45). Some students found themselves more proficient at organizing materials for presentation (n=56), and had greater confidence when interacting with an audience (n=43).

Some students reported the attainment of higher-order learning skills such as problem-solving skills (n=21), critical analytical skills (n=19), and time management (n=12). One student valued the study skills that she had acquired through the PBL process, "...these study skills are of great use in my future practice. I am now the fisherman who fishes for myself rather than waiting to be fed." Students also expressed their more independent approaches to learning (n=19) and the assumption of greater responsibility for their learning (n=11). One student claimed that the PBL methodology

encouraged her to be an active learner because she needed to decide 'what' and 'how' to learn from open-ended problems. Some students said they had developed active listening skills (n=23) and improved questioning techniques (n=16).

Habituation: To be able to routinely apply acquired study skills reflects a deep level of learning. Although students reported the development of independent study skills, it was less evident that they practiced the acquired skills in other learning situations (n=18). The following two excerpts may provide reasons for this observation. "As we receive comprehensive handouts in the non-PBL subjects, I don't feel the need to look up additional information." and "The timetable is so packed that I can hardly find time to further develop and consolidate the study skills that I learned from the PBL experience."

Volition: Some students reported an increased motivation for learning (n=15) and considered the PBL experience a rewarding one (n=26). Data showed that some students developed a deeper (n=29) and wider (n=14) understanding of the subject that reinforced their learning motives, and some reported their willingness to put extra effort into the PBL module due to a sense of achievement (n=16). The following excerpt demonstrates a student's motivation in the PBL subject:

Although the workload of this module is heavy, I like it. Unlike other subjects, I participate in every part of the learning process, just like baking a cake from its raw ingredients. ...I feel good when I receive positive comments from the tutor and peers, ...and these are probably the forces that push me forward.

Learning environment

Social aspect: Students favored the social situations created by the PBL methodology, such as group work, and appreciated the friendships generated (n=42). They acknowledged the benefits of PBL in promoting group work skills through information sharing and the assumption of

¹The number of responses is greater than the number of students, since each student can include more than one point.

responsibility. As one student stated, “What I like most in PBL is the opportunity to work together with peers who have different characters and learning aspirations. I learn from their strengths and weaknesses.” More specifically, students valued the learning opportunities gained through peer modeling (n=14) and peer feedback (n=28). For instance, a student treasured the brainstorming sessions and peer discussions because she was able to get a more comprehensive and critical appraisal of the study topic. In addition, negotiation (n=31) and decision-making skills (n=18) were developed through group work.

On a more personal level, many students (n=67) attributed the development of mutual support, trust, respect and friendship to the PBL process. One student shared her gratitude for establishing trust with fellow classmates, “We openly share the information and support each other whenever in need. ...We also learn to distribute the workload fairly among ourselves.” Having said that, a few students expressed their difficulty in working with classmates who were uncooperative and avoided shouldering responsibility (n=7).

Physical aspect: The time demands of the PBL methodology within a traditional curriculum distressed many students (n=53) because the tightly packed curriculum and the closely spaced tutorials left students little time for self-study. One student pointed out that the average of 30 hours’ class time every week put her in a very stressful position, as she needed to cope with PBL assignments and the assignments of other subjects at the same time. An insufficient supply of learning resources was another stressful learning experience (n=46). Although the Internet provided easily accessible information, students were concerned (and rightly so) about the accuracy of the information. The following excerpt reveals their frustration about the limited learning resources:

The library has insufficient textbooks and learning materials to share among us. With 90 students working on the same problem at the same time, we usually end up with nothing. We search from the Internet, but it often takes a long time to download the

information. Moreover, we are uncertain about the accuracy of the information because everyone can upload information onto the Internet.

Learning tasks: Students commented that open-ended problems were stimulating enough to promote learning (n=46) and increase their awareness of the complexity of the clinical problems they will encounter in future practice (n=23). Only a few students were confident about integrating information (n=12) and managing conflicting information from the literature (n=7), and many students found this very difficult to deal with (n=41). The latter group was eager to look for an absolute answer. Quite a number of students were uncertain about the scope of learning (n=27) and requested the provision of specific study guidelines and ‘official’ reading lists. Even though students valued the opportunity for peer learning, they actually had little confidence in the effects of learning from their peers (n=32). One student’s comment reflects this concern:

Some classmates are not serious about the learning task. Their presentations are loosely organized with a poverty of content materials. It is a waste of my time to listen to their presentations. Although we can ask them questions, we tend to keep quiet because we don't have a clue of what they talked about in the presentation. Moreover, they will be unhappy if they have to do additional work, after the presentation, to clarify our questions.

Discussion

Challenges

Kember and Gow (1991) argue that the learning environment is more significant than personal factors in shaping learning behaviors. This study, however, identified the interactivity of these two factors in shaping students’ learning perception and behaviors. The students in this study primarily learned through an expository teaching-learning methodology in their primary and secondary educations, which aim to meet the requirements of the Hong Kong examination syllabus (Morris, 1985). The learning behaviors of

this teaching-learning approach are characterized by passive listening, note-taking and getting teachers' tips for examination (Biggs, 1991). Stated another way, these occupational therapy students have been conditioned to a relatively passive and spoon-fed mode of learning for at least 13 years. Thus, a sweeping change to an active and deep learning approach can hardly be expected from students who have merely been introduced to the PBL methodology for 14 weeks.

The students' attachment to the spoon-fed learning pattern also accounts for their uncertainty about the scope and accuracy of learning. When placed in a new learning environment that requires active learning, students felt insecure and out of control. This finding is consistent with the observations of Stokes, Mackinnon, & Whitehill (1997) and Woods (1994), that the PBL methodology can be an anxiety-provoking learning experience, particularly in its first cycle of implementation. Adequate support is therefore essential to nurture a new learning experience, or students may lose confidence, direction and motivation in learning (Tang et al., 1997). This study identified some unfavorable factors, such as insufficient textbooks and learning resources, and the heavy workload, which need to be addressed in future implementation.

As the PBL methodology was introduced only to one subject in the whole occupational therapy curriculum, it is not surprising that the students compared the PBL methodology with the didactic mode of other subjects in terms of workload and teaching-learning methods. In particular, when the learning environment does not favor an independent learning mode, such as during periods with heavy workloads and assessments, the students' preference for a less demanding didactic teaching-learning methodology is understandable.

Opportunities

Despite the challenges, this study identified some favorable factors of implementing PBL methodology with Hong Kong occupational therapy students. Instead of working on an individual basis as in typical PBL modes, the students in this study worked through the problems

in small groups. The group work experience was strongly favored by the students. This finding echoes the observations of Biggs (1991) and Stokes, Mackinnon, & Whitehill (1997) that Chinese students favor group learning and perceive it as a form of collective work that enables them to achieve good academic results. In other words, the use of group work in this PBL methodology matches quite well with the characteristics of Chinese learners. Moreover, the group work experience enabled the students to develop study skills such as information sharing, communication skills, and critical analysis of different perspectives, which are considered important for healthcare professionals (Salvatori, 1999).

Although students' brief exposure to PBL methodology did not change much of their learning approach, it gave a positive push to the three human subsystems of learning (Kielhofner, 1995), most notably the performance subsystem. Evidently, the students were able to develop their study skills when provided with the appropriate learning environment. This observation lends additional support to Kember and Gow's (1991) finding that the quality of learning environments influences the shaping and development of learning behaviors. The transfer of study skills gained from the PBL experience to other learning situations was not evident in this study, indicating the need to develop integrated pedagogical strategies to promote students' habitual transfer of new learning behaviors to various learning situations.

Limitations of the study

The lack of a control or comparison group represents a major limitation of this action learning project. Since only one 14-week subject was included in the PBL implementation and only one group of students was included in the study, substantial and solid conclusions cannot be drawn based on this form of research design. A quasi-experimental study design consisting of a control group or a comparison group is suggested to improve the rigor of future study. Moreover, the low return rate of SPQ and ILP post-test may have warped the data interpretation, so caution is

needed not to over-generalize the findings.

Conclusion

One cannot expect learning behaviors to be developed or changed overnight: the shaping of learning behaviors takes place cumulatively. Hence, the fact that students' learning approach and learning preferences do not demonstrate a significant change after exposure to a PBL experience over a 14-week period is understandable, and students' complaints of a heavy workload and insufficient learning resources to support a new learning experience are totally valid. If the identified challenges are properly addressed, the potential benefits of PBL observed in this study, such as promoting an active learning attitude and developing core study skills, are positive signs for future PBL implementation with Hong Kong OT students. Moreover, the group work experience, which is highly valued by the students, should be further reinforced in future implementation.

As this was an explorative study examining the feasibility and potential values and limitations of PBL implementation for Hong Kong occupational therapy students, further studies can be geared towards refining the PBL methodology so as to address the challenges identified, and extending the PBL methodology to other subjects of the occupational therapy curriculum to reinforce the shaping of learning behaviors and development of study skills that are essential for reflective occupational therapists.

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Appendix

TEACHING-LEARNING METHOD

What is problem-based learning?

Problem-Based Learning (PBL) is any learning activity in which problems drive learning. In order to facilitate learning, students are given a problem. The problem is so designed that students develop learning issues that are required to solve the problem.

Benefits of problem-based learning

Through problem solving, students accumulate knowledge and develop flexible and cognitive strategies that help analyze unanticipated, ill-structured situations to produce meaningful solutions. Indeed, this is an essential skill needed to tackle problems of today's complex issues. Through PBL, students encounter problems in which they need to transfer their learning to new domains; such skills enable the independent learner to function effectively in society.

Real life problems seldom parallel well-structured problems, but present an ever-changing variety of goals, contexts, contents, obstacles, and unknowns that influence how each problem should be approached. And in real life, we seldom repeat exactly the same steps to solve problems. Therefore, students need critical thinking skills to interact with life. Moreover, to be successful in their career, students require practicing skills in solving ill-structured problems that reflect life beyond the classroom.

In PBL, students may work independently or in small groups to create viable solutions for a problem. Owing to a reduced amount of direct instruction in PBL, students assume a greater

responsibility for their own learning (Aspy, Aspy & Quimby, 1993). Moreover, students develop group work skills such as communication and division of labour.

Are there any secondary gains?

As noted from comments of retrospective students, most of them acquired the skills of information/literature search, reading and discussing articles, and presentation (Chung & Chow, 2000). Some developed skills of asking questions, critical thinking and analysis of information from different sources. A majority of students treasured the friendship and trust developed through group work. Students also learned the negotiation and discussion skills through teamwork. Through feedback, students learned how to give constructive evaluation on peers' performance and accept comments from peers and tutors.

Performance Components: Sensation and Perception

Principles

Normal development of the sensory-perception system

The seven sensory-perception modalities (visual, auditory, gustatory, olfactory, tactile, vestibular, and proprioceptive modalities) develop across the life span. Occupational therapists are particularly interested in visual, tactile, vestibular and proprioceptive systems. The understanding of the developmental changes

of these four sensory modalities helps occupational therapists to discriminate dysfunction from immaturity and senility.

Nature of four sensory-perception modalities

Occupational therapists are interested in two important functions, discrimination and modulation, of the sensory systems. Discrimination is the ability to compare and select the appropriate incoming sensory and perception information. Modulation is the capacity of the nervous system to regulate its responses to sensory stimulation, so that it neither over- nor under- responds (Spitzer, Roley, Clark, & Parham, 1996). Sensory discrimination is important for motor planning, while sensory modulation is essential for arousal.

Sensory-perceptual assessment used in occupational therapy practice

Occupational therapists use a variety of evaluation methods to identify function and dysfunction in sensory-perceptual modalities. Such methods include interview, observation and standardized assessment battery. Accurate interpretation of assessment data helps in formulating a sound base for occupational therapy interventions.

Occupational therapy management of clients with sensory-perceptual dysfunction

Occupational therapists utilize a number of interventions to maximize clients' functional independence. Two common treatment approaches adopted are remedial and compensatory. The analysis of the application allows occupational therapists to select the most appropriate treatment approach to meet clients' needs.

Learning objectives

After the completion of the module, students should be able to:

1. Describe the normal development of four sensory-perceptual modalities, namely, visual, tactile, vestibular and proprioceptive, which are typical of different life stages: childhood, adulthood and old age.
2. Understand the implications of function and dysfunction of four sensory-perceptual

modalities on the performance of occupational roles.

3. Discuss two main functions of the sensory-perceptual modalities: discrimination and modulation.
4. Conduct assessment related to sensory-perceptual functions, and interpret sensitively the assessment results in the context of clients' physical and psychosocial environments.
5. Integrate the knowledge on normal development and results of occupational therapy assessment to analyze therapeutic values of occupational therapy interventions.

Educational objectives

In addition to learning objectives, students should be able to achieve the following educational objectives:

1. The learner should be able to develop basic clinical reasoning skills, which include hypothesis generation, inquiry, data analysis, problem synthesis, and decision-making (Barrows, 1986).
2. The learner should be able to develop effective self-directed learning skills, such as being more sensitive to personal learning needs, locating and using appropriate information resources.

Roles of Students in PBL Classes

PBL is a student-centered learning process that facilitates students to assume responsibility of the learning process. Students are therefore encouraged to actively participate in tutorials, and aid the learning of others in the group. Also, PBL promotes students' integration of their prior knowledge and experiences to the problems studied.

During each session of PBL tutorial, students should have different roles,

Problem start

- * Find out the terms which are unclear
- * Identify key words

Brainstorming questions

- * Be creative
- * Raise questions relating to the key words
- * Identify concepts that needs to be learned

Learning issues

- * Identify important learning issues in the problem
- * Learn how to work together
- * Categorize questions raised into the relevant learning issues
- * Prioritize learning issues in relation to the learning objectives

Presentation

- * Adequate preparations on assigned learning issues
- * Present materials in an organised and concise manner
- * Listen attentively and raise constructive questions

Feedback

- * Be appreciative of the contribution of your group members
- * Learn how to evaluate knowledge
- * Decide if the problem is completed by considering if what you want to learn about the issues are all done

Overall Performance

- * Be more engaged, and show more participation in class
- * Be an active participant in order to contribute unique knowledge and ideas to the learning process
- * Learn to listen well. Let others speak without interrupting them
- * Develop effective communication skills
- * Learn from each other, share knowledge, expertise, and ability
- * Learn to consider time, resources and objectives and set priorities regarding the relative importance of each learning issue
- * Create own summaries of what they learnt between sessions which gives practice in organizing knowledge and they will remember what they have learned. Also make study and review easier
- * Return the references/study material once finished using

On the other hand, students should not,

- * Rely on the tutor
- * Attend the PBL tutorial without any preparation

- * Keep silence and seldom voice out opinions
- * Privately discuss with colleagues. They should openly discuss in front of the tutorial group and facilitator.

Roles of Tutors in PBL Classes

The tutor is an educator who facilitates a task-oriented group to successfully achieve the objectives of a teaching program. She facilitates students to identify key issues in the problem and find ways to learn the identified areas in appropriate breadth and depth. Moreover, she must be clear about the learning process so as to assure that the group stays on the targeted objectives and makes reasonable choices on key learning issues. In other words, she has to bring out the best in the group.

During each session of PBL tutorial, tutor plays different roles at different stages,*Problem start*

- * Focus the group by introducing terms to describe what the discussion is about
- * Remind students of relevant topics previously discussed but not fully understood

Brainstorming questions

- * Ask open-ended questions so as to help the students explore the richness of the situation and to help them develop their critical thinking
- * Challenge students' thinking so as to nurture deep learning and a search for meaning
- * Encourage student-directed discussion and the development of both knowledge and skills in critical thinking

Learning issues

- * Facilitate students to categorize questions into key learning issues
- * Advise students on methods of searching appropriate resources

Presentation

- * Raise appropriate questions to keep the group focused
- * Encourage students to present information and concepts in a precise and concise manner

Wrap up/feedback

- * Facilitate students to discuss concepts or

learning issues that are not clearly and properly addressed

- * Promote students' competence to integrate learning issues into the problem studied
- * Help students to see their contribution

Overall performance

- * Join the groups as participant, and pay attention to each student's contribution
- * Develop trust with students, that in turn creates a safe and stimulating atmosphere in which students are willing to discuss experiences and ideas without fear of being ridiculed
- * Give assistance to students if the learning process is not productive.
- * Monitor progress as to ensure that students are still on track and understand where they are in the process

On the other hand, the tutor SHOULD NOT,

- * Dominate the group with his/her opinion but rather facilitate the group dynamics
- * Be the group's expert resource who provides facts or concrete answers to questions

- * Keep too silent that may lead to students' confusion. Respond to direct inquiries if students have not exhausted their own logic and that there are other profitable learning experiences in suggesting an independent search.

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Factors Affecting Hand Function Following Reconstructive Thumb Operation (RTO): A Report of Eight Cases

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Abstract: Eight cases that had a reconstructive thumb operation (RTO) and were able to return to work were presented. In the present study, the functions of RT, the influence of the thumb on return to work, and how the recovered hands were used at work were investigated. The reconstructed thumb was evaluated based on the following 6 functions: “aspects of full return to work” (3 items), “thumb motion” (5 items), “sensibility” (3 items), “wrist range of motion (ROM)” (4 items), “strength” (3 items) and “dexterity” (3 items). Subsequently, the relation between the frequency of hand use based on subjective evaluation and each function was investigated. We observed significant correlations of the frequency of hand use with thumb opposition, thumb angle, pinch strength, 2-point discrimination (2PD), and the result of the Moberg picking up test ($p < 0.05$). It was thought that the improvement of pinch strength and dexterity of the thumb as well as that of sensory function was the factor to increase the frequency of hand use based on subjective evaluation, and the active hand therapy was necessary even before the operation.

Key words: Reconstructed thumb, return to work, hand therapy

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Introduction

The role of the thumb in hand function is tremendous, and a reconstructive thumb operation

(RTO) is often performed when the thumb is cut and lost due to external injury. RTO has been carried out by several methods with significant developments of microsurgery. Especially, the Wrap Around Flap Method (WAFM) can reconstruct the ungual, well-shaped thumb, and has little influence on the donor sites (Morrison *et al.*, 1980; Doi *et al.*, 1985). One of the major aims of hand therapy under RTO is recovering the effective functions of the hand along with

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Table 1. Parameters of case evaluation

Case	Sex	Operative age (years)	Diagnosis	Follow-up period (years)	Handness	Thumb amputation level	Occupational category (details of occupation)
A	43	M	Right thumb amputation	7.3	Right	Proximal phalanx	Businessman
B	18	M	Left thumb amputation	8.8	Right	Proximal phalanx	Skilled laborer (stone processing industries)
C	61	M	Right thumb amputation, Right Galeazzi fracture dislocation	7.8	Right	Proximal phalanx	Skilled laborer (press processing industries), self-employed
D	50	M	Right thumb amputation, Right middle finger amputation	8.3	Right	Proximal phalanx	Skilled laborer (a plumber)
E	55	M	Right thumb amputation	6.3	Right	Proximal phalanx	Skilled laborer (press processing industries)
F	28	M	Right thumb amputation, Right metacarpomultangular joint dislocation	8.9	Right	Metacarpophalangeal joint	Skilled laborer (construction machinery operator)
G	37	M	Right thumb amputation	0.7	Right	Metacarpophalangeal joint	Skilled laborer (construction machinery operator)
H	41	M	Right thumb amputation, Right Index–little finger amputation	7.1	Right	Interphalangeal joint	Skilled laborer (press processing industries)

acquiring original thumb functions. Some investigators perform the long-term follow up after RTO using WAFM (Lee and Hahn, 1995; Songcharoen, 1995), and the importance of sensory re-education is confirmed (Wei and Ma, 1995; Blomgren *et al.*, 1988). However, there have been few reports on the function of the reconstructed thumb (RT), the aspects of return to work, and how the recovered hands are used at long-term work (Bear-Lehman, 1983). In the present study, the functions of RT, the aspects of return to work, and how the recovered hands were used at long-term work were investigated in the patients who had received RTO and could return to work. In addition, the relation between the frequency of hand use based on subjective evaluation and these clinical measures of hand function was investigated.

Materials and Methods

Among 14 patients receiving RTO, the 8 right-handed males (8 fingers) who could be followed up were enrolled in the present study.

Out of these 8 patients, 7 had an injury in the right hand, and 1 in the left hand. Between May 1988 and January 1997, the patients underwent wrap-around procedures for thumb reconstruction at St. Marianna University School of Medicine Hospital. Full return to work was achieved, and the adequate follow-up was completed between August 1997 and January 1998. All the patients were diagnosed as having traumatic amputation of the thumb, and complications included Galeazzi fracture dislocation (case C) and injuries in the multiple fingers. Five patients had amputation at the level of the proximal phalanx, two at the metacarpophalangeal joint (MP joint), and one at the interphalangeal joints. MP joints were fixed in four patients (Cases D, E, F, and G) and not in residual patients (Cases A, B, C, and H). All the patients received WAFM in which the great toe was transferred to the thumb. In addition, in 1 patient (Case H), the second toe was transferred to the ring finger. One of the subjects was a businessman, and the others were skilled laborers (Table 1).

The items investigated are shown in Table 2.

Table 2. Clinical measures of hand function

I. State of Full Return to Work	IV. Wrist and Finger Range of Motion
① Operative age (years)	① % Wrist flexion; %WF (%)
② Full return to work (month)	② % Wrist extension; %WE (%)
③ Percentage of useful hand (%)	③ % Wrist radial deviation; %RD (%)
II. Thumb Motion	④ % Wrist ulnar deviation; %UD (%)
① % Total active motion ; %TAM (%)	V. Strength
② Opposition distance; Opp (mm)	① %Grip strength (%)
③ % Palmar abduction; %PA (%)	② %Key pinch strength; % Key pinch (%)
④ % Thumb length; %TL (%)	③ %Three-fingered pinch; %3 pinch (%)
⑤ % Thumb angle; %TA (%)	VI. Dexterity
III. Sensibility	① Simple test for evaluating hand function; STEF (score)
① Semmes-Weinstein mono filament test ; SWT	② %Moberg picking up test opened; M-opened (%)
② Static two point discrimination; S-2PD (mm)	③ %Moberg picking up test closed; M-closed (%)
③ Moving two point discrimination; M-2PD (mm)	

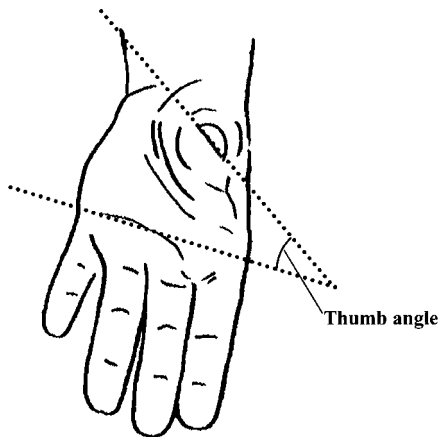


Fig. 1. Thumb angle is the angle which the intersecting point of the line of the distal palmar crease under the maximum palmar abduction forms with the line connecting the radial end and of the thumbnail to its ulnar end. This angle was measured by tracing it on the photos according to the method described by Beppu (1995).

To investigate “Aspects of full return to work”, the following three items were observed: 1) age at the time of operation, 2) the time period between completion of operation and full return to work, and 3) ratio (%) of frequency of hand use after surgery, which was subjectively evaluated, to that before injury (hereafter, Frequency of hand use). To investigate “Range of motion (ROM) of the wrist”, the 4-type ROMs of the wrists proposed by

Cambridge (1995) were observed. To investigate “Thumb motion”, the following 5 items were observed: 1) ROM of thumb, which was the ratio (%) of total active motion (TAM) range in the affected hand to that in the unaffected hand; 2) Thumb opposition distance, measured when the thumb was moved out of the plane of palm while approaching the fifth finger (mm); 3) Thumb palmar abduction, measured in a plane perpendicular to the palm (%); 4) Thumb length, measured from the carpometacarpal (CMC) joint to the tip or the point of the distal phalanx using radiography (%), and 5) The thumb angle was the angle which the intersecting point of the line of distal palmar crease under the maximum palmar abduction formed with the line connecting the radial end of the thumbnail to its ulnar end (%) (Fig. 1). All the measurements of the parameters described in 3) to 5) were expressed as the ratio (%) of the values in the affected hand to those in the unaffected hand. According to Beppu (1995), the thumb angle is used to determine the rotation angle of the thumb pulp in order to make RT easily pinch the objects. The large thumb angle indicates that the pulp of the affected thumb abducted to the palmer side compared with that of the unaffected thumb. The thumb angle was measured by tracing it on the photo (Fig. 1).

To investigate “Sensibility”, 1) Semmes-Weinstein mono filament test (SWT), 2) Static 2-point discrimination (2PD), and 3) Moving 2PD were performed based on the sensibility test

Table 3. Case result 1 : State of full return to work and thumb motion

Case	Full return to work (months)	Percentage of useful hand	%TAM	OPP (mm)	%PA	%TL	% TA
A	1	100%	23%	15	90%	95%	33%
B	18	90%	92%	0	100%	91%	109%
C	3	90%	25%	30	80%	100%	126%
D	12	80%	0%	35	41%	97%	79%
E	6	60%	0%	64	98%	100%	102%
F	12	30%	0%	66	65%	85%	194%
G	7	20%	0%	60	89%	101%	182%
H	12	10%	33%	35	104%	107%	152%

TAM; Total active motion, TL; thumb length, Opp; Opposition distance, TA; thumb angle, PA; Pamar abduction.

Table 4. Strength, sensibility test and dexterity test

Case	%Grip strength	%Key pinch	% 3 pinch	SWT	S-2PD (mm)	M-2PD (mm)	STEF (score)	% M opened	% M closed
A	106%	80%	100%	Purple	6	5	94	90%	109%
B	77%	88%	96%	Blue	4	3	98	104%	115%
C	83%	87%	100%	Purple	7	6	83	113%	120%
D	65%	85%	79%	Purple	15	13	81	104%	134%
E	94%	74%	80%	Purple	7	5	98	108%	109%
F	71%	32%	29%	Red	19	18	90	117%	124%
G	93%	50%	47%	Red	19	17	83	120%	151%
H	18%	39%	–	Purple	12	10	65	119%	199%

SWT; Semmes-Weinstein monofilament test. (Blue-diminished light touch, Purple-diminished protective sensation, Red-Loss of protective sensation). STEF; Simple test for evaluating hand function. M opened; Moberg picking up test and opened the eye. M closed; Moberg picking up test and closed the eye.

proposed by Bell (1995). To investigate ROM of the wrists, 1) Wrist flexion (%), 2) Wrist extension (%), 3) Wrist radial deviation (%), and 4) Wrist ulnar deviation (%) were performed. To investigate “Strength”, 1) Grip strength, 2) Key pinch, and 3) Three-fingered pinch were measured. To investigate “Dexterity”, 1) According to Kaneko (1990), Simple test for evaluation of hand function (STEF) and 2) Moberg picking up test were performed.

Subsequently, the correlation between Frequency of hand use and the clinical measures of each hand function was analyzed using the Spearman rank correlation test. P values of less than 0.05 were considered to be significant. The functional evaluation was carried out by two occupational therapists, while the questionnaire was performed by one occupational therapist.

Results

Regarding Aspects of full return to works, the mean age of the subjects at the time of operation was 42 years. The follow-up period ranged from 7 to 104 months (mean: 80 months). Case A (a businessman) showed remarkably early full return to work (one month), while it was observed within 3 to 18 months (mean: 8.8 months) in other patients. Frequency of hand use ranged from 10 to 100% (mean: 60%). No problems in particular were found in ROM of the wrists.

Regarding Thumb motion, Thumb ROM ranged from 0 to 92% (mean: 20%), and mean thumb opposition distance was 3.8 cm. The thumb palmar abduction was conserved (mean: 83%). The thumb length ranged from 84 to 107% (mean: 97%), which indicated the affected thumb was

Table 5. Correlations between percentage of useful hand and clinical measures of function

		Spearman rank correlation	p value
State of full return to work	Operative age	0.26	0.51
	Follow-up period	0.36	0.34
	Full return to work	-0.33	0.33
Wrist range of motion	%WF	-0.01	0.83
	%WE	-0.39	0.27
	%RD	-0.29	0.08
	%UD	-0.29	0.87
Thumb motion	%TAM	0.33	0.46
	Opp	0.70	0.05*
	%PA	-0.14	0.70
	% TL	-0.52	0.16
	% TA	-0.70	0.05*
Strength	% Grip strength	0.49	0.19
	%Key pinch strength	0.78	0.03*
	%Three-fingered pinch	0.89	0.01*
Sensibility	SWT	-0.35	0.14
	S-2PD	-0.70	0.05*
	M-2PD	-0.65	0.05*
Dexterity	STEF	0.51	0.19
	M opened	-0.84	0.02*
	M closed	-0.74	0.04*

*p<0.05. %TAM; % Total active motion, %WF; % Wrist flexion (%), Opp; Opposition distance, %WE; % Wrist extension, %PA; % Palmar abduction, %RD; % Wrist radial deviation, %TL; %Thumb length, %UD; % Wrist ulnar deviation, %TA; % Thumb angle, STEF; Simple test for evaluating hand function, SWT; Semmes-Weinstein mono filament test, %M-opened; %Moberg picking up test opened the eye, S-2PD; Static two point discrimination, %M-closed; %Moberg picking up test closed the eye, M-2PD; Moving two point discrimination.

slightly shorter than the unaffected thumb. The thumb angle was 122% (ranged from 33 to 194%), which indicated that the pulp of the affected thumb abducted to the palmar side. Concerning Sensibility, 5 patients had “diminished protective sensation” and 2 had “loss of protective sensation” in SWT. The number of patients who showed “not more than 6 mm” in static 2PD was 2, and that in moving 2PD was 4. Mean grip strength, key pinch strength, and three-fingered pinch strength were 76%, 67% and 76%, respectively. The mean score of STEF was 86. In the Moberg picking up test, the mean value of the test results with open eyes was 109% and that with closed eyes was 123%, which indicated the affected hand took a longer time than the unaffected hand.

Subsequently, the relation between Frequency of hand use (based on subjective evaluation) and each function was investigated. As shown in Table 5, we observed significant

correlations of Frequency of hand use with thumb opposition distance, thumb angle, pinch strength (key and three-fingered strength), 2PD (static and moving), and the result of the Moberg picking up test (open and close eyes) (p<0.05).

Discussion

In the present study, the functions of the thumb reconstructed using WAFM in 8 male patients (8 fingers) who returned to work were investigated. There were differences in the time required to return to work among subjects due to the differences of job categories, but most of the patients returned to work 6 months or later after operation. Tamai (1982) suggests that RT should have the following qualities: a certain range of free ROM, strength, a certain length, sensibility close to that of the normal thumb, and subjective satisfaction. In the present study, TAM and

opposition distance of RT were limited (20% and 3.8 cm, respectively). This might be because interphalangeal joints were fixed in WAFM. On the other hand, both grip strength and pinch strength ranged from 65 to 75%, which was similar to the results of Blomgran *et al.* (1988) and Lee (1995, 2000). A small number of patients showed “not more than 6 mm” in static 2PD, which indicated the unfavorable result. This result corresponded to that of Dellon (1981).

In addition, among such many estimations of hand function, which hand function had a close

relation with Frequency of hand use (based on subjective evaluation) was investigated. We observed significant correlations of Frequency of hand use with thumb opposition distance, thumb angle, pinch strength, 2PD, and the result of the Moberg picking up test. These results suggested that the improvement of Strength including pinch strength and Dexterity, as well as the improvement of sensory function as generally reported, was the factor to increase Frequency of hand use.

In the hand therapy before and after the operation, the exercise to improve dexterity using a pilot splint that determined thumb length, thumb angle and palmar abduction of the affected or reconstructed thumb was performed (Fig. 2). In addition, as one of the sensory re-education exercises and the dexterity exercises, handicraft activities were performed from the early stage after the operation to make RT be actively used (Fig. 3).

It is proposed that, despite the insufficient recovery after RT, the increase of opportunity to utilize proper activities raises the possibility of acquiring smooth pinch performance and enhancing the frequency of hand use. According to Jenmala *et al.* (1997), in order to adjust the fingers' abilities to pinch and pick up objects, either optical sensation or somatic sensation is needed to function, and tactile clues come to be

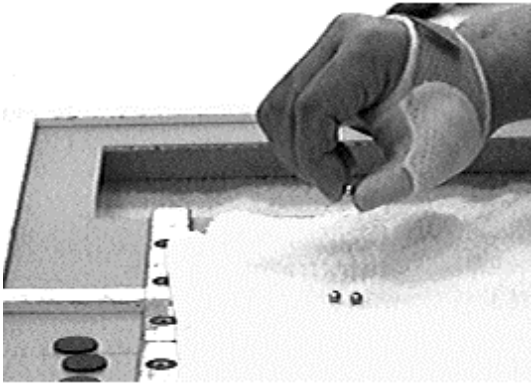


Fig. 2. Postoperative hand therapy approaches using a pilot splint

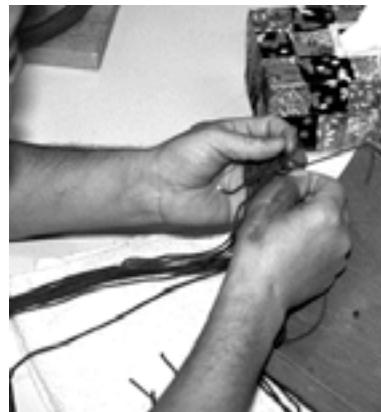


Fig. 3. Postoperative hand therapy approaches using handicraft activities. Right shows a net fancywork, macramé, and left shows a stick fancywork.

effective 0.1 second after the fingers touch the object. This is regarded as a requisite for improved frequency of hand use. Therefore, employing handicraft activities in the hand therapy is important to recover patients' hand function in various ways. Further studies should be performed to investigate the effect of handicraft activities. In addition, the relation of the subjective outcome measures using questionnaires that were oriented to patients (e.g., the disabilities of the arm, shoulder, and hand (DASH) proposed by Hudak, *et al.* (1996)) with function of the thumb would be investigated in the further studies.

Conclusion

In the present study, function of the thumb reconstructed using WAFM in the patients who returned to work, and the relation between the functional estimation and the frequency of hand use based on subjective evaluation, were investigated. We observed significant correlation of the frequency of hand use with thumb opposition distance, thumb angle, pinch strength, 2PD, and the result of the Moberg picking up test. It was thought that the improvement of pinch strength and dexterity of the thumb as well as that of sensory function was the factor to increase the frequency of hand use, and the active hand therapy was necessary even before the operation.

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