12月6日）

d. サンルイ大学ならびにパリ第5大学（パリ、平成17年12月7日）

e. イギリス Reallyenglish 社コンピューター試験開発部（ロンドン、平成17年12月9日）

f. ハーバード大学医学部（平成18年10月7日）

g. ケースウェスタン・リザーブ大学医学部（平成18年10月9･10日）

2）問題解決能力試験（Problem-solving ability test, P-SAT）の開発と実証実験

a. P-SATの概念

・ 臨床推論能力・臨床判断能力評価として開発する。

・ 臨床事例を提示し問題発見・情報検索・結果の判断解釈が順次性を持って行うように、コンピューター試験で行う。

・ 順次性を確保するために解答確定後は前問に戻れない構造として、情報の積み重ね、判断の深化を評価する。

・ 国家試験でも使用できるようにウェッブで行えるシステムを構築する。

b. P-SATの問題形式

・ 多選択肢問題：6から50個の選択肢から解答を選ぶ形式で、従来の五肢選択問題と比して類推、あるいは除外によって回答することが難しくなる。

・ 語句抽出型問題：事例の中から問題発見・解決に必要な語句を選ぶ形式の問題。

・ 短文記入型問題（ショートエッセイ問題）：必要な情報、判断の根拠などを短い文（語句）で記入する問題。

c. P-SATの評価形式

・ 臨床推論・臨床判断能力を評価するために、各設問についてクリニカル・エビデンスと専門医の判断で正しい選択・単語を決定した。

・ 解答は原則として複数選択として、すべてが専門医と同じ選択の場合評価A，一部が同じ場合B，同じではないが患者の不利益とはならない選択の場合をC，患者の不利益・禁忌・倫理的に行い得ない選択を含んだ場合をDとした。

・ 単語抽出あるいは記入問題では、あらかじめ設定した回答が得られるとは限らないので、設定以外の解答について作問者がオンラインで検討し評価を行うシステムを構築した。

d. 実証実験と事後評価

・ 平成20年2月6日に医学部学生（第4学年）95名についてP-SATを行なった。

・ cで述べた評価を行い、同時期同じ対象者に実施した想起的知識評価法である共用試験 CBT との比較を行った。

C. 結果

1）欧州における医師国家試験のコンピューター化のニーズ

・ ドイツ・フランス・イギリスでは医師国家試験に computer-based testing（CBT）は導入されていないが、様々な形で研究・検討がされている。ＥＵでは医師のＥＵ内での移動を各国が規制できないので、教育レベルの国家間での差を減少させたいとフランス・ドイツでは考えている。医師資格の付与は各国で異なるので、医科大学の

共通評価を通じて教育の質を統一しようとしている。このため、ヨーロッパ医学教育連盟は世界医学教育連盟のグローバルスタンダードを批准した。

- 教材開発の電子化が進んでいるので、教材を試験問題として使用することも可能なことが明らかになった。よって教材開発がCBTを促進することも考えられる。ただし電子的な教材開発は初期投資が必要で、また国家試験として使用するのであれば統一的な規格に基づいて電子化を進める必要がある。

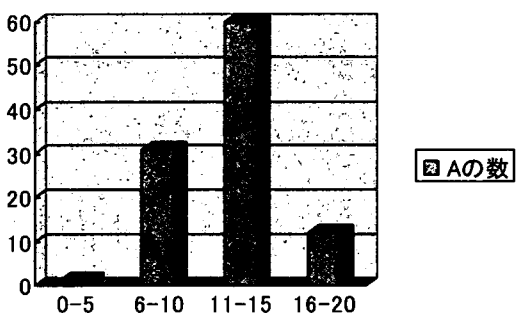
2） 米国における医師国家試験のコンピューター化と患者管理問題による評価

- 医師国家試験に相当するNational Medical Board Examinationはステップ1から3の3回実施される。
- National Medical Board (NMB)試験は電子化が進んでおり、大学もそれに対応している。
- コンピューター試験により単なる想起的な多肢選択問題（MCQ）よりも高度な判断・問題解決能力を評価することができるようになっている。従来のMCQを単にコンピューター化するのでは、実践能力を評価することが出来ない。
- コンピューター化試験により、従来の試験よりも多様な医師としての能力評価が可能となっている。日本での医師国家試験のコンピューター化を検討するときにも、コンピューター試験の特性を生かした従来の試験よりも医療の実践に即した評価方法を取り入れ、一方でコンピューター化できない評価対象を明確にして、その部分は別の評価法を検討する必要がある。

3） P-SAT 実証実験

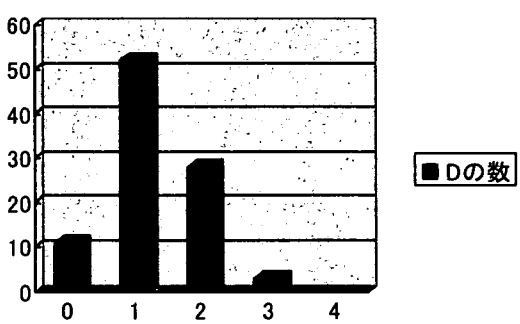
- 試験実施結果
  - 平成20年2月6日に95名の学生が受験した。
  - 2時間で58問を出題したが、全問題を解けない学生が約45%いた。
  - 前年度に実施し、設問・解答パターンが明らかになっている29問についてAからD評価を行った。
  - 29問中A評価の数による受験者の度数分布を図1に示す。

図1



  - 29問中D評価の数による受験者の度数分布を図2に示す。

図2



  - 共用試験CBTとA評価の数、D評価の数の相関：同時に行われた共用試験CBTの成績とA評価の数、およびD評価の数の相関を検討した。どちらについても有意の相関

は認めなかった。

D. 考察

医科大学は、医学教育ニーズとともに資格試験も考慮に入れて教育内容あるいは教育設備投資を行うので、資格試験をどのように行うかは教育機関の運営とも密接に関連する。

ヨーロッパ 3 国における医師国家試験の CBT 化が研究段階であったのに対して、米国では実用化段階である。CBT 化の利点として、従来のペーパー問題に対して、臨床的推論・判断を評価することができると考えられている。米国ではその利点を活かした臨床問題（Patient management test）が国家試験としてコンピューター化されている。

本邦でも医師国家試験のコンピューター化を考慮する際に、経済性、効率性だけでなく、試験自体が従来より高度の能力評価を行うことができる利点を取り入れるべきである。PMP や P-SAT はこの点に特化したコンピューター試験システムである。今後国家試験として実施するには多人数同時受験における信頼性、試験問題の能力の識別力などを検討しなくてはならない。平成 19 年度に行った P-SAT の実証実験は、能力評価が一定の分布を示すことが明らかになったが、一方想起的知識評価としては全国規模で行われ信頼度の高い共用試験 CBT との成績の相関を認めなかったことは今後の検討を要する。この結果は、ただちに P-SAT の信頼性がないということではなく、P-SAT と CBT では別の能力を測定している可能性を検討しなくてはならない。臨床医に必要とされる推論能力・判断能力は従来の評価では測定が難しく、今後 P-SAT 評価結果が、臨床実習あるいは卒後研修などでの臨床推論・判断能力と相関するかの検討を行わなくては最終的信頼性判定ができない。

今回の研究調査では医師資格について国際的評価への動きが高まっていることが明らかになった。すなわち国際的な動向として、医科大学の認証評価が進んでいる。これは医師資格と共に、医師の資質を涵養する医学教育機関の質を向上させかつ国際的に均一化する動きである。平成 18 年度の段階で、韓国・中国などの一部の大学で World Federation of Medical Education (WFME) のグローバルスタンダード基準に基づく評価が行われている。さらに、平成 19 年度はヨーロッパ医学教育連盟が WFME global standard を修正のうえ採択した。ヨーロッパでは EU 内での医師の移動が活発であり、教育スタンダード将来的には国際的資格認証が必要となってくると考える。Global standard の導入は、米国でも一部検討されている。米国も医師を多く輸入しおり、国外の医学教育を受けた医師がどのような水準の教育を受けたかを評価するニーズがあると考える。日本では、大学基準協会が医科大学の認証評価基準を作成しているが、その実践あるいは国際基準（WFME の global standard）との整合性などの検討はされていない。医師国家試験のコンピューター化を検討する場合は、資格試験の国際標準も視野に入れなくてはならない

E. 結論

医師国家試験のコンピューター化は今後実現する意義が非常に高い。コンピューター試験は、経済性・効率性の利点だけでなく、従来の国家試験では評価できなかった医師としての能力特性を評価できる可能性を持ち、国家試験の評価内容と臨床および臨床研修で求められている医学の実践能力が乖離している現状を打破できる可能性がある。また、国際的基準による評価を行

うことにより、世界で医師資格の標準化が論じられている中で日本が孤立しないための一つの戦略となる。

一方P-SATの結果などから、臨床能力(臨床推論・臨床判断) 評価の妥当性、再現性、識別性などについては更なる検討が必要であり、大規模研究を行う体制を整えなければならない。

研究成果の刊行に関する一覧表

書籍

著者氏名	論文タイトル名	書籍全体の編集者名	書　籍　名	出版社名	出版地	出版年	ページ

雑誌

発表者氏名	論文タイトル名	発表誌名	巻号	ページ	出版年
Ishihara S, Matsui K, Sato Y, Tang AC, Suganuma T, Fukui Y, Yamaguchi N, Kawakami Y, Yoshioka T.	Self-efficacy achieved through problem-based learning tutorial.	医学教育	38	391-397	2007

医学教育 2007, 38(6) : 391～397

Comprehensive Research

Self-efficacy achieved through problem-based learning tutorial

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Positive self-esteem helps students build and maintain self-efficacies to affect later clinical practice. We examined the outcome of problem-based-learning (PBL) curriculum by evaluating self-efficacy in terms of sustained learning and clinical competencies among medical school graduates.

1) We compared practicing doctors who either had PBL tutorial experience or who had not by a questionnaire survey.
2) The subjects self-evaluated whether they had achieved expected abilities (1) at the end of undergraduate years, (2) during 2-year internship, and (3) at present.
3) Among 1,502 doctors surveyed (response rate = 36.0%), doctors with PBL tutorial experience had higher self-efficacy (odds ratio > 2.1) in their clinical abilities than doctors without it, especially during the school years.
4) In the later 2 periods, doctors with PBL experience had higher self-efficacy in communication skills.
5) PBL tutorial foster self-efficacy in clinical abilities, especially in communication skills, during earlier clinical career.

Key words: PBL, self-efficacy, learning ability, communication skill

INTRODUCTION

Many medical schools adopted PBL tutorial as a medical education strategy[1]. The educational outcome of PBL has been discussed in the variety of settings yielding different results[2,3]. However, students generally prefer and accept PBL because of its learner-directed component[4, 5]. Our medical school introduced PBL to enhance self-directed learning and problem-solving skills in 1990[6, 7]. Upon implementation of PBL, curriculum on "attitudes toward active communication" and "expression of own view" was also included[8~10]. In PBL, students are also expected to pursuit knowledge of basic science, facilitate active self-directed learning, and promote ability to integrate psychosocial and humanistic concepts in patient care. These competencies are expected to remain in the postgraduate careers.

Some studies have compared behaviors or motivations between students who had been exposed to PBL tutorials[3,6,11]. PBL tutorial is student-centered, however, little studies have examined learners' confidence in terms of their

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learning ability, practice, and behavior through PBL, or self-efficacy[12]. In other words, the outcomes of PBL from the learners' perspective are rarely evaluated. The objective of this study is to quantify self-efficacies in doctors who had PBL tutorial experience. Our medical school had about 700 graduates with 4 year PBL/lecture hybrid curriculum at the time of study. Our study was performed on these graduates and on 700 graduates who graduated immediately before the implementation of PBL curricula.

METHODS

Subjects

There were 1,502 students who graduated from Tokyo Women's Medical University (TWMU) before and after the implementation of PBL tutorial (from 1989 to 2003). Both groups finished their 6-year medical school curriculum which contained 4 years of preclinical and 2 years of clinical studies. The first-year medical school students were mostly high school graduates and a few college graduates. Among these subjects, 783 subjects had 4-year PBL tutorial experience (PBL+) and graduated from TWMU between 1996 and 2003. Other than that, 615 subjects had no PBL tutorial experience (PBL−) and graduated between 1989 and 1994. The remaining 104 students who graduated in 1995 experienced a tutorial trial. Questionnaires were sent to all these graduates.

A detail of the PBL curriculum has been given elsewhere[7]. Briefly, the medical school curriculum is a 4-year organ-based lecture/PBL/lab hybrid curriculum followed by a 2-year clinical clerkship. During the 4 years of preclinical studies, PBL sessions are conducted twice a week for 105 minutes by a group of 6 to 7 students with a non-content expert tutor, followed by a 170-minute self learning time (also twice a week). In the self-learning time, students studied common learning issues that were adopted through group discussions. One case is studied in 4 PBL sessions (group discussion with a tutor). A total of 49 cases are studied during the preclinical years.

The PBL− group underwent a didactic lecture-based curriculum for the preclinical years which consisted of different discipline-based lectures in a large lecture room. Thus, lectures were given in an order of premedical, basic medical and clinical medical disciplines. Laboratory works were combined into the course. The preclinical years were followed by 2 years of clinical clerkship as in the PBL+ group.

Questionnaire:

A questionnaire that contained 85 questions was constructed. The questionnaire was composed of 5 sections. The first section contained 14 questions asking about issues in the undergraduate years. The second section contained 15 questions asking about PBL tutorials (limited to those who had PBL tutorial experience). The third section contained 17 questions asking about issues related to the 2-year internship. The fourth section contained 29 questions asking about present issues and the last section contained 10 questions asking about other information. The items that asked about the 2-year internship and the present issues were the same, and they were more clinically focused. Subjects were asked to evaluate their self-efficacy using a 5-point-scale, ranging from −2 to +2, where −2 = not achieved, −1 = little achieved, 0 = neutral, +1 = fairly achieved, and +2 = achieved.

Subjects were asked to retrospectively evaluate themselves on whether they had achieved the abilities expected of them as doctors during the 3 different defined periods. Questionnaires were sent to all of the subjects by post in April, 2004.

Data analysis:

Self efficacy was compared between the 2 groups (PBL+ and PBL−) during the 3 defined periods (at the end of undergraduate years, 2-year internship, and at present). The 5- point-scale response was further reduced into 2 main groups for subsequent analyses. Mainly, subjects who responded 1 or 2 were grouped as "achieved" and the others were grouped as 'not achieved' . The difference between PBL+ and PBL− were compared by the "n" values in terms of odds ratio. Statistical analysis was performed using JMP IN for Windows (Version 5.0.1a, SAS Institute Inc.).

RESULTS

A total of 121 posted mail were returned for reasons such as unknown address. A total of 541 subjects responded to the questionnaire (total response rate = 36.0%). The response rate excluding subjects with unknown address was 39.1% . Out of these subjects, PBL+ group (n = 239, response rate = 30.5%) and PBL− group (n = 211, response rate = 34.3%) were almost equivalent in number. The remaining 91 subjects included students who experienced the tutorial trial or whose graduation year could not be decided according to their responses. (**Table 1**) The PBL− was older than the PBL+ because their graduation years were earlier than that of PBL+. The age distribution was wide in both groups.

Table 2 shows the doctors' self-efficacy at the

Table 1 Characteristics of the subjects in the Study Groups

		PBL + (N = 239)	PBL − (N = 210)
Graduation Year		1996 ~ 2003	1989 ~ 1994
Present Age	Median	29.8	37.5
	Range	47 ~ 25	53 ~ 33
	SD	2.6	2.6

PBL = problem-based learning.

Table 2 Proportions of subjects who achieved the expected ability "at the end of undergraduate years"

abilities expected to be achieved in PBL	PBL(+)	PBL(−)	OR	95% CI
Attitudes in learning				
self-studying	195 (81.6%)	125 (59.5%)	3.05	1.99, 4.67
collecting information	190 (79.5%)	86 (41.0%)	5.75	3.78, 8.75
multi-phasic thinking	175 (73.2 %)	106 (50.5%)	2.80	1.88, 4.15
logical thinking	154 (64.4%)	97 (46.2%)	2.15	1.47, 3.15
Problem-solving				
setting up and considering a hypothesis	172 (72.0%)	58 (27.6%)	6.87	4.54, 10.41
finding and solving patients' problems	176 (73.6%)	95 (45.2%)	3.41	2.30, 5.07
connecting a knowledge to each case	171 (71.5%)	96 (45.7%)	3.00	2.03, 4.45
Communications				
communication with doctors	148 (61.9%)	84 (40.0%)	2.46	1.68, 3.59
communication with nurses	79 (33.1 %)	44 (21.0%)	1.87	1.22, 2.87
Group discussion				
discussion with students	203 (84.9%)	83 (39.5%)	8.80	5.60, 13.85
cooperative attribution to group	203 (84.9%)	157 (74.8%)	1.94	1.21, 3.10
Knowledge				
Knowledge on subject matters	155 (64.9%)	135 (64.3%)	1.03	0.70, 1.51

PBL(+) : subjects with problem-based learning experience; PBL(−) : subjects without problem-based learning experience;
OR: odds ratio; CI: confidence interval

Table 3　Proportions of subjects who achieved the expected ability "at the end of 2-year internship" and "at present"

Abilities expected of doctors	the end of 2-year internship				at present			
	PBL(+)	PBL(−)	OR	CI	PBL(+)	PBL(−)	OR	CI
Clinical problem-solving								
finding the key to problem-solving for yourself	185(77.4%)	153(72.9%)	1.33	0.86, 2.06	199(83.3%)	197(93.8%)	0.32	0.12, 0.82
finding appropriate literature	178(74.5%)	158(64.0%)	0.99	0.64, 1.53	196(82.0%)	186(88.6%)	0.81	0.42, 1.58
checking the reliability of information	121(50.6%)	114(46.2%)	0.88	0.60, 1.27	175(73.2%)	186(88.6%)	0.37	0.20, 0.68
Writing medical record based on POS	192(80.3%)	156(63.2%)	1.46	0.92, 2.31	197(82.4%)	169(80.5%)	1.98	1.10, 3.57
Communication with patients								
communication at clinical interview	218(91.2%)	189(76.5%)	1.22	0.61, 2.44	212(88.7%)	201(95.7%)	0.21	0.02, 1.82
listening to patients well	219(91.6%)	188(76.1%)	1.38	0.69, 2.77	209(87.4%)	200(95.2%)	0.26	0.05, 1.25
explaining to patients of their diseases	186(77.8%)	161(65.2%)	1.11	0.70, 1.75	208(87.0%)	198(94.3%)	0.47	0.14, 1.54
answering to patients' questions clearly	181(75.7%)	152(61.5%)	1.21	0.79, 1.87	202(84.5%)	200(95.2%)	0.13	0.03, 0.60
Communication with doctors								
with colleagues	221(92.5%)	194(78.5%)	1.06	0.49, 2.31	216(90.4%)	197(93.8%)	5.48	0.63, 47.34
with doctors of different specialties	189(79.1%)	154(62.3%)	1.41	0.90, 2.21	207(86.6%)	195(92.9%)	0.74	0.28, 1.99
with doctors of different hospitals	163(68.2%)	125(50.6%)	1.49	1.00, 2.20	198(82.8%)	188(89.5%)	0.72	0.35, 1.50
Communication with co-medicals								
with nurses	201(84.1%)	180(72.9%)	0.89	0.51, 1.53	204(85.4%)	199(94.8%)	0.34	0.11, 1.08
with medical-engineers	189(79.1%)	176(71.3%)	0.72	0.44, 1.19	204(85.4%)	200(95.2%)	0.26	0.07, 0.92
Group discussion								
promoting the others' understanding	176(73.6%)	143(57.9%)	1.36	0.89, 2.06	201(84.1%)	191(91.0%)	0.66	0.29, 1.49
considering the others' thoughts and logics	186(77.8%)	132(53.4%)	2.19	1.43, 3.34	201(84.1%)	186(88.6%)	1.01	0.49, 2.11
giving your opinion	81(33.9%)	57(23.1%)	1.40	0.93, 2.11	138(57.7%)	133(63.3%)	0.89	0.60, 1.34
Others								
making full use of internet or e-mail for collection of information or communication	147(61.5%)	46(18.6%)	5.88	3.86, 8.96	178(74.5%)	178(84.8%)	0.59	0.34, 1.03

Note: PBL(+) = subjects with problem-based learning experience; PBL(−) = subjects without problem-based learning experience; OR = odds ratio; CI = confidence interval for the OR, POS = problem oriented system.

end of undergraduate years. Most items showed high odds ratios, which were statistically significant (OR = 1.03-8.80). All the items of problem-solving showed higher odds ratios (OR = 3.00-6.87). The abilities of group discussion showed the highest proportion of PBL+ doctors who achieved those abilities (84.9%).

Comparing with the result "at the end of undergraduate years", less items showed higher odds ratio than 1.0 "at the end of the 2-year internship". However, the ability in "communications with patients" and in "group discussion" have higher overall odds ratio (OR = 1.11-2.19). Only the item of "considering others' thoughts and logics" was statistically significant but this superiority in the PBL+ doctors was overcome by PBL- doctors "at present". These odds ratios were overall under 1.0 "at present" (OR = 0.13-1.01).

DISCUSSION

Our study demonstrated self efficacy of medical graduates under PBL curriculum. Our results showed that at the end of the undergraduate years, doctors with PBL tutorial experience have strong self-efficacy in some dimensions which were also some of the objectives of PBL. At the end of the medical school years, PBL graduates showed higher confidence in most of the items listed as attitude of learning, problem-solving, communication and group discussion, compared with non-PBL graduates. This confidence was based on the subjective impression or recall memory of the graduates, yet, the comparison between PBL+ and PBL- showed a clear difference in most of the items. Thus, the PBL had implemented the learners' confidence even after graduation from the PBL curriculum.

Similar findings have also been found among immediate graduates of PBL curriculum[13], but our results showed a longer lasting self-efficacy after graduation. Many studies investigated the outcomes of PBL and had diverse conclusions[2]. It is not surprising to observe a diversity because the outcomes are usually not the sole consequences of education in a medical school and the study effects are often influenced by many confounding factors after graduation. Our results showed that the learners maintained confidence in their learning attitude and skills even after graduation.

The average post graduation year of the PBL+ is shorter than the PBL- and may have affected our results. The answers on self-efficacy given "at the end of 2-year internship" and "at present" showed less or no difference. The results may be interpreted as that the postgraduate experiences are different between PBL+ and PBL-. In addition, the questionnaires addressed the competencies of skills and attitude for medical practice, which may not have directly related to self-efficacy acquired by PBL, showed no difference between PBL+ and PBL-.

Self-efficacy related to communication varied. At graduation, the PBL+ group showed high self-efficacy in communication with doctors but not with nurses. They also showed high odds in discussion with students. Communication with colleagues showed high odds "at present" while communications with co-medicals and with patients were not. PBL may have cultivated an atmosphere to "get along with colleagues". Since clinical doctors usually join the PBL tutorial classes as facilitators, this encounter may have given students good opportunities to build self-efficacy in communicating with other doctors in their early clinical career. On the other hand, nurses scarcely join in any of the PBL tutorials, resulting in fewer chances to talk with nurses during undergraduate years. Similarly, rather low odds in PBL+ in self-efficacy in communication with patients were observed at present. Interviewing skills are not a major objective of

PBL in our university. However, our recent PBL includes role plays of medical interview and bad news telling in order to understand the patient-doctor relationship and the importance of medical communication. These experiences may indirectly promote doctors' communication skills. With regard to the communication ability, some studies showed gender difference[14]. Our study did not address gender difference because our medical school comprises of all female students. Other competencies asked were low at present in PBL+. Again, these competencies are achieved through variable clinical experiences. Therefore it is difficult to interpret data in direct relation to PBL.

Our study showed a difference in self-efficacy in terms of some skills and attitudes learned through PBL between graduates of PBL curriculum and non-PBL curriculum. PBL curriculum can increase confidence among students, especially among those who just graduated from medical school. From the students' perspective, building such confidence is valuable because the students, especially those in preclinical years, have a lot of uncertainties about their future. Although PBL may not be a magical tool to solve all problems in medical education, it certainly is an enjoyable tool for learning and building self-efficacy at the end of medical school. Further study on PBL providing other dimensions of educational outcome should be performed.

The response rate for our study was 36.0% (40% when excluding subjects with unknown addresses) and the rates were not different between the two groups. We consider the response rate acceptable for a study as ours. Unlike in-class survey, a retrospective study on graduates tends to be low[15]. Response rate, as well as difference in age at answer, which was about 8 years in median between PBL+ and PBL− may have affected the results, in addition to possible bias caused from low response rate.

In conclusion, implementation of PBL tutorial provides medical students the opportunities to foster self-efficacy in clinical abilities especially in communication skills in their earlier clinical career.

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