

Special Article
Editing, Writing &
Publishing



Critical Thinking and Scientific Writing Skills of Non-Anglophone Medical Students: a Model of Training Course

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OPEN ACCESS

Received: Sep 5, 2018

Accepted: Oct 17, 2018

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Disclosure

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Barroga EF, Mitoma H.
Methodology: Barroga EF, Mitoma H. Writing-original draft: Barroga EF. Writing - review & editing: Barroga EF, Mitoma H.

ABSTRACT

There are currently very limited reports on the strengths and weaknesses of Japanese medical students in processing (i.e., searching, reading, synthesizing, writing, editing, refining) and presenting medical content based on scholarly journal articles. We developed and offered a 3-week group independent research course in English as a summer elective named “Improving Medical English Skills and Creating English Medical Content (PPT and video) Based on Medical Journal Articles” to our fourth-year Japanese medical students who follow a 6-year medical curriculum as the target audience. Herein, we describe the specific strengths and weaknesses of 6 students who chose and completed the course. Thereafter, we assessed the possible reasons underlying these weaknesses, pondered on the potential implications of such weaknesses on the critical thinking, logical reasoning, and communication skills of Japanese medical students, and suggested approaches to further enhance these skills. The assessments, implications, and suggestions given may provide medical educators new insights on how to newly organize educational and clinical programs to address such weaknesses, improve searching, reading, writing, editing, and presentation skills, enhance critical thinking and logical reasoning abilities, and gain in-depth knowledge essential for effectively appraising and communicating medical content.

Keywords: Communication Skills; Critical Thinking; Editing; Journal Article; Scientific Writing

INTRODUCTION

Despite the increasing need of medical students for English courses or programs on processing and presenting medical content based on scholarly journal articles in countries like Japan, Korea, and China, such courses or programs remain scarce. In other non-Anglophone countries, such courses are not even available. Moreover, strong evidence is lacking to support specific course formats and contents that enhance critical thinking, logical reasoning, and communication skills of non-Anglophone medical students.

In our efforts to produce more of these courses for medical students in Japan who follow a 6-year medical curriculum (i.e., first-year to sixth-year students), we developed and offered a 3-week group independent research course in English to our fourth-year Japanese medical

students as the target audience. This served as an elective for their required undergraduate summer research program which is usually conducted in Japanese. The course name was “Improving Medical English Skills and Creating English Medical Content (PPT and video) Based on Medical Journal Articles.” Six students chose and completed the course.

In this article, we reflected on how the students performed during the course. Particularly, we aimed to 1) describe the specific strengths and weaknesses of the students at each stage of the 3-week course, 2) assess the possible reasons underlying these weaknesses, 3) identify the potential implications of such weaknesses on the critical thinking, logical reasoning, and communication (writing and speaking) skills of Japanese medical students, and 4) suggest ways to further enhance these skills in non-Anglophone medical students.

OBJECTIVES OF THE THREE-WEEK RESEARCH COURSE

This medical English course was conceptualized in reference to our previous works on editing, writing, presenting, and publishing.¹⁻³ The course aimed to improve skills in understanding English medical journal articles, drafting and editing the slide presentation and oral script on a chosen topic based on synthesized information from the journal articles, learning how to create online video educational materials from the slide presentation, and delivering the presentation.

The core activities in each stage of the course involved searching, reading, critical thinking of, synthesizing, logical reasoning of, writing, editing, e-learning publishing of, and presenting medical content based on the selected journal articles.

STRUCTURE OF THE THREE-WEEK RESEARCH COURSE

The course consisted of four sequential stages of cognitive engagement with specific aims as follows:

- 1) Stage I involved the identification of a medical research topic by each group of 2 students. This was followed by the selection of the theme and the comprehension of related English medical journal articles searched from online indexing databases for the group topic. This stage aimed to increase the students' skills in reading, comprehending, and integrating information from the articles.
- 2) Stage II consisted of creating a slide presentation for the research topic based on the selected medical articles, receiving feedback on the slide presentation from the faculty supervisor, and making initial revisions. This stage aimed to improve the students' proficiency in organizing, writing, editing, revising, and presenting their content after synthesizing information from the articles.
- 3) Stage III included receiving feedback on the presentation content from faculty experts in our university, preparing a 10-point quiz based on the presentation content, developing video educational materials from the slide presentation, making the final revisions, and uploading the educational materials online in our university e-learning website. This stage aimed to enhance the students' skills in developing and uploading video educational materials online.
- 4) Stage IV involved the presentation of the educational materials using the slide presentation created by each group, and summation and course recap. This stage aimed to enhance the students' presentation and communication skills.

The details of Stages I, II, III, and IV are shown in **Tables 1, 2, 3, and 4**, respectively. Each stage consisted of various core academic activities. Under each core academic activity, a descriptive observation of the strengths and weaknesses of the Japanese medical students was provided.

E-portfolio was used for feedback at each core academic activity. Camtasia (TechSmith, Okemos, MI, USA), a screen recording and video editing software, and Xerte (University of Nottingham, Nottingham, UK), an open source software for authoring learning objects, were used for uploading the slide presentation with narration and the developed quizzes, respectively.

MAIN STRENGTHS WHEN PROCESSING AND PRESENTING MEDICAL CONTENT

Considering that English is not their native tongue, the students showed adaptability in modifying their presentation content in accordance with the feedback they received from the faculty experts.

The addition of final slides describing their summary and recommendations is a commendable attempt to analyze the implications of their content and make suggestions,

Table 1. Stage I of the 3-week group independent research course of the fourth-year Japanese medical students (n = 6; 4 men, 2 women) in English involving identification of a medical topic for research, selection of a theme, and comprehension of related English medical journal articles on the topic

Stage	Core activities	Strengths	Weaknesses
STAGE I (week 1) -Identifying research topic -Selecting specific theme -Comprehending English articles	1) Course introduction: a) Giving medical perspectives b) Sharing specialization plans	a) Eagerly introduces specialization plans b) Identifies specific fields of interest	a) Lack of firm basis for planned specialization b) Weak perspective of local and global medical standards c) Cannot fully explain main roles of planned specialization d) Medical specialization strongly influenced by parents (doctors)
	2) Review of research article structure	Familiar with basic research article structure	a) Familiarity is up to the heading level only but not in content b) Unfamiliar with different types of research articles c) Lack knowledge of the structure of different research articles
	3) Review of research study designs and indexing databases	Slightly familiar with PubMed, Google Scholar	a) Lack acuity in identifying research study designs b) No knowledge of research reporting standards c) Lack experience in using Scopus, Web of Science, etc. d) Poor information searching skills using search engines e) Limited qualitative and quantitative research knowledge
	4) Searching online databases for articles	Adaptable in learning how to search for articles	a) Unfamiliar with best target journals for retrieving articles b) Lack knowledge of 'predatory journals' c) Not familiar in making search, inclusion, and exclusion criteria
	5) Selecting articles as guide in making educational materials		a) Lack skills in judging the quality of selected articles b) Not aware whether the article is the latest in the field c) Lack ability to decipher the most important data in articles d) There is a risk of identifying minor findings as significant e) Weak article appraisal owing to unfamiliarity with terminology
	6) Reading selected articles		a) Lack skills in making in-depth analysis of research importance b) Cannot proficiently assess the methodology and results c) Limited skills in speed reading and scanning of articles
	7) Understanding selected articles		a) Lack of understanding of English medical terms b) It takes time to fully comprehend an article c) Limited experience in reading and interpreting English articles
	8) Synthesizing main points and data of selected articles		a) Lack knowledge of statistical terminology and methods b) Unfamiliar with study designs and their statistical analysis c) Poor appraisal skills of language, content, and logic
	9) Analyzing content of selected articles		a) Low ability in understanding the novelty of the selected articles b) Shallow critical thinking of research implications c) Lack of confidence in analyzing the relevance of the study d) Inability to accurately interpret the results

Table 2. Creation of slide presentation by the fourth-year Japanese medical students (n = 6; 4 men, 2 women) for their research topic based on the related medical articles, receiving feedback on their presentation content from the faculty supervisor, and making initial revisions

Stage	Core activities	Strengths	Weaknesses
STAGE II (week 2) -Creating slide presentation -Receiving faculty supervisor feedback -Making initial revisions	1) Developing educational materials		a) Lack concept of presentation story b) Unfamiliar with how to create logical flow c) Lack skills in using appropriate tables, graphs, or images
	2) Composing slide presentation: drafting, editing, and writing	Some can create graphics of causative mechanism of disease	a) Grammatical errors in slide text b) Incorrect punctuations, hyphens, spelling, capitalization, plurals, abbreviations, units of measure c) Fail to remember correct sentence structures and patterns d) Not confident in rewriting incorrect sentences e) Unfamiliar with using scientific language f) Inappropriate use of style and words g) Many mistakes in citing and referencing h) Poor skills in streamlining headings and content i) Lack familiarity with online materials j) Poor ability in checking reference accuracy/formatting k) Lack skills in composing good presentation title l) Poor knowledge of plagiarism m) Prone to plagiarize or misinterpret information
	3) Formatting slide presentation: formatting and structuring text and images; editing text		a) Very weak skills in improving visual data b) Poor skills in text editing and formatting c) Low skills in evaluating detail orientation d) Weak skills in evaluating layout e) Poor ability in making concise corrections f) Lack writing skills in achieving brevity g) Lack skills in achieving logical flow
	4) Writing, editing, and revising the presentation oral script		a) Low ability in writing informative oral text b) Lack skills in writing scientific text in slides c) Incorrect formatting, style, grammar, and phrases d) Inaccurate terminology e) Unfamiliar with scientific nomenclature f) Lack skills in writing an interactive oral text g) Poor skills in using language and syntax h) Low proficiency in eliminating ambiguities

Table 3. Development of video educational materials by the fourth-year Japanese medical students (n = 6; 4 men, 2 women) from their slide presentation, receiving feedback from faculty experts, making final revisions, and uploading the educational materials online

Stage	Core activities	Strengths	Weaknesses
STAGE III (week 3) -Developing video educational materials -Receiving feedback from faculty experts -Making final revisions -Uploading educational materials	1) Discussion between students and faculty experts to check for accuracy of content		a) Not sure of the faculty experts to consult
	2) Revising slide presentation based on the comments	Flexible in modifying content	a) Tendency to just accept all suggestions
	3) Composing, formatting, editing, and finalizing educational materials	Analyze implications and make suggestions: imply critical thinking and reasoning abilities	a) Lack zeal in rechecking the slides several times b) Weak motivation to upgrade terminology, fix image format, achieve brevity, and check all formatting c) Inability to estimate information to convey d) Mainly focused on finishing the slides
	4) Making a short quiz	Enthusiastic in making a 10-point quiz based on slide content	a) Lack knowledge of the sentence format to use b) Lack of clarity of questions c) Questions need logical flow d) Wording and sentences require upgrading
	5) Narration /video development of educational materials	Showed persistence in recording narration using PC video software	a) Must improve voice volume, speech clarity, tone, narration speed, pronunciation, and emphasis b) Lack proficiency in audio file preparation

Table 4. Presentation of educational materials by the fourth-year Japanese medical students (n = 6; 4 men, 2 women) using their slide presentation, summation, and course recap

Stage	Core activities	Strengths	Weaknesses
STAGE IV (week 3) -Summation and course recap -Slide presentation	1) Student summation of research experience	Realized the need to a) improve in processing and presenting medical content b) use English regularly c) use medical terms and formal language in slide presentations	Summations mainly focused on a) how they enjoyed the research and presentation activities b) their desire to learn more English
	2) Slide presentation	a) Did not read oral script b) Conveyed intended message	a) Lack of skills in persuasive and extemporaneous speaking b) Difficulties in pronouncing medical terms and disease names

both of which are important components of critical thinking and reasoning. They also showed good enthusiasm in making the quiz.

Moreover, they demonstrated persistence and patience in recording their composed narration when developing and uploading their slide presentations as educational materials online using Camtasia.

At the end of the course, they also expressed realization of their need to seriously improve their abilities in processing and presenting medical content based on English journal articles. They also recognized the vital importance of regularly using English for communication.

MAIN WEAKNESSES WHEN PROCESSING AND PRESENTING MEDICAL CONTENT

The students had limitations in fully expressing their perspectives and discussing in-depth their planned area of medical specialization in English. They also needed substantial information regarding research article structures, study designs, and indexing databases. Mentored guidance in searching online databases for reference articles was necessary.

There was a lack of proficiency in deciphering the most important data after reading the articles. The risk of identifying less important findings as significant could not be excluded. It was obvious that the students' experience in reading English articles was limited. This likely explains their unfamiliarity with English medical terminology and expressions for a particular specialty. Such unfamiliarity limited their ability to quickly connect facts; synthesize, write, and edit information; and interpret findings.

When making the slide presentation, their concept of the whole story and its logical flow was vague. Most students needed guidance on how to make concise summaries and recommendations to address, scrutinize, or improve the medical field they were discussing.

Regarding writing and editing skills, these were not remarkable as there were considerable instances of incorrect punctuations, hyphenations, spelling, capitalization, abbreviations, numbers, units of measure, and plurals. Their skills in streamlining, editing, and organizing the slide headings as well as in accurately correcting the content to achieve smooth organization and logical flow were insufficient. Detailed guidance in making concise slide and oral presentation text corrections was needed. Moreover, the wordings and sentence constructions for the quizzes the students prepared needed careful checking.

In terms of delivering their slide presentation, the students needed to overcome problems with posture, gestures/mannerisms, use of gadgets, eye contact, facial expressions, voice volume, speech clarity, tone, speed of delivery, pronunciation, emphasis, enthusiasm, and reading of the presentation text. Difficulties in pronouncing medical terms, particularly disease names, were obvious.

OVERALL ASSESSMENT OF POSSIBLE CAUSES OF THE WEAKNESSES

The possible causes of weaknesses are summarized in **Fig. 1** and described in detail below.

Student learning seems to cater more to observing rather than participating

In agreement with Kuwabara et al.,⁴ most of the medical school training of Japanese students are simply observing rather than conducting hands on training in the primary care areas as experienced by third- and fourth-year medical students in the US. Naturally, this implies less opportunities for critical thinking, judgment, logical reasoning, problem solving, or evaluative action.

The teaching of critical thinking skills in clinical medicine appears to be delayed

Of great interest is the recent increase in the number of Japanese medical students choosing to bypass the traditional Ikyoku system of training⁴ and instead undergo training in medical

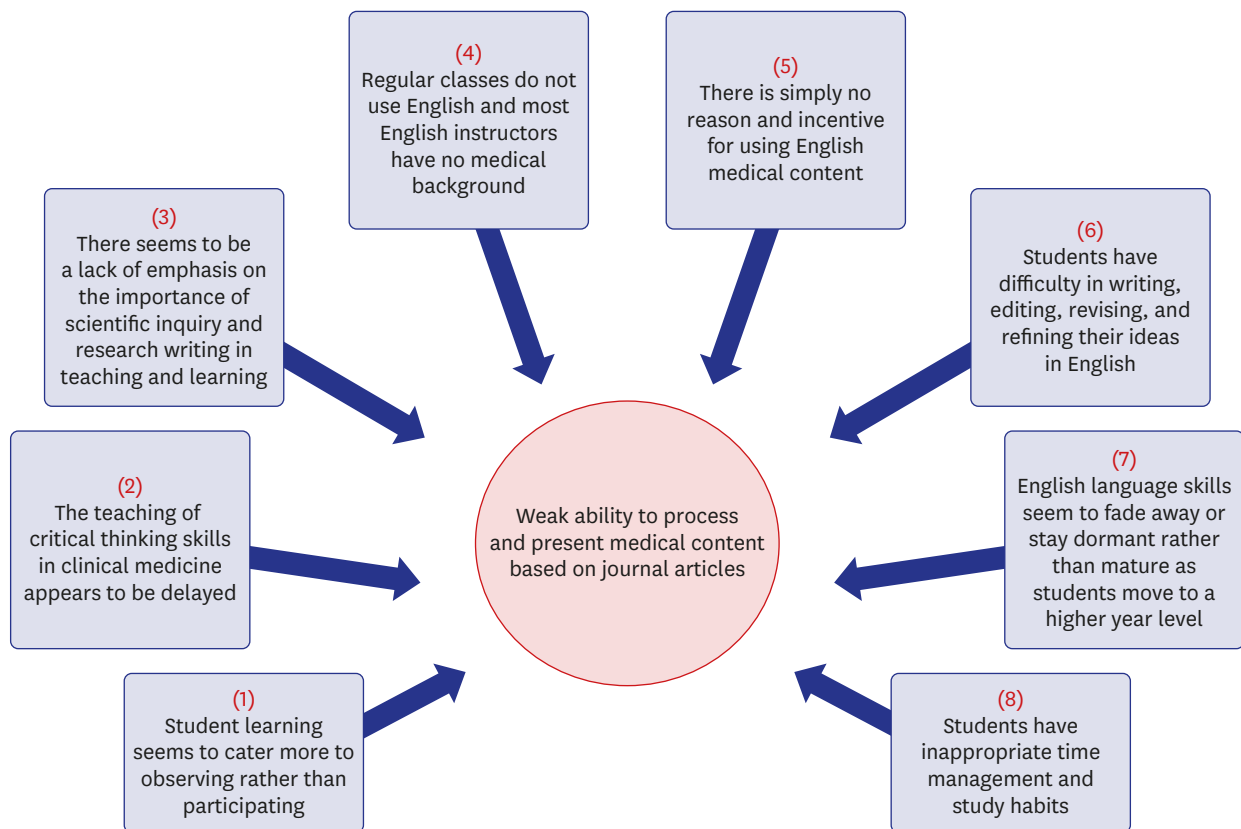


Fig. 1. Overall assessment of possible causes of weaknesses of Japanese medical students when processing and presenting medical content based on scholarly journal articles.

systems that are similar to those in the US. The Ikyoku (or “department”) system is embedded in each Japanese medical university and is chaired by a professor. It provides training to most Japanese medical students after graduation in the areas of education, research and primary care.⁴ Bypassing this system indicates the growing recognition of the delayed introduction of clinical medicine teaching in Japan compared with the US, which suggests the late teaching of critical thinking skills.

There seems to be a lack of emphasis on the importance of scientific inquiry and research writing in the teaching and learning process

The medical education model core curriculum (2016 revision)⁵ stipulates the need to develop courses that will train students to understand fully the necessity of medical research in the global context, acquire critical thinking ability, and participate in academic and research activities. Such courses appear scarce in the Japanese medical program.

Regular classes do not use English and most English instructors have no medical background

In line with Maruyama's report,⁶ it is difficult for Japanese medical students to easily retain skills in using medical English, as well as in synthesizing, writing, and editing English medical information because they do not actually use the medical English learned in class in everyday life. In addition, most medical English teachers in Japan are non-medical majors and they may not be able to explain in-depth medical aspects in English as would medical English teachers with a strong medical background.

There is simply no reason and incentive for using English medical content

Maruyama correctly assesses that Japanese students simply have no critical need for knowing and using English technical terms.⁶ Thus, the recognition of the importance of medical English content may be more theoretical because there is neither incentive nor advancement in using it.

Students have difficulty in writing, editing, revising, and refining their ideas in English

Many Japanese medical students have difficulty in writing and refining their ideas in English because categorizing facts, arranging ideas logically, and expressing and refining them coherently in writing can be an intimidating undertaking. This situation seems to be rather true for many Japanese doctors as well, thus their dependency on commercial editing companies. Maruyama correctly stated that this difficulty is usually complicated by the students' dictionary-dependence, lack of dictionary skills, or insufficient reading skills.⁶

English language skills seem to fade away or stay dormant rather than mature as students move to a higher year level

This is similar to the “canning concept” of Maruyama⁶ wherein the imbibed medical English knowledge during the earlier years of learning seems to fade away or stay dormant as students move to a higher year level.

Students have inappropriate time management and study habits

We concur with the findings of O'Dowd⁷ that Japanese medical students usually take a passive role in their medical English education and that some settle for merely passing grades as these grades have little weight in the Japanese system or future employers. Memorizing mechanically without a clear understanding is also a common problem. Similar to O'Dowd's contention,⁷ a reluctance to add extra time to study naturally results in shallow learning.

IMPLICATIONS OF THE WEAKNESSES ON CRITICAL THINKING, LOGICAL REASONING, AND COMMUNICATION SKILLS AND SUGGESTIONS FOR ENHANCING THESE SKILLS

Although the development and teaching of English courses are clearly essential, the present findings strongly suggest the crucial importance of education on logical thinking in terms of reading, writing, and speaking as summarized in Fig. 2 and detailed below.

Medical educators must continually develop better teaching approaches

We recognize the importance of Jenicek's appraisal that classroom assessment methods can be geared towards a "more participatory, focused, structured, and goal-oriented" manner.⁸ In line with this, we feel that critical thinking must be taught and learnt early following the Socratic Method described by Jenicek.⁸ This involves "clarification, probing assumptions-

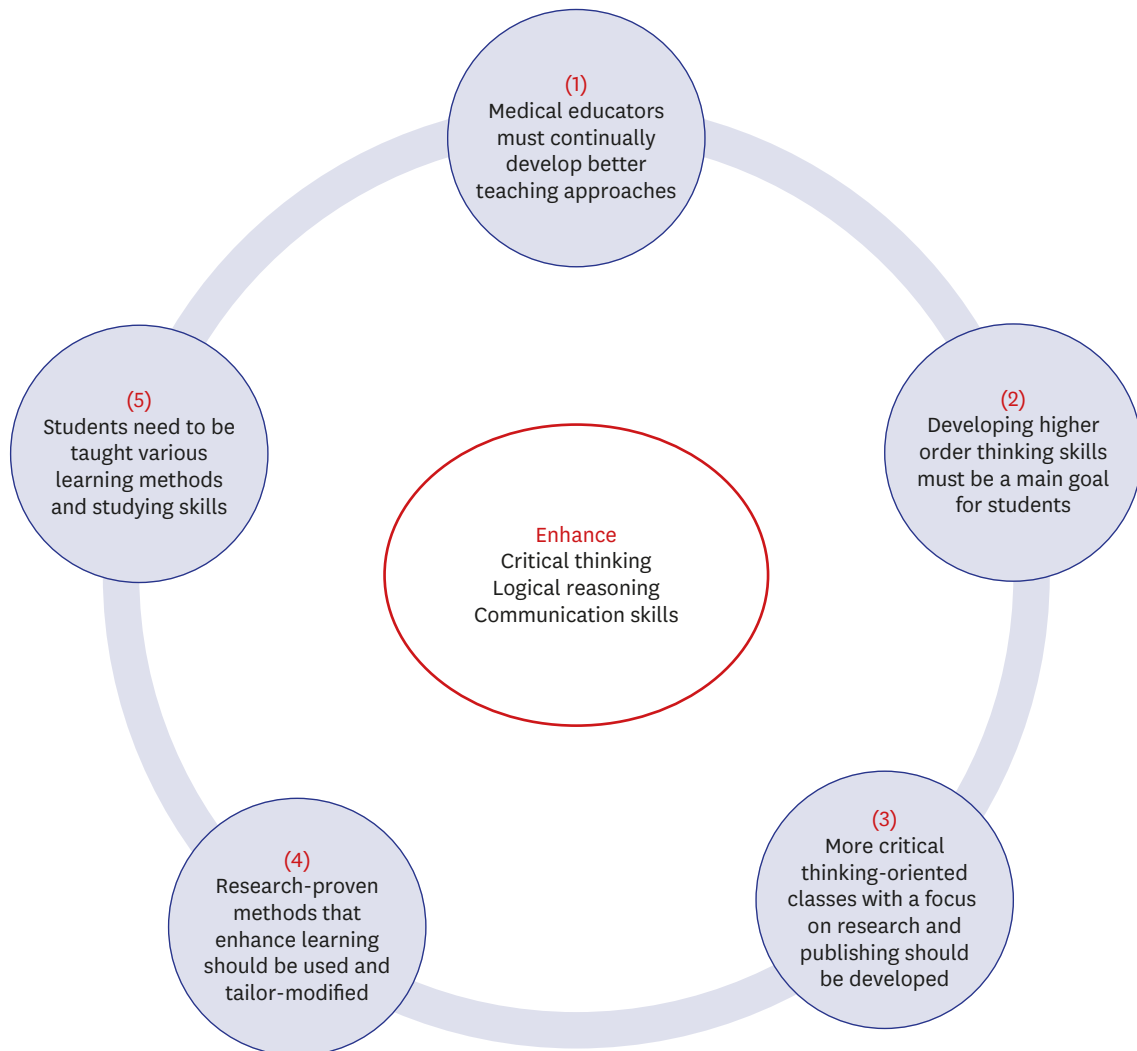


Fig. 2. Suggestions for enhancing critical thinking, logical reasoning, and communication skills of Japanese students when processing and presenting medical content.

questions–reasons–evidence–implications and consequences, and revising viewpoints and perspectives” to improve critical thinking, logical reasoning, and communication (i.e., writing, editing, and presentation) skills.

Developing higher order thinking skills must be a main goal for students

Learning must be carefully planned to address cognition, comprehension, critical thinking, and higher order thinking as suggested by King et al.⁹ The aim must be to improve the ability and skills on how to critically analyze medical situations and related medical information, apply the critical thinking methodology, and evaluate the accuracy and importance of the experience.

More critical thinking-oriented classes with a focus on research and publishing should be developed

It is important to develop more English medical education classes and trainings that are in line with the medical education core curriculum's aim to “improve skills in searching and organizing the latest information from textbooks and papers, and connecting them to understanding and deepening diagnosis and treatment of diseases, based on analyses of patients and diseases.”⁵ This should involve more exposure to and regular activities on ‘searching’ for specific scholarly information using specialist bibliographic databases,¹⁰ ‘reading’ medical and scientific journals, ‘writing’ good quality scientific articles¹¹ and reviews,¹² ‘editing’ and ‘revising,’¹¹ ‘publishing’ in non-predatory journals,¹³ and ‘presenting’ medical articles. In this way, “skills in setting new hypotheses from extracted clinical information and participating in scientific research to arrive at a solution”⁵ may be improved.

Research-proven methods that enhance learning should be used and tailor-modified

We have noted the favorable findings of Itatani et al.¹⁴ regarding the use of problem-based learning (PBL). Indeed, PBL and other similar research-proven methods could be an effective means of improving critical thinking, logical reasoning, and communication skills. These methods enhance various components, namely, knowledge acquisition, group collaboration, communication, critical appraisal, literature retrieval, and ongoing learning within a team environment. These components involve “reflection,” which is the main concept in critical thinking.¹⁴ However, we also recognize that these methods must be tailor-modified to a particular country and students as we have had difficulties in applying PLB in Japan owing to cultural differences.

Students need to be taught various learning methods and studying skills

As suggested by O'Dowd,⁷ students must be taught how to raise their learning productivity using various learning methods to enable them to maximize their study time.

LIMITATIONS

The strengths and weaknesses of the Japanese medical students in processing and presenting English medical content based on scholarly journal articles discussed here are certainly not conclusive or exhaustive. The assessments of the strengths and weaknesses were based on daily observations during the course and careful reflection based on long years of experience in teaching medical students in Japan. This study is purely observational and descriptive and not a structured research involving multi-institutional data across medical institutions in Japan.

CONCLUSION

The weaknesses of the Japanese medical students in processing (i.e., searching, reading, writing, editing) and presenting English medical content based on scholarly journal articles clearly outnumbered their strengths, indicating a problem possibly beyond language skills that needs careful attention. We believe that identification of these specific weaknesses, assessment of the possible causes, clarification of their implications on the critical thinking, logical reasoning, and communication skills of Japanese medical students, and the suggestions for enhancing these skills will provide educators novel perspectives on how to newly organize educational and clinical programs. These programs may provide a foundation for addressing these weaknesses, improving the skills, and gaining in-depth knowledge, especially for medical students in non-Anglophone countries.

ACKNOWLEDGEMENTS

We thank Raoul Breugelmans, Head of the Department of English, and Hitomi Yukawa, Research Associate (ICT) of the Department of Medical Education, Tokyo Medical University for their valuable assistance in teaching the students how to use Camtasia, Xerte, and e-portfolio, as well as in providing timely guidance to the students in their research activities. We also thank Chie Tanaka of the Department of Medical Education for logistic and administrative support.

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