Journal of the Academic Society for Quality of Life (JAS4QoL)

2016 Vol. 2(4) 1:1-14

An Effective Approach for Learning Science English by Non-Native English Science Students: The Stepwise-Stepup Tertiary Science English Education System

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Citation: FOONG, F. W. An Effective Approach for Learning Science English by Non-Native English Science Students: The Stepwise-Stepup Tertiary Science English Education System *JAS4QoL* **2016,** *2(4) 1*:1-14. Online: http://as4qol.org/?p=1710#art1

Received Date: 2016/12/25 Accepted Date: 2016/12/25 Published: 2016/12/31

JAS4QoL

Mini Review

An Effective Approach for Learning Science English by Non-Native English Science Students: The Stepwise-Stepup Tertiary Science English Education System

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Abstract

Many senior Japanese scholars and educators often lament the poor communication ability of Japanese graduates and professionals on the international stage, despite these having learned literary English for at least 8 academic years. Literary English is different from science English (SE) or pharmaceutical science (PS) English (PSE). Therefore, a totally new approach was adopted for Japanese students to learn SE for science-oriented fields, because the terms, expression, and contents are entirely different from those of ordinary literary English. A 4-year program for teaching/learning PSE provided a novel approach, where the PSE level progresses to higher levels of learning with each passing academic year: i.e. a stepwise-stepup tertiary science English Education (SSTSEE) system. Year-1 (Yr-1) students learn the SE basics, Yr-2 then apply the SE basics acquired in Yr-1, and in Yr-3 and -4, they further pursue and develop their PSE ability. Lectures are not unilaterally delivered; students participated actively in developing skills in the reading, listening, writing, and speaking of SE/PSE in a stepwise-stepup fashion. Active-plus-deep learning prompted students to participate actively in lectures, and they further developed the above skills with deep-learning using additional references, as well as illustrations, posters, and powerpoint slideshow presentations. By the end of the Semester 1 in Yr-4, average-level achievers should have established an independent and competent level of reading, listening, speaking and writing ability in PSE. Based on the Japanese education system, the SSTSEE system accommodated students in a timely fashion to develop communications skills for PS students (in semester 2) before they do their practical fieldwork (clerkship/housemanship) at pharmacies/hospitals in Yr-5. The SSTSEE system – involving active-plus-deep learning – is a very practical approach for pharmacy students to develop professionalism with a scientific mindset that will prepare them for higher academic degrees.

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1. Background

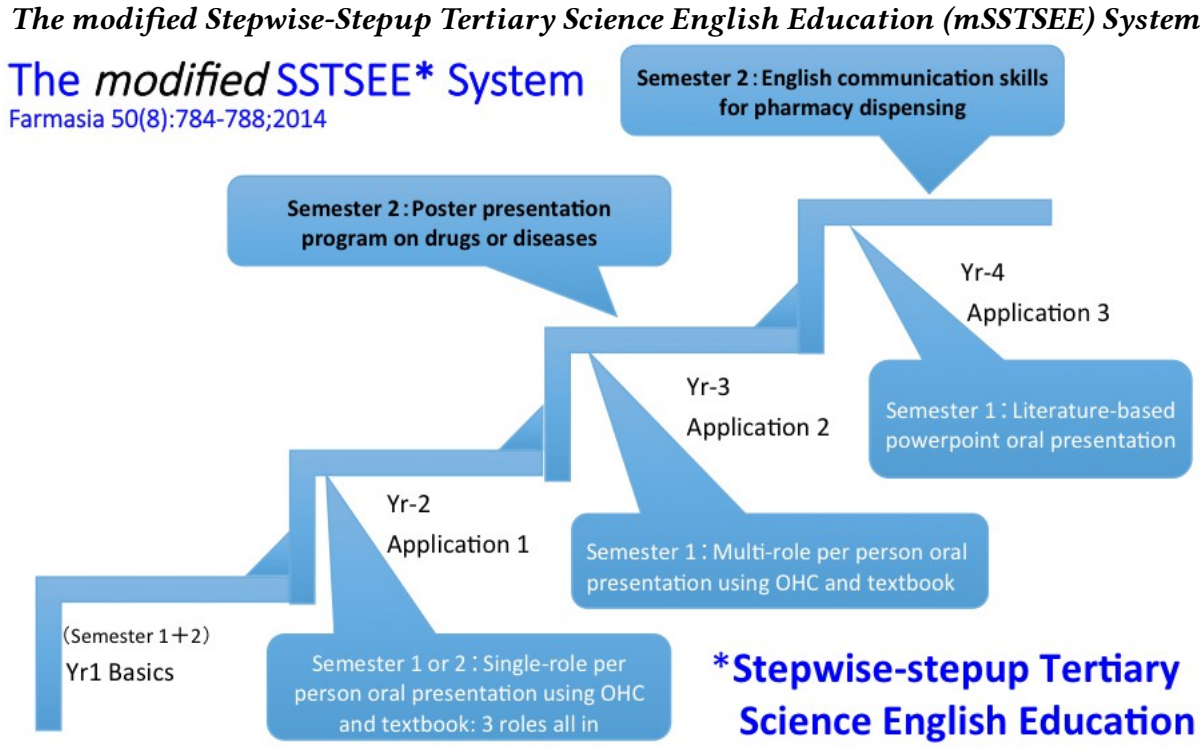
In conversations with many senior Japanese scholars and educators at meetings and conferences, senior scientists often lament the poor communication ability of Japanese graduates and professionals on the international stage,[1] despite having learned English for at least 8-9 academic years (yr) while following the education program used in Japan (3 yr in junior, 3 yr in senior high school; and 2-3 yr at university). Although English has recently been introduced in all elementary schools, the results of this change have yet to be seen. In any case, the English these students learn in their 8-9 yr is literary English, which is different from English for special purposes (ESP). Both science English (SE) and pharmaceutical science (PS) English (PSE), which require the understanding, learning, and acquisition of various PS-relevant technical terms and content-specifics are in fact ESP.[2-4] A totally new approach was adopted for science- and PS-oriented students to learn SE and PSE, respectively, because the terms, expressions, and materials are content-specific and are entirely different from those of ordinary literary English. Apart from its use to name, record, compare, explain, analyze, design, evaluate, and theorize on how the natural world appears to us,[5] SE and PSE are a form of English for special purpose (ESP) required for expressing observations, reasoning, valuation, analysis data, and routine communication in content-oriented disciplines, with the functional use of technical terms, typical expressions, materials and tools[6] relevant to transmitting scientific concepts and discoveries.[1,7-9]

2. Establishing a novel PSE teaching-learning program: the SSTSEE system

The Stepwise-Stepup Tertiary Science English Education (SSTSEE) system[10] represents an approach that had never been practiced before in Japan nor for that matter in many other non-English speaking countries. In this article, a modified Stepwise-Stepup Tertiary Science English Education (mSSTSEE) system is reviewed.

In reviewing results obtained from the present teaching program adopted at university A, the mSSTSEE (Fig. 1) instead of the complete SSTSEE (cSSTSEE; Fig. 10) system was adopted. Basically, the SSTSEE system comprises a systematic method of SE/PSE-teaching that stretches from Yr-1 to Yr-4, and where the PSE level progresses with each passing academic year to higher levels of learning. Due to the class-size in university A, the mSSTSEE (Fig. 1) where students at academic Yr-2 level did only one-

Fig.1: The mSSTSEE system designed for non-native English learners to acquire pharmaceutical science English in university A in Japan. Notice that only one semester is used in Yr-2 (versus 2 semesters in the cSSTSEE system (see Fig. 10).



semester instead of 2-semester study (cSSTSEE system) was employed (note: one academic year has semesters I and II); otherwise the study programs are rather similar in both systems. Note that the data below are all derived from studies based on the mSSTSEE system in university A.

Yr-1: Briefly, at the outset of mSSTSEE system, Yr-1 students learn about the basics of SE/PSE. These basics[11-27] include: numerals and units;[11] shapes, sizes and dimensions;[12,13] expressing mathematical/chemical equations/relationships;[13,14,15] describing writing names of chemical elements, organic/inorganic compounds, reactions;[15,16] understanding and coining of scientific words based on Greek and Latin.[17] In addition, characteristic SE/PSE grammar and content-based vocabulary[18-21] for understanding and describing the physical/chemical properties of chemical agents (i.e. contents which in English-speaking countries would have been mastered by the time students preparing for matriculation/advance level examination or before entering university) were taught/learned using relevant material and tools.[22,23]

Yr-2: Building on these acquired basics, students in Yr-2 apply these skills when giving oral presentations before their peers on topics related to life-science basics (photosynthesis, respiration, carbohydrates, lipids & proteins; nucleic acids & the genetic code; the cell, bacteria & viruses), chemistry (IUPAC system; types of chemical reactions & chirality), and physics (pH and pKa; radioactive decay & radioisotope) with reference to a textbook[24] such that students from different classes in the same academic year follow material similar in content and scope.

Yr-3: When students ascend to Yr-3, they need to prepare slides for illustrating orally presented findings related to the textbook contents[25] that include: basic organic chemistry; food additives and preservatives; digestive tract system; circulatory system; drug administration; prostaglandins, leukotrienes; prostanoids; drug discovery; severe acute respiratory syndrome (SARS); human immunodeficiency virus (HIV); metabolic syndrome; Alzheimer's disease, herbal medicine; kampo; nuclear medicine, characteristics of X-ray, ions & electrons). Students are encouraged to search for relevant illustrations of and additional information on the topics they are supposed to orally present, although illustrations from the textbook can also be used. Semester II in Yr-3 requires students to learn the appropriate way to present findings using posters. The presentation themes are associated with diseases and drugs as follows: background and type of disease, characteristic signs and symptoms, infection routes, contraction opportunities, etiologies, treatment, and prevention. For treatments using drugs, the category, mechanism of action, indication, dosage and regimen, administration route, adverse drug reactions and contraindications (if any) of the drug are included.

Yr-4: In Semester I of Yr-4, students prepare the presentation material from sources of published scientific manuscripts in journals, and divide the content among themselves in such a way that each is responsible for preparing an oral presentation for a certain section of the manuscript using powerpoint slides. No two manuscripts presented cover the same source and content. When and where appropriate, students are required to prepare additional schematic diagrams, illustrations (if necessary), and background data to facilitate understanding of all the sections presented. In Semester II of Yr-4, students learn about pharmacist-customer/patient interviews for over-the-counter (OTC) and prescription drugs using a textbook with listening aids or compact disk (CD) attached.[26,27] Greeting customers/patients, finding the signs and symptoms of diseases, connecting signs/symptoms with possible complications, providing instructions for dosage and regimen, informing customers/patients of adverse drug reactions, checking for possible allergic reaction to substances, helping to promote good compliance, and reminding of contraindications (if any) using professional approach, proper language, psychology, and professional advice in ensuring optimal healthcare and effective treatment with therapeutic knowledge, healthcare knowhow, drug dosage, regimen and the relevant.[28-31]

In addition to oral presentations (Yr-2 to -4), written tests (no written tests for Yr-4) covering grammar and certain technical terms used in PSE,[18-21] and tasks for expressing Japanese-to-PSE contents are given. To cover the extensive syllabi, both multiple-choice and written test are incorporated into the program,[32] as after all extensive knowledge and scientific manuscript writing ability are both ultimate goals of learning PSE in Japan, or for that matter in any non-native English country. With the use of consistent learning materials and tools[6] over the years, time-related progress in reading, listening, writing and speaking SE/PSE at Yr-1, -2, -3 and -4 levels for the SSTSEE system can be established. The essential conditions for establishing this time-related progress included: (i) stepwise-stepup learning tools, (ii) well-

trained teaching staff, and (iii) an active-plus learning system, as well as (iv) the enthusiasm, cooperation, and drive of students.

With the launching of the SSTSEE system, over time not only were students enrolled to use the curricula for academic Yr-1 through Yr-4,[10] but related content-based materials and teaching tools, as well as relevant staff provided with adequate training and guidance, were assembled. In the SSTSEE system, teaching staff were encouraged to make use of microphones[33] in lectures. Training the teaching staff and getting the teaching material and tools ready were closely timed. Since teaching staff were basically scientists (although not language-trained lecturers), training was not all that effort- or time-consuming. Once a team of capable lecturers evolved over time, with each was trained to cater for students in their respective academic years, and they were requested to write relevant content-based textbooks for the four academic yr to meet the learning tools'[6] requirements for students learning PSE at the respective levels,[22-28] with reference to the syllabi taught in Japanese in the university curricula of the respective academic yr (i.e. with the appropriate content in PSE for the respective academic levels).

Academic Yr-1 students learn SE/PSE basics based on active-learning. When students are promoted to Yr-2, they started oral presentations (Yr-2 to -4). In addition to nurturing speaking ability via oral presentations, students had to improve their writing ability via written tests (except for Yr-4) covering grammar and certain technical terms[23-26] used in PSE, and tasks for expressing/translating content from Japanese-to-PSE; both multiple-choice and written questions are incorporated into the written tests.[32] In teaching, all lecturers and students used microphones[33] during lectures at all academic levels because it is the most effective way for mispronunciations to be heard and noticed and for correctional action to be taken when teaching proper pronunciation,[34-38] because all parties present can listen to the proper pronunciation on correction (apart from confidence-building).

3. Methods and Results

It is this very foundation of acquiring these basics (Yr-1) that subsequently provides a springboard for young Japanese science/technology-based students to pursue further knowledge at higher levels (Yr-2 to -4) in SE/PSE-related disciplines and practice their professionalism as pharmacists. Students have found the curriculum useful and interactive, and that it involves active-plus-deep learning, albeit they are required to improve certain aspects of PSE communication at higher levels.

To make any educational program a success, a plan is necessary. A plan does not work without a system. To implement a system into the academic curricula, contents are introduced on a gradual basis with each academic yr adopting a curriculum with a higher level of specificity and content. As the academic yr advances, learning materials and tools were prepared to accommodate the needs of students in learning contents for the relevant levels. Qualified staff were asked to study the Japanese syllabi so that the written SE/PSE learning materials would not be so difficult and complicated as to discourage and pose a burden to students: i.e. parallel learning of the same content was employed. Therefore, content textbooks were developed with each passing yr up to Semester I of academic Yr-3 (published reference books/journals were used from Semester II of Yr-3 to Semester I of Yr-4). The above-mentioned conditions (i) and (ii) were therefore achievable since we employed the appropriate staff to teach and prepare the learning materials and tools on a stepwise and stepup basis; however, condition (iii) was a critical factor, because no matter how perfect and useful a system is, it would fail if those using the system were not motivated or made aware of the useful results and future benefits of the learning process. In other words, students need to be motivated to actively and productively participate in the learning process. Now that an SSTSEE system is in place, conditions (i), (ii) and (iii) are required to be established to make the system functional and productive.

Yr-1: Preparing (i) the stepwise-stepup learning material/tools, and (ii) well-trained teaching staff for Yr-1: Since the author has taught SE/PSE for more than 15 yr, textbooks were promptly prepared for the use of academic Yr-1 students.[22,23] Science-based educated teaching staff were trained to teach the basics before the academic term began. Lecturers were briefed on the teaching methods and content each morning before the lecture, and over time they were all competent and productive in their own teaching approach: i.e. on a stepwise and stepup basis without haste, and they spent 2 semesters in one academic yr to gradually learn and productively acquiring the SE basics.[11-21] As for (iii) the Japanese students, since they were new to SE basics, they were taught using textbooks with attached audio aids (compact disks

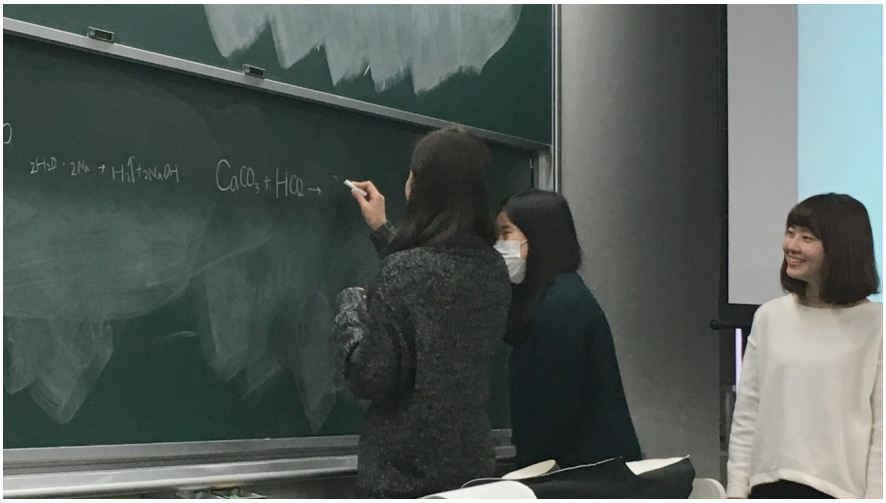


Fig 2: A student is working hard to write out and balance the chemical equation narrated by her peer on the board, while others are enthusiastically looking on and waiting for their turns: active participation from all parties stimulates positive learning.

for listening) to complement listening and pronunciation of SE/PSE terms. Additionally, this is also to ensure that students could access and use the tools to appreciate spoken SE/PSE and learn appropriate pronunciation whenever they were in doubt, as both listening and speaking are essential parts of communication.

Therefore, for condition (iii) to be established, reaping the enthusiasm, cooperation, and drive from students was vital. In the author's experience, conventional unilateral delivery of lectures would be acceptable but could be improved by the following teaching methods. As the learning materials and tools were provided, students could always refer to them for preparation and revision of lectures; and as the process was conducted in a stepwise-stepup fashion, students had ample time and space to accommodate and follow lectures for acquisition of SE/PSE basics. Learning at ease with proper materials and tools was thus established, and now learning with the right attitude was necessary. To generate interest and enthusiasm, lectures were planned and conducted with a combination of lectures and active participation. Lectures accompanied by reproductive learning activities involving participation of all students were included in the lecture. For example, in learning numbers and units, students read certain sentences with numeral and units while others wrote what were read on the board. Or when students had learned elements, chemical compounds and chemical reactions, they were asked to listen to their peers reading a certain self-thought reaction and wrote on the board (Fig. 2). In this way, all students participated in the lectured done for the day, and their understanding would be reinforced through practice and productive thinking each time all participated in the active-learning process. Their enthusiasm, cooperation, and drive from students were well reflected in their feedback via questionnaire (Fig. 3) given to them after the lecture sessions were over.

Perception feedback of students on the teaching content was analyzed using a questionnaire (see contents in Fig. 3, right) at the end of Semester I. Students managed to score significantly higher mean test scores after the lectures compared to their pre-lecture scores, revealing that significant improvements had been achieved in both classes after lecture.[39,40] Interestingly, before the lecture results from testing indicated a general weakness with regards to written answers, and so the consistent improvement established after lectures in Section A (written answers) was significant.[36] However, post-lecture results on

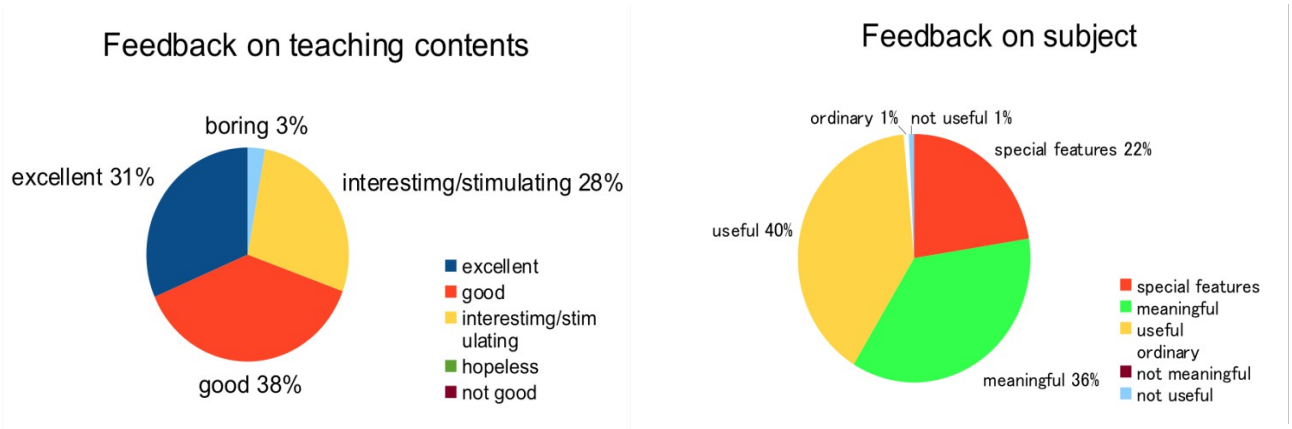


Fig.3: Perception feedback on subject (right) and teaching contents (left) from students at the end of semester using a questionnaire: Students exposed to PSE-based or SE learning for the first time exhibited much enthusiasm, proactive and affirmative feedback throughout Yr-1.

Fig 4: Students presenting their respective sections in a book as a group. Each student plays 3 different roles (English presentation, Japanese summary, and showing visual aids or illustration in a rotational system.

some questions in Section B (multiple choice answers) have demonstrated that student improvement showed inconsistencies, although the scores were improved on the whole. Despite undergoing these quizzes, students indicated affirmative interest in facing the challenge these questions posed. As for subject feedback on SE learning (Fig. 3, left), students were pleased that they had been taught material that they had never heard of or been exposed to before in secondary education, and knew the contents learned would facilitate their academic pursuits in terms of improved understanding and communication in future PS-related endeavors.

Yr-2: In Yr 2 (subject in syllabus: PSE-2), students apply SE basics acquired in Yr-1, and orally present their understanding of PSE contents before their peers.[41] Oral presentations based on textbook contents[24] – comprising life sciences, chemistry and physics – were adopted as challenges by students for the first time since their secondary English education. Certain contents are uniformly streamlined for students so they can learn similar contents in both Japanese and English concurrently: viz., what is learned in Japanese lectures on certain subjects is relearned – only this time in PSE – during the lectures. The class is divided into small groups of 3-4 students and each group is required to read and understand certain passages and/or sections in the textbook, and get to prepare and present relevant visual aids (e.g. illustrations) aimed at facilitating understanding. Each student plays 3 roles in the presentation-rotation: presenter of the main contents in English, of the summary in Japanese and of pointing relevant illustrations while the presentation is being done by presenter (Fig. 3). In addition, students are required to search for additional information related to the passage/section: i.e. deep learning. Lecturers help in understanding the topics by summarizing the textbook contents, and in revising grammar[18-21] and correcting mispronunciations[34-38] made by the students. Meanwhile, the parties listening – the audience – summarize the presented contents in writing using English. As this is their first exposure to PSE, each of 3-4 students plays one of the three roles in the presentation (role-1: presenting in PSE; role-2: summarizing the presentation in Japanese; role-3: showing illustrations in synchronization during the presentation) designated for each subgroup (students are advised to practice among themselves before presentation). Additionally, students listening to each unit complete make/write a question relevant to the presentation and a summary as homework assignment with the use of the textbook. It is gratifying that often students were able to acquire and appreciate through this method what they at first could not understand in the Japanese lectures, and vice versa. This integrated Japanese-PSE style of learning topics enhances, compensates and complements PS-specific learning. Students also learn to orally present their understanding in PSE before their peers, nurturing their reading and writing abilities, and building up their confidence in speaking PSE. As for the audience, they learn to listen to spoken PSE and to ask questions and summarize their understanding in PSE, thus developing a scientifically inquisitive mind, and ability to receive information and expressing their understanding in writing, respectively.[42,43] All in all, students complement each other in learning to read, write, listen, and speak PSE in life science, chemistry, and physical sciences. In summary, the SSTSEE system emphasizes 'basic needs learning,' 'original and creative thinking,' 'teamwork,' 'information-search learning,' 'confidence-building,' and 'public speaking' in PSE learning. Due to lack of time and class-size, question-and-

Table 1: Subject- and Content-related Items after Completion of Presentation Sessions (PSE-2)

About the subject	Count (%)	Presentation content	Count (%)
Specialty	53 (27.5)	Excellent	24 (14.4)
Useful	54 (28.0)	Interesting/stimulating	24 (14.4)
Meaningful	21 (10.9)	Good	88 (52.7)
Ordinary/challenging	48 (24.9)	Not good	10 (5.9)
Not meaningful	10 (5.2)	Hopeless	0 (0)
Not useful	7 (3.6)	Boring	21 (12.6)

Table 2: Perception feedback after presentation (Yr-2): PSE-2

Post-presentation feedback items		Counts (%)
1.	I have learned to do oral presentation in English	41 (27.2)
2.	I have learned certain skills in English presentation	16 (10.6)
3.	I now have more confidence in speaking science English	14 (9.3)
4.	Y have become a better person via group work	38 (25.2)
5.	I have learned to pronounce English words/numerals better	39 (25.8)
6.	I can understand science English better now (via presentation)	18 (11.9)
7.	I have learned to summarize presentations by others in English	7 (4.6)
8.	I have learned nothing	0 (0)

answer (Q&A) sessions between students are abbreviated in Yr-2; however, Q&A sessions are the norm in Yr-3 and -4. In Yr-2 student assessments, the average scores on evaluations of the presentation content (showing of illustrations, providing extra information) and skills (pronunciation, voice volume, grammar, flow/eloquence, illustration provision) and written tests are taken as their grade for the subject. Feedback from students has been encouraging, and the classes were interactive - involving active and deep learning - as well as the approach was useful for students and rewarding for lecturers.[41] It is indeed rewarding to see that pronunciation of certain technical PSE terms and expressions improved with time, although there is still room for further improvement.

At the end of the presentation session, each class was asked to fill out a questionnaire distributed by the lecturer. Of the 168 questionnaires, the effective response rates for ratings of content and perceptions were 98.2 and 90.0%, respectively. The counts for each type of response were expressed as a percentage of the total count, and the respective items were calculated and expressed accordingly (Table 1, previous page). For positive perceptions of the subject-related items (comprising specialty, useful and meaningful), the summed rate was 66.4%, neutral perception accounted for 24.9%, and negative items (not meaningful, not useful) accounted for 8.8% (Table 1, previous page).

For positive perceptions of content-related items comprising excellent, interesting/stimulating and good, the cumulative preference rate (Table 1; right) was 81.5%, while negative perceptions of hopeless and boring accounted for 5.9%. The respective counts (%) for items 1-8 for the 151 students who provided feedback on their perceptions after their presentations (Table 2) indicate that the most frequently given

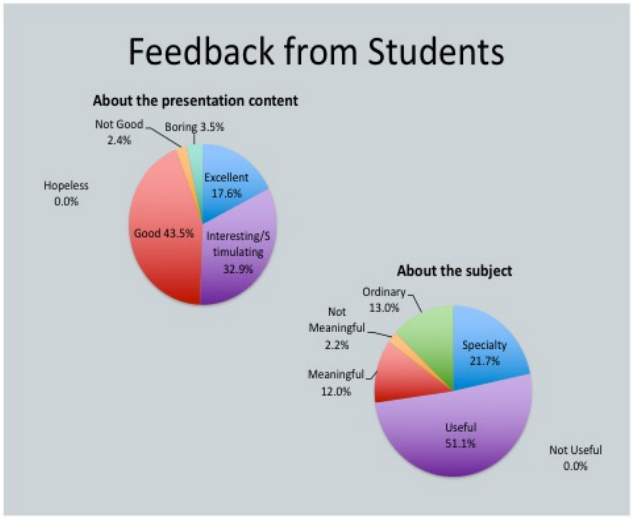


Fig. 5: Yr-3 students revealed that the present contents were: excellent (17.6%), good (43.5%), interesting and stimulating (32.9%, not good (2.4%), boring (3.5%), and hopeless (0%). Accordingly, the subject was: meanigful (12.0%), useful (51.1%), speciality (21.7%), ordinary (13.0%), not mreaningful (2.2%), and not useful (0%).

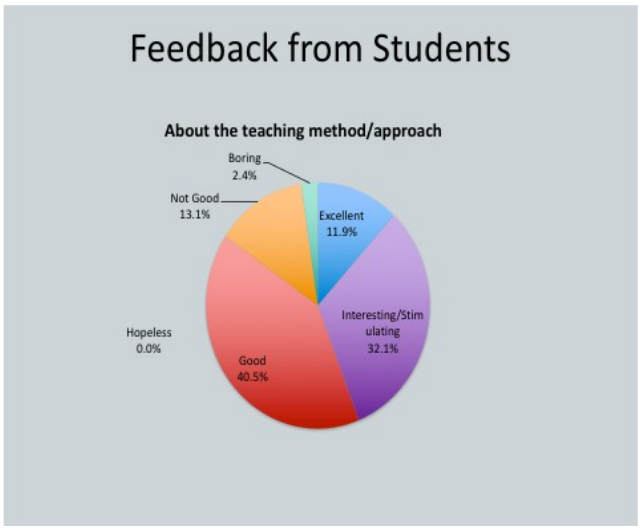


Fig 6: Students found that teaching method and approach excellent (11.9%), interesting and stimulating (32.1%), good 40.5%), not good (13.1%), and hopeless (0%).

post-presentation impression was that students had learned to do oral presentations in English, followed by their ability to understand PSE was better than before (via presentation), although 7% of responded students felt they had learned nothing.

Fig. 7: Students performing oral presentation using a self-designed poster as a group. Each student takes turn to do his/her respective sections with questions from the floor after presentation.

Yr-3: By the time students are promoted to Yr-3, they will have acquired good enough command of the Yr-2 curriculum basics and SE knowledge to participate in PSE communication. A standard textbook is again recommended for Yr-3 students in semester I as a continuing guide them in learning topics more closely relevant to PS. Students (divided into 9-10 groups of 4-5 students each) are free to choose one of the 17 topics from the textbook[25] and the contents of the chosen topic are divided among members of the group. In a manner similar to Yr-2 (active-plus-deep learning),[41] each student has to read, understand, and search for extra information on the section he/she is responsible for. Each lecture covers one unit, and the students listening to presentations need to make a question about and write a summary of each topic presented on the day. Additionally, students listening submit their questions and summaries when the lecture finishes on the same day. A certain time-interval is reserved after the presentation for Q&A.[42,43] When listening-students asks questions, the lecturer writes the questions down and projects them on a screen using an overhead projector to enable all to view them: the questions are revised when incorrect, and the student asking the question reads the revised question aloud to ensure all other students understand the revisions being done. Meanwhile, the lecturer checks the pronunciation of the questioner.[34-38] Here again, on the presenting students' side, they learn to read, write, understand, search for information, and to make an effort to facilitate the audience's understanding by using appropriate illustrations, either taken from reference books or self-created, besides how to answer questions from the floor to enhance understanding. Meanwhile, those on the listening side learn to summarize spoken contents, and construct questions aimed at seeking the truth and developing and exploring their curiosity. Intriguingly, grammar, content, and quality of the questions all showed improvements over time. In response to questions, presenting students are to provide answers in a proper manner[42,43] (albeit there is often room for improvement). Student performance is assessed based on their presentation skills (as in Yr-2, vide supra), Q&A tasking, written summaries, and written tests. The above activities are designated for Semester I of Yr-3.

In Semester II of Yr-3 (subject in syllabus: PSE-3B), students are divided into 9-10 groups of 4-5 students each. In this semester, students are guided on designing and making a poster presentation. Students in each group gather and participate in choosing a theme for the presentation (Fig. 7); the group decision-making serves as an impetus to develop teamwork and rationale-based decision-making. The presentation themes comprise topics related to diseases and drugs as follows: background and type of disease, typical signs and symptoms, infection routes, contraction opportunities, etiology, treatment, and

Table 3: Perception feedback after poster presentation (Yr-3): PSE-3B

Post-presentation feedback items	Counts (%)
1. I have learned to make poster for presentation in science English	48 (28.9)
2. I have learned to do English presentation orally	28 (16.9)
3. I now have learned to speak proper science English	24 (14.5)
4. I can now speak science English more confidently	19 (11.4)
5. I have learned certain skills in poster presentation	24 (14.5)
6. I gain much via group work and communication	11 (6.6)
7. I have learned to listen to questions and answer in English	12 (7.2)
8. I did not learn anything	0 (0.0)

Fig. 8: A Student presents presenting findings from a published manuscript from journals before their peers using power-point slides. Listening students summarize the contents in writing during presentation, and ask questions after the presentation.

Fig. 9: Student answering a question from the floor (right), while another (right) confirming the answer.

prevention. For treatments using medicines, the category, mechanism of action, indication, routine administration route, adverse reactions and contraindication (if any) of the drugs are included in the presentation. Once the topic has been chosen, students in each group share the responsibilities among themselves in preparing the poster: each student is responsible for the presentation and answering questions on his/her assigned section. Each group is obliged to assemble and make an oral presentation using the poster; they then ask each other questions among themselves to enhance their understanding of the sections and the topic before the actual presentation. On the day of presentation, each group gives the presentation using their self-made poster, and other students ask questions after the presentation on a voluntary basis (Fig. 7). Besides nurturing the inquisitive mind of young scientists, this methodology is very important for the development of confidence and self-motivation in students. In a manner similar to Yr-2 (vide supra) and Semester I of Yr-3, the students listening again ask questions and summarize the topic presented by each group. In addition to the group poster, each student of the class on an individual basis chooses and designs a poster on a certain topic. Topics of individual posters should not include material coinciding with or resemble contents presented, although overlapping topics are allowed. Therefore, each individual student submits a title for his/her individual poster for the lecturer to compare with other poster titles. The students' grades are based on the average of scores on presentation skills & contents (vide supra), the summary of each poster, presentation, poster design/content of group, Q&A tasking, and the individual posters. No written tests were given in this lecture session. The objectives of this series of lectures are: the sharing of knowledge on diseases and drugs; cultivating teamwork; reading and understanding of manuscripts; strategies for planning and facilitating comprehension on topics; summarizing research findings; handling Q&A in a proper manner; information-search ability; and the ability to work by oneself. Student questionnaires have revealed that students learned to: design posters for presentations, present findings (Table 3, previous page) in a comprehensive manner, carry out Q&A sessions, and contribute with teamwork.

Fig. 10: Students in pairs performing role-play presentation of OTC in this case. They are also required to role-play prescription drug dispensing using visual aids such as illustrations (shown in upper right).

Table 4: Perception feedback after role-plays (Yr-4): PSE-4B

Item	Description	Poor	Fair	Good	Excellent	Average score
1	Usefulness of subject/lectures	1	2	3	4	**2.93**
2	Textbook/teaching material	1	2	3	4	**3.00**
3	Acquisition of technical terms	1	2	3	4	**3.06**
4	Ability to think in English	1	2	3	4	**2.75**
5	Ability to write in English	1	2	3	4	**2.70**
6	Ability to speak in English	1	2	3	4	**2.84**
7	Ability to construct and ask questions	1	2	3	4	**2.72**
8	Ability to handle/answer questions	1	2	3	4	**2.67**
9	Confidence in public speaking	1	2	3	4	**2.90**
10	Acquisition of therapeutic/disease knowledge, etc.	1	2	3	4	**2.90**

Yr-4: By the time students have passed PSE-3A & PSE-3B, they are well versed in presentation and illustration/data analysis. Students are as before placed into groups of 4-5 students/presentation, and trained to present and performed Q&A as if they were in a conference or meeting.[41] Moreover, when it is called for by the situation, they have to create their own illustrations. Illustrations are first incorporated into the presentation and then presented, including the use of 'animation techniques' when and where appropriate. Note that students at this stage explain and describe the background concepts, methods, results, discussion, and conclusions by merely referring to the visual aids, although some still read from scripts that they have prepared (Fig. 8). They are also required to answer questions from the floor (Fig. 8). Assessment of students is based on: the average scores of their presentation skills/contents (vide supra), summaries of each poster presentation by listeners, and slide design/content of presentation. No written tests were given in this lecture session.

Come Semester II, students in the SSTSEE system are considered ready and able, i.e. sufficiently prepared to learn how to communicate with customers purchasing over-the-counter (OTC) products at pharmacies or chemists, as well as to learn (via role-plays) how to interview and advise patients when performing prescription-based dispensing in pharmacies and/or hospitals (Fig. 10), before students go on their clerkship/internship at pharmacies and hospitals. By this semester, students would have learned the basic technical terms necessary for consultation on the dispensing of drugs and therapeutics, although additional communication skills and certain psychological skills may have to be learned for various situations involving pharmacist-customer and pharmacist-patient interviews. Students again follow a textbook[27] (with listening aids) where communication useful in various situations including pharmacist-customer interviews during OTC purchases at pharmacies, and pharmacist-patient interviews in prescription-based dispensing at pharmacies and/or hospitals.[28-31] The 14-lecture sessions involved listening, presenting of different case studies. In addition, students are required to acquire intensive communication skills using role-plays on case-studies related to OTC product purchase, and prescription-based dispensing. Besides playing the roles of pharmacist and customer/patient, students read, understand, and present the etiological background, signs and symptoms, indications and treatments, drug actions, drug dosages and regimen, compliance/adhesion, adverse drug reactions, complications, and contraindications when and where appropriate before going into each case study. Students in pairs - each time with a different partner (to be versatile and adaptable with any party) - go to the front of the lecture room and discuss the designated disease and/or prescription with visual aids (i.e. illustrations). The students are judged on their ability to use communication skills, presentation skills, role-play content, knowledge for the needs of a given situation (pharmacist-customer in OTC product purchase and pharmacist-patient prescription-based dispensing), understanding of human relationships, psychological skills, and handling of monetary matters (such as discussing prices, quantities), etc. No written tests are administered in this semester. Based on their feedback, students rated highly the teaching materials used, were satisfied with acquisition of technical terms, were able to learn the basics in dispensing using role-plays (i.e. good-excellent), and ranked the other items shown as fair-good (Table 4).

4. Inferences

Yr-1: Based on the post-lecture findings (Fig. 2), students achieved a significant improvement in acquiring SE content (Fig. 2, left side) using appropriate materials and tools,[6,39,40] demonstrating that the basics of SE can be learned and effectively acquired with the help of proper teaching and proactive interest-based instruction using appropriate learning materials. Furthermore, in their feedback (Fig. 2, left), students exposed to SE learning for the first time showed they had acquired a remarkable level of enthusiasm and a proactive attitude for active learning. The SE–learning program given to students in the first few lectures of the SSTSEE system received enthusiastic feedback, although follow-up studies on responses for step-up learning in Semester II warrant further assessment to examine if SE-learning can be enhanced and more fully accepted by students as part of their learning process.

Yr-2: Before entering Yr-2 of this lecture program, most - if not all - students had not done any presentations in English, although they had learned some basic SE in academic Yr-1. Based on their reported perceptions (Table 1, left side), a cumulative 66.4% of the relevant students found the presentation sessions offered sufficient specificity, were useful, and meaningful, while 24.9% described the session as ordinary/challenging (since they had been exposed to SE in Yr-1), accounting a total of 91.3% of the positive perceptions of the subject matter (i.e. presentations using English). As for the presentation contents (Table 1, right), 81.5 perceived the facts and phenomena favorably as excellent, interesting/stimulating, and good, as opposed to those complaining of the contents not being good (5.9%) or boring (12.6%). In-depth studies are required to find out why certain students found the contents not good or boring, although the latter (i.e. boring) could have arisen if the students were being repeatedly taught the same content, or if these students thought they had learned or knew the contents thoroughly enough. Additionally, 57% cited that they had learned to do oral presentations in English via the presentation sessions using science contents (Table 2). Together, the 7 positive post-presentation feedback items (Table 2) demonstrated that the students had gained much more than they would have under conventional unilateral lecturing by the a lecturer/professor and passive learning by the students.

Yr-3: Feedback from students (Fig. 5, 6) for semester I was encouraging, and the lectures appeared useful for students and rewarding for lecturers. It is indeed rewarding to see that the grammar, quality of questions posed, pronunciations of certain technical PSE terms, and English expressions used improved with time. In the Semester-II feedback (Table 3), students reported learning to: make posters (29%), speak PSE (14.5%) and give oral presentations in PSE (16.9%) using posters, with some reporting developing presentation skills (14.5%) and confidence (11.4%). Some learned to make questions, while others learned to conceive answers, although there was room for improvement as far as handling Q&A (especially in answering questions) was concerned.

Yr-4: Semester I (PSE-4A) deals with the presentation of published articles, and by now students have completed the process of learning how to read, listen to, strategize, orally present using posters, powerpoint presentations, or slideshows, and communicate in PSE. Although not all achieved independence and competence at reading, listening, speaking and writing PSE, most did achieve a level high enough to be able to get a jump start on these four linguistic elements of communication for use on the international stage. It is no wonder that a certain number presented their findings without even looking at their prepared written scripts. In short, students were doing just what full-fledged scientist presenting their findings at international meetings and conferences would do,[41,42,43] the skillful performance of which is one of the ultimate aims of the SSTSEE system. In Yr-4 Semester II (4B), the outcomes of students' role-plays for OTC and prescription drug dispensing were satisfactory. The feedback received indicates that students received adequate preparation to handle customers at pharmacies or drug stores,[28,29] and patient interviews at pharmacies/hospitals.[30,31] They further revealed that the PSE-4B sessions are inspirational and helpful in taking on the challenge of the OSCE (objective stimulated clinical examination); passing this exam serves as a prerequisite for pharmacy students aiming to do practical fieldwork (clerkship/internship) in Yr-5. Students are bound to improve on PTC and prescription drug dispensing with time, if they have been given training and they themselves have learned the communication skills.

5. Discussion

Having received the 4 years of training described above, students are now ready to go for their prac-

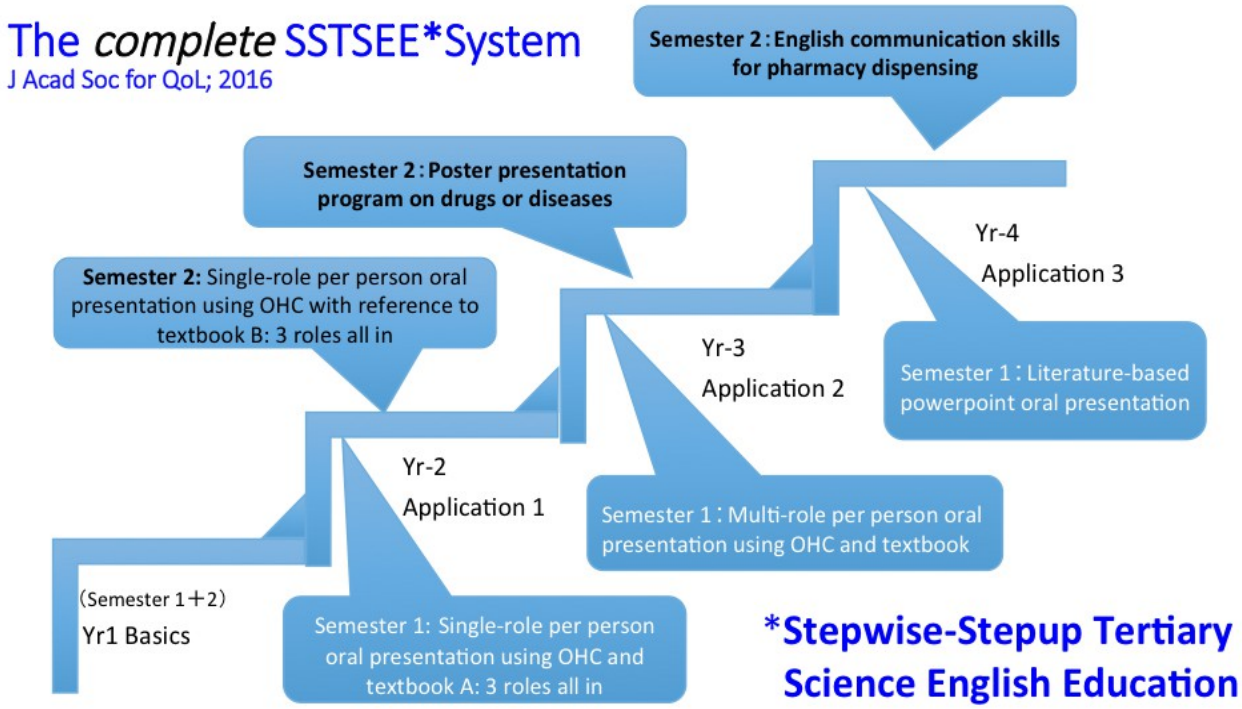


Fig.11: The complete stepwise-stepup tertiary science English education (cSSTSEE) system designed for non-native English learners to acquire pharmaceutical science English requires 2 semesters in Yr-2 (1 semester in the mSSTSEE system) so that students can learn more topics on pharmaceutical sciences for further application in understanding, speaking, and writing.

tical field training at pharmacies and hospitals designated for Yr-5 students as part of a 6-year pharmacy course in Japan. Because of the learning and training they have been exposed to, conscientious and devoted students, who have followed the 4-yr courses faithfully, would be most likely to satisfactorily perform presentation of scientific findings at international meetings and/or conferences as well as professionally perform as pharmacists at pharmacies/hospitals when the needs arise.[28-31,42]

Although the system described here is a modified version (mSSTSEE) of the complete SSTSEE (cSSTSEE) system (Fig. 11), it is still a very effective and practical approach for Japanese pharmacy students to follow in order to overcome the language barriers for globalization. Additionally, the mSSTSEE system facilitates pharmacy students in practicing their profession as pharmacists: i.e. when providing consultation and advice to foreign patients on therapies and drug usage, especially those who only understand English and cannot communicate in Japanese, and when searching for novel drug information. Apart from the Japanese, this system is equally useful for other non-native-English speaking (e.g. Thai, Indonesian, Cambodian, etc.) students aspiring to practice their respective professions. It is a teaching/learning system where active-plus-deep learning is involved. Students learn to speak their own minds, find evidence to substantiate their concepts and inferences, and give due consideration to those in need of their professional service: viz., they develop confidence in public speaking and professional communication using SE/PSE, develop their own philosophy, seek references to support their ideas and positions, ask and answer questions in an appropriate manner, write out their thoughts and conclusions, while not forgetting to use the spirit of teamwork to efficiently and effectively produce and summarize findings.

For those seeking higher degrees and aspiring to do research work at graduate schools, the cSSTSEE system (Fig. 11) indeed provides a more extensively basic groundwork in SE/PSE communication to allow students to become fully immersed and thoroughly excel while studying in foreign laboratories, and to disseminate their findings thereafter on the international stage with confidence and precision. Going on to pursue graduate study at English-speaking and other foreign countries (where English is also used extensively) is, under the SSTSEE system, is practical and useful.

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