CLINICAL & BASIC RESEARCH

Comparative Difficulties with Non-Scientific General Vocabulary and Scientific/Medical Terminology in English as a Second Language (ESL) Medical Students

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صعوبات المقارنة بين المفردات غير العلمية العامة والمصطلحات العلمية / الطبية في اللغة الإنجليزية كلغة ثانية لطلاب الطب

توماس هيمنج، شوبها نانداجوبال

الملخص: الهدف: التعليم الطبي يتطلب استيعاب الطلاب لكل من المفردات التقنية (العلمية / الطبية) وغير التقنية (العامة) على حد سواء. وجدنا من خلال تجربتنا مع اللغة الإنجليزية كلغة ثانية أن الطلاب العرب يعانون عادة من مشاكل في فهم البيانات العلمية بسبب ضعف فهمهم للمفردات غير العلمية. تهدف هذه الدراسة لتحديد ما إذا كان الطلاب يجدون صعوبة في اللغة الإنجليزية كلغة ثانية مع المفردات العامة التي قد تعوق فهمهم للنصوص العلمية / الطبية. الطريقة: قمنا بدراسة مسحية بتوزيع نص للغة الإنجليزية لطلاب طب في بلد عربي في سنوات التعليم الأساسي الذي يسبق التعليم الطبي. تتألف الدراسة من عينة من الأسئلة التي تُعطى في اختبار القبول بكليات الطب بالولايات المتحدة الأمريكية. طلبنا من الطلاب تحديد جميع الكلمات غير المعروفة في النص. النتائج: بدأ الطلاب المذكورين الدراسات الأساسية التي تسبق الدراسة الطبية مع نقص جوهري في المفردات الإنجليزية. وكان الطلاب الذين يدرسون اللغة الإنجليزية بالمدارس الثانوية كلغة أولية يعانون من نقص انتقائي في المصطلحات العلمية / الطبية الذي اختفى مع مرور الوقت. بينما كان الطلاب الذين يدرسون باللغة العربية بالمدارس الثانوية يجدون صعوبة في كلا من المفردات العامة إضافة إلى المفردات العلمية / الطبية. لوحظ أن تلك الصعوبات تتضاءل مع الوقت، ولكنها ما تزال موجودة حتى بعد ثلاث سنوات من التعليم الجامعي باللغة الإنجليزية. الخلاصة: بشكل عام، عند تدريس المواد الفنية لطلاب الطب غير الناطقين بالانجليزية، يتم التركيز على المفردات التقنية الخاصة بالموضوع والمرتبطة بها. تلقي هذه الدراسة الضوء على أن الطلاب غير الناطقين بالإنجليزية يواجهون أيضا صعوبات مع المفردات العامة المستخدمة في بناء عبارات تستخدم الكلمات التقنية. ويمكن لمثل هؤلاء الطلاب الاستفادة من زيادة معرفة المصطلحات العامة.

مفتاح الكلمات: التعليم الطبي، تعليم ما قبل الطب، لُغة، انجليزية، طلاب الطب، التعليم، عُمان.

ABSTRACT: **Objectives:** Medical education requires student comprehension of both technical (scientific/medical) and non-technical (general) vocabulary. Our experience with "English as a second language" (ESL) Arab students suggested they often have problems comprehending scientific statements because of weaknesses in their understanding of non-scientific vocabulary. This study aimed to determine whether ESL students have difficulties with general vocabulary that could hinder their understanding of scientific/medical texts. **Methods:** A survey containing English text was given to ESL students in the premedical years of an English-medium medical school in an Arabic country. The survey consisted of sample questions from the Medical College Admission Test (USA). Students were instructed to identify all unknown words in the text. **Results:** ESL students commenced premedical studies with substantial deficiencies in English vocabulary. Students from English-medium secondary schools had a selective deficiency in scientific/medical terminology which disappeared with time. Students from Arabic-medium secondary schools had equal difficulty with general and scientific/medical vocabulary. Deficiencies in both areas diminished with time but remained even after three years of English-medium higher education. **Conclusion:** Typically, when teaching technical subjects to ESL students, attention is focused on subject-unique vocabulary and associated modifiers. This study highlights that ESL students also face difficulties with the general vocabulary used to construct statements employing technical words. Such students would benefit from increases in general vocabulary knowledge.

Keywords: Medical education; Premedical education; Language; English; Medical students; Teaching; Oman.

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ADVANCES IN KNOWLEDGE

- *"English as a second language" (ESL) students commencing premedical studies had difficulties with English vocabulary, including both scientific/medical and general terms.*

- *The magnitude and persistence of these difficulties, specifically in general vocabulary, differed markedly between students from Arabic-medium secondary schools versus those from English-medium secondary schools.*

- *Difficulties with general vocabulary might hinder understanding of scientific/medical information for ESL medical students, depending on the students' prior exposure to English.*

APPLICATION TO PATIENT CARE

- *English is the de facto language of international medicine, and English proficiency is a prerequisite for success in undergraduate and postgraduate examinations.*

- *The ideal goal of English-medium medical schools in non-English-speaking countries is to produce graduates who are competent in English as well as the first language of their patients in order to support academic success, effective physician-patient communication, and for virtually all aspects of workplace professional communication in the country, as well as the in the globalised medical world.*

- *The present article suggests this is an achievable goal for Arab ESL medical students and discusses strategies to facilitate their English proficiency.*

THERE IS A SIZEABLE BODY OF LITERATURE about the education of "English as a second language" (ESL) students in health sciences;[1–4] however, much of this information addresses ESL students in English speaking countries. There is less information about the challenges faced by ESL students studying health sciences in English in non-English speaking countries. These students may encounter English only during academic activities; consequently, they will have fewer opportunities to develop their English language skills. Moreover, since clinical training in such environments involves interaction with non-English-speaking patients, it necessarily requires switching back and forth between English and the local language. This requirement emphasises the advantage for such students to become competent in English as well as the local language.

Oman Medical College (OMC) is a private medical school in Oman, an Arabic-speaking country. Education at OMC is conducted exclusively in English. OMC's curriculum includes a one-year Foundation Program, followed by a six-year Doctor of Medicine (MD) programme. The MD programme consists of two years of premedical studies followed by four years of medical studies. Students receive approximately 22 hours per week of English-language instruction in the Foundation Program. Before advancing to the MD programme, students must achieve a score approaching 500 on the externally-benchmarked "Test of English as a Foreign Language" (TOEFL). Students receive an additional 6 credit hours of English-language instruction during their premedical studies.

Success in medical studies requires an understanding of both technical (scientific/medical) and non-technical (general) vocabulary. Technical words are often perceived as harder to understand than non-technical words. However, our experience suggested that Arab ESL students often have difficulty comprehending scientific/medical statements because of weaknesses in their understanding of general vocabulary. The present study aimed to determine if this is indeed the case.

Methods

A survey was conducted at the beginning of the academic year, during regularly-scheduled classes, with students in years 2, 3 and 4 of the medical curriculum. In this way, students in year 2 had completed the Foundation Programme, students in year 3 had completed the first premedical year, and students in year 4 had completed the two premedical years. Students were informed that the survey's purpose was to obtain information about their English vocabulary skills. The survey was completed voluntarily and anonymously. It was approved by the institutional review board.

The survey consisted of sample questions from the Medical College Admission Test (MCAT).[5] The survey comprised approximately 2.5 pages of text. Students were instructed to read the text and circle the words they did not know. The survey contained 310 different words, of which 87 were judged to be scientific/medical terms and 223 were general terms. A word was classified as a scientific/medical term if it met the following criteria: it was listed in Dorland's Illustrated Medical Dictionary, or it had no meaning outside its scientific context.[6]

Table 1: Characteristics of student responders (number of students per group)

Group	Curriculum Year		
	Year 2	Year 3	Year 4
Group 1 On-time students from Arabic-medium secondary schools	71	61	39
Group 2 On-time students from English-medium secondary schools	20	24	15
Group 3 Delayed students from Arabic-medium secondary schools	4	5	19
Group 4 Delayed students from English-medium secondary schools	1	1	3
Total number of student responders (response rate)	96 (94%)	91 (89%)	76 (86%)

Students also provided the first two digits of their student identification number and the language of instruction at their secondary schools. The first two digits of the student number indicate the year of initial enrollment. This information allowed the responders to be classified as on-time (Groups 1 and 2: students who had progressed along the expected timeline) or delayed (Groups 3 and 4: students who were delayed because of unsatisfactory performance). Students identified as advanced placement (who had been exempted from the one-year Foundation Programme) were excluded from the study.

The tagged words (words identified as unknown) in completed surveys were compiled. Data for delayed students from English-medium secondary school (Group 4) were omitted from further analyses because the sample size was insufficient to provide meaningful information [Table 1].

Finally, the same survey was distributed to instructors of year 2–4 courses. The instructors were asked to identify the words they believed students did not know. In total, 10 faculty members (response rate = 45%) volunteered to participate. The tagged words (words predicted to be unknown to students) were compiled.

Statistical treatment of the data included one-way analysis of variance (ANOVA). A *P* value of ≤0.05 was considered statistically significant. The data are shown as an arithmetic mean ± standard error of the mean (SEM), unless stated otherwise.
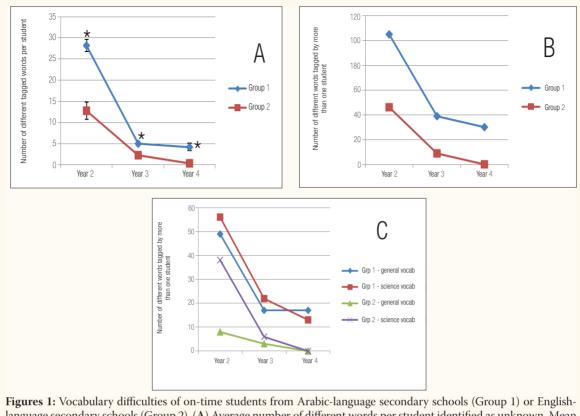
Results

Table 1 shows the number of responding students by group. ESL students in year 2 had substantial deficiencies in English vocabulary. The deficiency was particularly acute for students from Arabic-medium secondary schools. Figure 1a shows the number of different tagged words per student for on-time students (Groups 1 and 2). In year 2, on-time students from Arabic-medium secondary schools (Group 1) tagged an average of 28.2 ± 1.4 (n = 71) different words per student. In contrast, on-time year 2 students from English-medium secondary schools (group 2) tagged less than half that number (12.8 ± 2.0, n = 20).

The same trend was observed when the data were analysed to obtain the total number of different tagged words. However, a comparison of the total number of different tagged words between groups is complicated by differences in the number of students in each group. For example, if each student tagged only one word but tagged a different word than classmates, the total number of different tagged words would reflect group size and not student vocabulary skills. To reduce this bias, the data were analysed to obtain the total number of different words tagged by more than one student. These data [Figure 1b] show that Group 1 tagged approximately twice as many words as did Group 2.

There was a dramatic improvement in vocabulary skills as students advanced through the curriculum [Figure 1]. For Group 1, there was an 85% reduction in the incidence of tagged words between years 2 and 4. Likewise for Group 1, there was a 71% reduction in the total number of words tagged by more than one student between years 2 and 4. The vocabulary skills of Group 2 also improved with time. By year 4, Group 2 knew every word in the survey.

Figure 1c shows the distribution of tagged words between science and general vocabulary for on-time students. Group 1 had difficulty with both science and general vocabulary. The vocabulary skills of Group 1 improved with time, but the number of tagged words in any specific year was almost equally split between science and general terms. In contrast, Group 2 students began premedical studies with a

Figures 1: Vocabulary difficulties of on-time students from Arabic-language secondary schools (Group 1) or English-language secondary schools (Group 2). (**A**) Average number of different words per student identified as unknown. Mean values ±SEM (see Table 1 for sample sizes). (**B**) Total number of different words identified as unknown by more than one student. (**C**) Specific difficulties with general and scientific/medical vocabulary.

* = significant difference between groups (P <0.05); SEM = standard error of the mean.

selective deficiency in science vocabulary but little difficulty with general vocabulary. The deficiency in science vocabulary for Group 2 disappeared incrementally with time.

To examine the retention of vocabulary skills from foundation to advanced level, the tagged words were compared with the Foundation course's academic word list.[7] Of the 310 different words in the survey, 38 were on the academic word list. Figure 2 shows the number of foundation words

tagged by more than one student. Group 1 tagged a substantial number of foundation words in each year. In contrast, group 2 students tagged a small number of foundation words in year 2 and, thereafter, knew every foundation word in the survey.

Another analytical approach evaluated the persistence of specific vocabulary deficiencies by determining the total number of different words that were tagged by students across academic years. In other words, it identified the specific words that

Table 2: Ability of faculty to predict vocabulary difficulties of Group 1 students (on-time students from Arabic-medium secondary schools)

	Number of different words					
	Unknown to students in only one year		Unknown to students in any two years		Unknown to students in all three years	
	General terms (n = 32 words)	Science terms (n = 32 words)	General terms (n = 21 words)	Science terms (n = 17 words)	General terms (n = 17 words)	Science terms (n = 19 words)
Number of matching words, predicted by faculty to be unknown to students	9	12	13	12	13	15
Accuracy of faculty prediction	28%	38%	62%	71%	76%	79%

Figure 2: Retention of vocabulary knowledge from foundation to more advanced levels.

Figure 3: Persistence of specific vocabulary difficulties for Group 1. Number of specific words tagged as unknown by one or more students in only one year, in any two years, or in all three years.

were tagged in more than one year. The analysis was confined to Group 1. The data [Figure 3] emphasise that Group 1 had substantial deficiencies in general vocabulary, similar to their deficiencies in scientific/medical terminology.

Delayed students had greater difficulty with the text than did on-time students. This can be seen by comparing the incidence of unknown words for Group 3 with Group 1 after taking into account the additional time that delayed students had spent in higher education [Figure 4]. This adjustment was necessary because delayed students had repeated an academic year. Where there was overlap between the two data sets, Group 3 tagged about twice as many words as did Group 1.

Instructors were aware of student difficulties with vocabulary. The faculty predicted 60–80% of the "persistently-tagged" words, (i.e. words tagged by Group 1 in more than one year [Table 2]). This applied to both general and scientific/medical vocabulary.
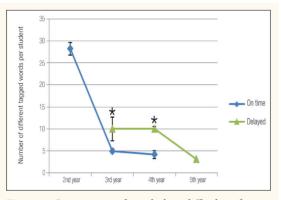

Figure 4: Comparison of vocabulary difficulties for on-time (Group 1) and delayed (Group 3) students. Mean values ± SEM (see Table 1 for sample sizes).
* = significant difference between groups (P <0.05); SEM = standard error of the mean.
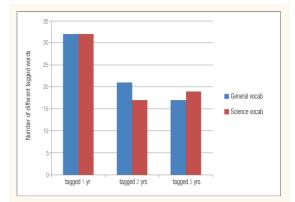
Discussion

On entry to premedical studies, ESL students in this study exhibited considerable deficiencies in both general and scientific/medical vocabulary. Their vocabulary skills improved with time; however, for some students, the deficiencies remained even after three years of higher education. The students with poorer performance had attended Arabic-medium secondary schools. Our past experience indicates that many of these students are effectively monolingual (Arabic only) on entry to higher education. These students had poor retention of vocabulary from foundation studies to more advanced years. They commenced their premedical courses with sizable deficiencies in general and science vocabulary, which did not disappear over the subsequent two premedical years. Not surprisingly, they constituted the bulk of students whose academic progression was delayed due to unsatisfactory performance.

In contrast, ESL students from English-medium secondary schools fared much better. They demonstrated good retention of foundation vocabulary. They commenced premedical studies with a deficiency in science terminology, but relatively good knowledge of general vocabulary. For these students, vocabulary deficiencies disappeared during their premedical studies. Few were delayed in their academic progression. Our past experience indicates that these students are, to some degree, competent in multiple languages (Arabic and/or another language, as well as English) on entry to medical school.

Past studies of second language acquisition have proposed two dimensions to language proficiency: basic interpersonal communication skills (BICS) and cognitive academic language proficiency (CALP).[8–10] BICS are the language skills involved in the development of conversational fluency, whereas CALP describes the use of language in decontextualised academic situations. It takes learners about 2 years of immersion in a second language to achieve conversational fluency but significantly longer, perhaps 5–7 years, to achieve academic linguistic proficiency to the level of peers who are native speakers.[8–10]

A number of factors probably explain the difficulty with general vocabulary exhibited by some Arab ESL students. It seems obvious that ESL students with limited exposure to secondary school English would have poorer vocabulary skills than students from English-medium secondary school. Basically, the students are at different stages in BICS/CALP development. A more subtle influence relates to the inherent interest in ESL. Arabic is the principal language of instruction at public schools in Oman. In order to obtain a secondary education conducted in English, one must attend a private school which entails a financial burden. Thus, one can assume that ESL students from English-language secondary schools had a family interest in English fluency that was acted upon years before medical school enrollment.

It is possible for ESL students in a non-English-speaking country to function in an effective monolingual environment using the local language or a mixed-language (local language/English) environment. The authors' impression is that many Arab ESL students with poor English skills function in a largely monolingual-Arabic environment. These students have minimal interactions with English-speaking peers and little exposure to English outside their studies. As a result, they have minimal opportunity to develop BICS during casual interactions with peers. This effectively negates the distinction between BICS and CALP. For these students, all second language acquisition (both general and scientific vocabulary) is part of the development of their "medical English" CALP.

On the other hand, in our experience, Arab ESL students with good English skills function in a mixed Arabic-English environment. They practice and expand their BICS during non-academic interactions with English-speaking peers. This allows them to focus in their studies on adding scientific/medical terms to their CALP.

A number of strategies could facilitate the development of English proficiency in Arab ESL students, including increased exposure to English, fostering interest in becoming competent in English, and providing increased opportunities for interactions with English-speaking peers. As noted previously, ESL students benefit from using English outside their classroom activities.[11] It also follows that a diverse student population with English-speaking peers is beneficial. For example, European ESL students prefer informal, interactive learning methods (e.g. direct contact with English-speaking peers) over theory-oriented, classroom-based methods of second language acquisition.[12]

Further, since proficiency in a second language develops incrementally over years, it is important that ESL students remain in the curriculum long enough to develop their CALP.[8–10] Thus, it would be beneficial to adopt pedagogic approaches during the early curriculum years that are specifically designed to support students with underdeveloped English proficiency. Such methods could include linguist/cultural adaptation of examination questions, providing extra time during examinations, and using teaching methods that address the unique difficulties that Arab ESL students face in reading English text.[13–16] These "crutches" could be discarded incrementally in later curriculum years as students improve their English proficiency. Given that faculty understand the students' vocabulary deficiencies, faculty input would be valuable to determine how much support to give students entering medical school and how quickly students could be weaned from that support.

It also is important to foster students' interest in becoming competent in English, which involves a degree of acculturation with English. English-language acculturation is a reliable predictor of academic performance for ESL students.[17] If nothing else, students should recognise the utility of English competence in an increasingly-globalised healthcare environment. This could be accomplished by exposing students to bilingual Arabic-English faculty and clinicians as role models. Finally, it cannot be forgotten that learning is driven by testing. Undoubtedly, ESL students will attach increased importance to English skills if they are

assessed for English proficiency in their science and clinical courses.

Previous work has suggested that during the process of learning one language the learner acquires a set of metalinguistic skills and knowledge that are utilised when learning a second language.[8–10] This is the theoretical basis of the common underlying proficiency (CUP) model of second language acquisition.[8,10] According to this model, there is enough cognitive overlap between a person's first and second languages that enhancing the first-language proficiency of an ESL student will benefit the student's acquisition of English. Indeed, there is evidence of cognitive crosstalk across linguistic boundaries in Arab ESL medical students.[18] Thus, instruction in Arabic communication skills is another strategy for enhancing English proficiency in Arab ESL students. As a bonus, instruction in Arabic communication skills will enhance the ability of students to communicate with Arab patients.[19]

ESL students who were delayed in their academic advancement had poorer vocabulary skills than did on-time peers. Other studies with Arab ESL medical students have found a similar correlation between English proficiency and student performance.[20,21] Still, the present data are not sufficient to determine a cause-and-effect relationship, i.e., whether poor academic performance was due to weak vocabulary skills or merely that vocabulary skills and academic performance were indirectly related to each other via another factor (e.g., inadequate study skills). Nonetheless, for delayed students, the difficulty with general vocabulary was an additional challenge to academic success. Thus, it would be helpful to provide additional English instruction to ESL students who perform poorly in preclinical/clinical courses.

Conclusion

English is the *de facto* language of international medicine. Fluency in English is necessary for access to an array of medical/scientific information and for success in many postgraduate medical examinations. However, English is not the first language of most of the world's population. The implication for English-language medical schools, whose graduates will treat non-English-speaking patients, is that graduates should be competent in both the first language of patients and English. The present data suggest this is an achievable goal for Arab ESL students. By the end of premedical studies, students from English-language secondary schools had no difficulties with the survey text. Students from Arabic-language secondary schools had difficulties with both general and scientific/medical vocabulary. Nonetheless, they showed incremental improvements during premedical studies. Such students would benefit from more time and support, as well as further coaching in academic study skills (e.g. help in paraphrasing to avoid plagiarism), to develop their English proficiency.

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