Discovering the role of morphology on the understanding of biomedical terminology by paramedical students

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Abstract. The ability to learn specialized languages, such as biomedical language, requires not only specialized knowledge specific to this area, but also linguistic skills. We propose to study this hypothesis on the example of biomedical language as it is learned by advanced paramedical students in Algeria. Two particularities are to be addressed: linguistic specificities of biomedical terms and the fact that learning process is done in French while the native language of students is Arabic. We perform a questionnaire-based study through which students have to work on recognition and production of biomedical terms and of their components. Several difficulties are observed. We propose that terminology learning programs should strongly develop and rely on linguistic skills of students and on their morphological conscience.

Keywords. Terminology as Topic, Teaching, Paramedical Personnel, Algeria

Introduction

The ability to master specialized languages, such as biomedical language, requires not only specialized knowledge specific to this area, but also linguistic skills [1-2] that help decoding information conveyed by terms or concepts. In this situation, language can be seen as communication means and as the essential factor that permits acquisition of new knowledge and information, understanding of human activity, etc. From this point of view, biomedical language shows several specificities [3]: very frequent use of Greek and Latin words (*eg*., *stimulus)* and bases (*eg*., *hepato-*, *cardio-)*, word construction modes such as derivation (in which the base word is combined with affixes, such as in *hepat<u>ic</u>*, *cardi<u>ac</u>*, *stimulat<u>ing</u>*), composition (in which at least two components are combined, such as in *tachycardia*, *cardiopathy, hepatectomy*), shortening of complex expressions in abbreviations *(eg.*, *NOS* for *not otherwise specified*, *HT* and *HTN* for *hypertension*, *sec.* for *second)*, and also borrowings from other languages. In our study, we propose that a better knowledge of linguistic specificities of biomedical language can help the acquisition of biomedical terminology by paramedical students. One particularity of our study is that the terminology is taught in French for students who are Arabic native speakers. Hence, another challenge is related to the second-language acquisition and mastering [4-5]. The traditional teaching

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of medical terminology to this kind of students in Algeria is by-heart learning of huge lists of terms. We propose to evolve the situation with new methodological approaches. The main motivation of our work, is that it is important to develop linguistic skills of students in order to set up the bases for the acquisition of biomedical terminology and knowledge. More particularly, the following issues are involved in this process: (1) Understanding and learning of biomedical information also depend on knowledge of linguistic phenomena, for which reason the teaching of biomedical terminology should systematically rely on methodological bases; (2) If teaching of biomedical terminology is only based on translation of terms, students are unable to identify elementary units that build the terms, and have difficulties with learning these terms; (3) If students neglect morphological and semantic information on terms, through their learning by-heart, they are unable to recognize terms already learned and to understand new but similar terms. The objective aimed by the current work is to propose descriptive and analytical approach in order to study whether understanding language and terminology is important in biomedical learning of paramedical students. We expect that such results may allow proposing new and better adapted methods for terminology teaching.

We present now the material used, and our method for studying how paramedical students perceive and understand medical terms. We then present and discuss the results, and conclude with directions for future work.

Material and Methods

Our material is composed of a set of medical terms typically taught to paramedical students. An important part of these terms are compounds (eg, *cardiologue (cardiologist), névrite (neuritis)*). In order to study the perception and understanding of these terms, we have developed questionnaires submitted to advanced paramedical students. Terms from questionnaires have been studied during their training. Questionnaires have seven questions dedicated to various tasks:

1) *Decomposition of medical terms*: students have to decompose medical terms (*ie.*, *cardiologue (cardiologist), névrite (neuritis), hypercalcémie (hypercalcemia), bradykinésie (bradykinesia), myalgie (myalgia)*), for which they have to recognize morphological components and to master the meaning of these components. In most of the cases, terms must be decomposed in two components, except for *hypercalcémie* that contains three components.
2) *Construction of medical terms*: students have to create medical terms starting with given components *(ie., -pnée, -cardi, lipo-, arthro-*) and the meaning of the expected compound to be coined. Given components can be located at initial or final position. Students must know the components meaning and the composition rules to create semantically meaningful terms. For instance, if *-pnée* (*-pnea*) means *breathing*, term that means *absence of respiration* (*absence of breathing*) – *apnée* (*apnea*) must be indicated.
3) *Understanding of morphological components related to anatomy*: for suppletive components (from Greek or Latin) such as *céphalo- (cephalo-), ostéo- (osteo-), hépato- (hepato-), néphro- (nephro-), myo- (myo-)* students have to indicate the corresponding words in French, such as *myo-* means *muscle.*
4) *Detection of semantic head of terms*: students have to detect the semantic head of terms *(ie., amygdalite, arthropathie, gastroscopie, ostéome, appendicectomie,*

fibrome, *hépatite*, *urographie*, *tuberculose*, *homéopathie*, *arthrose*, *mammographie*). The expected knowledge is related to the composition rules of biomedical compounds and the fact that semantic head of such compounds is mostly positioned at the end: *-ite* in *amygdalite*, *-pathie* in *arthropathie*, etc.

5) *Classification of terms as disorders and procedures*: students have to classify terms as disorders *(eg., amygdalite, ostéome, hépatite, arthropathie, urographie, fibrome, tuberculose, homéopathie, arthrose*) and procedures (*eg., urographie, mammographie, gastroscopie, appendicectomie*). The expected skill is to be able to detect the semantic head of terms and to know its meaning. For instance, *-ite* (*-itis)* means *inflammatory disease* and is a disorder, *-ectomie* (*-ectomy*) means *removal* and is a procedure.

6) *Processing and understanding of abbreviations*: students have to explain the meaning of abbreviations *(eg., VIH, ADN, LCR, AMP, Hb, labo*).

7) Non-expert to expert transformation: students have to coin expert term starting with a given non-expert paraphrase. Three paraphrases are tested: *j'ai des douleurs au niveau de l'estomac* (*I have stomach ache*) *– gastralgie (gastralgia), j'ai perdu l'appétit (I lost appetite) – anorexie (anorexia), j'ai une accélération du rythme du battement cardiaque (I have accelerated heart rhythm) – tachycardie (tachycardia)*. This question requires knowledge of biomedical components, their general language equivalents and rules for their combination.

Questionnaire is submitted to students. The investigator is present during the test. The results are analyzed in order to draw conclusions on the knowledge acquired and on processing of these terms. 38 advanced paramedical students participated in this study. Students have studied for three years and all of them followed the same courses on biomedical terminology (12 hours). These students are intended to practice as nurses, radiologists, technicians, midwives, or medical secretaries. Knowledge of biomedical terminology is important for all of them.

Results

The population of students that participated in the study has been characterized according to an existing grid [6]. It appears that these students are all university students that follow the training courses, their first language is Arabic, they are training for paramedical specialties, they have to meet the language objectives (acquire biomedical terminology), the objectives of their training are precise (training), the terminology courses are part of a larger paramedical training, the training is done in a French-speaking country that is the same than the birth country, all the teaching materials are offered by school and teachers. We assume that this student population can be qualified as homogeneous from linguistic and academic points of views.

Table 1. Evaluation of students' answers according to the seven tests.

Task		*Correct*	*Wrong*	*No answer*
1	***Cardiologue***	34	4	-
	Névrite	30	-	8
	Hypercalcémie	16	22	-
	Bradykinésie	32	-	6
	Myalgie	28	10	-
2	***-pnée***	29	9	-
	-cardi	23	15	-
	lipo-	26	12	-

	arthro-	36	2	-
3	***céphalo-***	25	-	13
	ostéo-	33	-	5
	hépato-	26	-	12
	néphro-	21	17	-
	myo-	28	-	10
4	***Semantic head***	27	9	2
5	***Classification of disorders***	13	25	-
	Classification of procedures	19	19	-
6	***VIH***	5	33	-
	ADN	13	25	
	LCR	22	-	19
	AMP	23	-	15
	Hb, labo	20	14	4
7	***J'ai des douleurs au niveau de l'estomac***	31	-	7
	J'ai perdu l'appétit	8	30	-
	J'ai une accélération du rythme du battement du coeur	29	5	4

In Table 1, we indicate the students' answers to the questionnaire. We can observe that globally students manage quite well the terminology they have been studying for three years. Yet, several tasks show difficulties, such as explanation of abbreviations (task 6), classification of terms (task 5), and processing of anatomy terms (task 3). We discuss the obtained results in more detail in the following section.

Discussion

The first question on the term segmentation is successfully performed by students: in this task they have to recognize the components already available in the analyzed terms. Only one term h*ypercalcémie* appears to be difficult to be segmented. We assume the one reason is that this term is composed with three components. As a matter of fact, students attempt to segment it (*hyper-calcé-mie, hypercal-cém-ie*, etc.) but their proposals are wrong. Another reason is that these components may be less frequent in language and less familiar as compared to *-ite* or *-logue*, which brings additional difficulty. Situation is similar with *myalgie*, which also shows segmentation problems.

The task on construction of terms starting from one known component fully relies on production of new items. Such production tasks are usually more difficult to perform as they depend on active knowledge of biomedical terminology and of its components. We can observe indeed that several expected terms cannot be coined or are wrongly coined. It appears also that both, initial and final, positions of the components may be problematic for students.

Task three on recognition and translation of anatomic components also appears to be complicated for students. We assume that several reasons may be responsible for this result: (1) anatomy terms correspond to highly specialized terms often reserved to medical experts, (2) the components involved in the study may show comparatively low frequencies in general and biomedical languages, (3) some components may be confounded with each other (*eg*, *néphro- and neuro-*).

Task four on recognition of semantic head is quite successful as almost all the students are able to perform the task on almost all the terms. Only nine terms are processed incorrectly and two terms are not processed.

Surprisingly, task five on classification of terms presented some difficulties. Since this task is closely related to the task four (detection of semantic head), we expected it

would show better results. Nevertheless, the results indicate that it is necessary not only to correctly recognize the semantic head but also to know its meaning, and to manage fundamental knowledge on biomedical classification. Mastering all these skills together appears to be difficult.

As expected, task six on explanation of abbreviations is felt to be complicated. This is both, recognition and production, task. Besides, there is almost no formal clues that would help to perform this task, since the only clues available are the first or initial letters of complex expressions. Hence, student must know exactly the meaning of these abbreviations and the expanded form of each letter. This last condition is particularly complicated and requires solid learned knowledge.

Finally, the task on creation of expert terms starting with non-expert paraphrases appears to be not so difficult for student. We expected this task would be more complicated for them as it requires sophisticated knowledge (exact equivalence between non-expert and expert words and components, and composition rules).

The obtained results seem to support the idea we proposed to study: learning of biomedical terminology strongly depends on knowledge of linguistic phenomena, as biomedical terminology shows several linguistic and morphological specificities. Besides, we assume that teaching of biomedical terminology should systematically rely on methodologies that are based on linguistic skills and realization of morphological conscience [7] of learners. In this case, processing of new biomedical terms is expected to be easier for these learners.

Conclusion and Future work

We presented a study in which we observed that paramedical students may have some difficulties in semantic processing of biomedical terms they have learned during their training. Since these terms show a high linguistic and morphological complexity we propose that terminology learning should also develop linguistic skills and morphological conscience of learners, and rely on these for the terminology teaching. Our future work is to propose such methods and to test them on the same kind of population of paramedical students. Besides, the fact that students learn in French while their first language is Arabic may also influence the learning process, and we would like to research this point as well.

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