

The importance of technical writing skills for students of engineering and science studies

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Abstract

In the 21st Century, the needs of those who learn English evolve. The acquisition of vocabulary is a fundamental and important component in any course to most foreign language learners. In the last decades, the English courses for specific groups of learners have become highly important. English for specific purposes has found its way with the economic, technological and scientific development. In order for students to develop technical and scientific literacy, they need to gain a knowledge of technology and science content and practice scientific habits of mind. This is impossible without knowledge of specific vocabulary. The paper provides the readers with the authors experience and the research results in this field.

Keywords:

Technical terminology
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1 Introduction

In the 21st Century, the needs of those who learn English evolve. The acquisition of vocabulary is a fundamental and important component in any course to most foreign language learners. In the last decades, the English courses for specific groups of learners have become highly important. English for specific purposes has found its way with the economic, technological and scientific development. In order for students to develop technical and scientific literacy, they need to gain a knowledge of technology and science content and practice scientific habits of mind. This is impossible without knowledge of specific vocabulary. The paper provides the readers with the authors experience and the research results in this field.

With rapid advances in technology come rapid advances in the language of technology, or English for Science and Technology (EST). EST courses are usually designed to inculcate students with an ability to read and write the scientifically and technologically oriented English that they are likely to encounter in their professional careers. Teaching of English for Specific Purposes at non-philological fields of university studies is grossly underestimated. The results of our research show that the reasons are different. The study deals with specifics of technical vocabulary to show its importance in the process of individual professional development.

There is no doubt that English language has become a language of Science, Technology and Business. Having a good understanding of technical vocabulary is a requirement of many professions. Often in the fields of Science, Engineering, Information Technologies, Medicine, there is a need to manipulate technical language with ease and fluency. In Arts, Humanities and Social science disciplines, there is also a requirement to use what may be termed 'specialised' vocabulary, though this will not usually be regarded to be 'technical'. Technical vocabulary is a major concern for learners who have special purposes in language learning (Chung, Nation, 2004). One of the prominent aspects of the linguistic knowledge needed to comprehend specialized texts is the corresponding specialized vocabulary or "technical words that are recognizably specific to a particular topic, field, or discipline" (Nation, 2001). Technical vocabulary development is essential in order to achieve proficiency in English for Science and Technology. Research has shown us that there are several barriers to the application of this approach in teaching ESP/ESAP courses. We can conclude that these are several subjective and objective reasons: insufficient teacher training, resistance and reluctance of teachers, insufficient time allotment, incorrectly adjusted curriculum, poor methodological course management, vaguely

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motivated students, lack of interest of students, lack of specialised textbooks, lack of teaching materials, teacher training colleges curricula. The purpose of this study is not to discuss the above reasons, but offer some solutions, as well as to share some outputs of the KEGA national project "Model for improving the quality of graduates and job applicants in European labour market".

2 Technical writing in Science and Engineering fields of study

How important is the quality of the English language in an article? With ever-increasing standards of excellence in both research and publishing, it is in authors' interest to make sure their manuscripts are in the best possible form when they submit them for publication. One important factor is the quality of the language used: errors in grammar, spelling or punctuation could delay publication or even lead to rejection of the manuscript, preventing the research from receiving the recognition it deserves. It is often due to the poor quality of language that editors return manuscripts to authors to make improvements. What impact does language quality have on the peer-review process? It is the author's responsibility to provide a well-written manuscript. Editors and reviewers are not responsible for making language corrections. Well-structured manuscripts with correct language usage help ensure that the peer-review process runs smoothly by enabling editors and reviewers to focus on academic merit, and not be distracted by language errors. Finally, providing a well-written and properly structured manuscript could result in faster process of publishing (Elsevier.com).

According to papers indexed by Institute for Scientific Information, in 1980, 53% of 28,000 papers written in France were in French. By 2000, the proportion of French-language papers had dropped to 13%. Likewise, German-language papers fell from 47% of overall papers produced in Germany in 1980 to 11% by 2000 (Reis, 1997). According to Richard M. Reis "Almost any scientist will say that if you lack English fluency, your career will go nowhere. And that is probably true of those whose English skills stop at the conversational level. Some protest the dominance of English, but most accept the fact that it has become the de facto language of science (Reis, 1997)." Evidently, in order to get recognition, researchers must publish results in English. Why has English become so important? "English has a larger vocabulary than any other language besides ancient Greek and Latin," says Mary Barkley, a biology professor at Case Western Reserve University in Cleveland, Ohio, and also an associate editor of the journal *Biochemistry*. "It's easier to articulate on technical matters in English than in any other language." (Jaffe, 2003) According to my experience, some work fellows with poor English skills who often publish in English language journals rely heavily on English-speaking colleagues who are also their close friends. However, the demands placed on the friendship can be excessive. "It's too time-consuming to work on someone else's English writing skills," says Robert Williams, chemistry professor at Colorado State University, who is a former editor of the journal *Amino Acids*. He stopped offering such help to colleagues when he discovered that he was spending more time on that than on doing actual science. (Jaffe, 2003) What more, some researchers rely on automatic translation software, what produces more errors and more crucial work for a proof-reader. Anyone who has used freely available web translators such as Google's translator service (www.google.com) can see that the technology is in its infancy: good enough to get across the meaning of a simple conversation, but nowhere near accurate enough to translate technical documents. Without English, a scientist lacks a crucial tool for his/her career. The next generation of scientists in non-English speaking countries might have it better than their parents, though most scientists agree that English education in Eastern Europe has improved dramatically over the last few decades.

3 Material and methods

At the Faculty of Natural Sciences, University of SS. Cyril and Methodius in Trnava, Slovakia, we realize the fact that only language training and tutorial of doctoral candidates, postdocs and young scientists is the solution of the above-mentioned problem. Therefore in 2008, we carried out needs analysis of this target group, and built up an English language syllabus for doctoral courses, where there was included the course of English for Specific and Academic Purposes aimed at the topics resulted from the analysis (Miština, 2012). To improve the content of the course and intensify the academic language training and improve its efficiency, we did not rely only on this analysis. Since January 2009 until May 2013, we did linguistic analysis of 57 research papers of PhD candidates, postdocs and young researchers. The papers were submitted for proofreading, and therefore not in the final form for peer reviewed journals or proceedings. Some of the analysed research papers were developed together with older and experienced research fellows, professors or associate professors, PhD advisors and supervisors. The manuscripts were from the field of biotechnology, chemistry and applied

chemistry, analytical and bioanalytical chemistry, ecochemistry, environmental technologies, waste management, food technology, applied informatics, and related fields.

From linguistic data alone, it is often impossible to determine reliably what kind of error a learner is making. In addition, error analysis can deal effectively only with learner production and not with learner reception. In the mid-1970s, Corder et al. (1967) moved on to a more wide-ranging approach to learner language, known as interlanguage. Error analysis is closely related to the study of error treatment in language teaching. Today, the study of errors is particularly relevant for focus on form teaching methodology. Considering the second language acquisition, we used error analysis that studies the types and causes of language errors. The errors here are classified according to:

- modality (level of proficiency, in this case in writing),
- linguistic levels (grammar, vocabulary, style),
- form (omission, insertion, substitution),
- type (systematic errors/errors in competence vs. occasional errors/errors in performance),
- cause (interference, interlanguage),
- norm vs. system.

According to Corder (1967), the following are the steps in any typical error analysis research:

- collecting samples of learner language (57 manuscripts from the fields related to natural sciences),
- identifying the errors (process of proofreading and text analysis, classification into groups),
- describing the errors (proofreading outputs and notes),
- explaining the errors (proofreading outputs and notes, methodology),
- evaluating/correcting the errors (proofreading outputs and notes, methodology materials, teaching process and/or tutorial, discussion, training).

The primary aims of error analyses were to identify types and patterns of errors and to establish error taxonomies. These were supposed to be used to describe interlanguage and its development, i.e. the learner's internal syllabus. Common difficulties in second language acquisition were to be identified. On this basis, error analysis was supposed to contribute to a comprehensive knowledge about processes of second language acquisition. In addition, results were intended to be used for a revision of theories of language learning as well as help to evaluate and improve language teaching.

4 Results and discussion

In this study, we present only partial and generalized results of research because of the limited space. Detailed results will be published in a forthcoming monograph and have been taken into account in the development of methodological materials for PhD candidates. We focused on subcategories of syntactic-morphological errors. Description, classification and explanation of the errors committed by the target group of doctoral candidates, postdocs and young researchers in the 57 manuscripts submitted for proofreading are detailed here. The total number of these errors is 1016 representing miscellaneous categories as shown in Table 1. Categories and subcategories of errors are presented descendently according to their ranking orders; i.e. beginning with the highest-frequency errors.

Tab. 1: Results of the analysis of the type and number of errors recorded

No.	Type of error	Frequency	Percentage
1	Tenses	214	21
2	Articles	201	19,8
3	Active and passive voices	129	12,7
4	Verb groups	119	11,7
5	Lack of concord (subject-verb agreement)	117	11,5
6	Prepositions	84	8,3
7	Plural morphemes	77	7,6
8	Parts of speech	35	3,4
9	Relative clauses and pronouns	28	2,8
10	Comparatives/superlatives	12	1,2
	Total	1016	100

Errors in the Use of Tenses:

These errors are the most recurrent ones in this category. The total number of errors here is 214 with a percentage of 21 %. They are represented in four main areas as follows:

- Lack of the third person singular morpheme 's' when using the simple present tense;
- Using simple past instead of simple present;
- Using present continuous instead of simple present;
- Using simple present instead of simple future.

Errors in the Use of Articles:

These errors occupy the second rank in this category. Their total number is 201 with a percentage of 19.8 %. They are represented in five main areas as follows:

- Omission of the definite article 'the';
- Omission of the indefinite article 'a/an';
- Erroneous use of the definite article 'the';
- Erroneous use of the indefinite article 'a/an';
- Wrong use of articles: - 'the' instead of 'a/an';
- 'a/an' instead of 'the'.

Wrong Use of Active and Passive Voice:

These errors occupy the third rank in this category. Their total number is 129 with a percentage of 12.7 %. They are represented in three main areas as follows:

- Using wrong structure to form the passive;
- Using active voice instead of passive voice;
- Using passive voice instead of active voice.

Errors in the Distribution and Use of Verb Groups:

These errors occupy the fourth rank in this category. Their total number is 119 with a percentage of 11.7 %. They are represented in four main areas as follows:

- Omission of copula 'be';
- Wrong use of infinitives and gerunds;
- Wrong retention of copula 'be';
- Wrong construction of verbs and participles.

Errors Due to Lack of Concord (Subject-Verb Agreement):

These errors occupy the fifth rank in this category. Their total number is 117 with a percentage of 11.5 %.

Wrong Use of Prepositions:

These errors occupy the sixth rank in this category. Their total number is 84 with a percentage of 8.3 %. They are represented in two main areas as follows:

- Wrong choice of prepositions;
- Redundant use of prepositions.

Wrong Use of the Plural Morpheme:

These errors occupy the seventh rank in this category. Their total number is 77 with a percentage of 7.6 %.

Wrong Use of Parts of Speech:

These errors occupy the eighth rank in this category. Their total number is 35 with a percentage of 3.4 %.

Errors in the Use of Relative Clauses and Relative Pronouns:

These errors occupy the ninth rank in this category. Their total number is 28 with a percentage of 2.8 %. They are represented in two main areas as follows:

- Retention of subject pronouns;
- Retention of direct object and possessive pronouns.

Wrong Use of Comparative and Superlatives Structures:

These errors occupy the tenth and lowest rank in this category. Their total number is 12 with a percentage of 1.2 %.

Finally, here I present several illustrations of some frequent, typical and, in some cases, curious errors young researchers did in their research papers. The presented examples should better understand the importance of technical writing in a wider sense. Because of the ethical reasons, we do not provide examples with names and paper titles. The examples were collected from papers of doctoral candidates and post-docs / young researchers. Each example is commented with a note below it:

oil reaction. Obtained *E*-values of uppermost soil horizons showed
 Our paper confirmed the effect of soil reaction, composition and
 ability. For further assessment of zinc bioavailability is needed to

They are usually “research” of “findings/results of the research” that confirm some assumptions and not the “paper”.

fractionation in soils are commonly used
 as a part of fraction analysis.

...wrong use of the article.

centrifugation (5 min at 5000 rpm). This procedure
 CEC determination consist of suspending of
 BaCl₂ and agitation for 19 h at 22°C. After

...verb in third person of singular...

To 2.5 g of soil samples was added 25 ml of 0.05 mol/L CaCl₂. T

...word order and plural of the verb...

concentrations can be utilized as fertilizer and soil conditioner in agriculture. For determination of metal
 bioavailability can be used a wide range of extraction protocols and fractionation analyses. We studied the

...word order and sentence structure...

culture. Information about metal binding into sorption sites of sludges are limited
 application of sludges into the soil. The ecological and toxicological effect of
 essentially toxic metals from sewage sludge on agro-ecosystem is directly related to
 partitioning between mobile and complexed species in the highly heterogeneous
 system (MERRINGTON *et al.*, 1997). Many factors influence this partitioning

...spelling... what about to apply Microsoft Word's Spell Checker?

als in anaerobic sludge

...another spelling mistake...

(Slovak republic).

...spell checker would correct it...

was determined

...was determined...

added to flask with 20-30 ml 0.1 mol/dm³ HCl and 0.5 ml 0.01 mol/dm³ KMnO₄. The
 solution was heated to 80-95 °C for 5-10 min and. Oxalic acid was added to reduce

...not completed sentence...

potential bioavailability has to be considered v

...spelling...

The aim of this paper was to determine optimal conditions of the extraction of lipid portion
 from the flax seed in relation to oil yield and quality of the targeted preparations, appreciate
 by acid value and presence of the coloured accompanied lipid components (carotenoids,
 phospholipids etc.) important from consecutive fractionation and purification point of view.

...too long sentence...

The examples show, that there is a scale of errors that can be can be avoided in the very early stage of the paper development.

5 Conclusion

There were investigated 57 manuscripts written by mostly young researchers – non-native speakers of English, PhD students, participants in the ESAP course within the period of five years. Error analysis has shown quite weak level of English language writing skills in this specific field of productive language outputs. Errors of various kinds were analysed and classified to provide the results to students. This feedback should help them

to improve their language skills. We identified the language errors, but the most crucial task is to identify their sources. There are several of them being identified - poor knowledge of English grammar and some specific features of scientific and technical language. Besides the linguistic analysis, we are planning investigation of continuous improvement of the researched language skills by the target group, as a proof of efficiency of this kind of analytical research. The research has shown that process of writing papers is not only about its lexicogrammatical correctness, but also about process of its development and communicative effectiveness.

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