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Communication Skills in Engineering Professions: Communicative Language Ability in Foreign Languages*

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The importance and the levels of foreign language communication skills of engineering students, prospective engineers, in the fields of agronomy and food technology are analyzed in the paper. The models of communicative competence and communicative language ability are illustrated. Communicative language ability was measured by applying the instrument Communicative language ability scale. The sample consists of 60 engineering students in the fields of agronomy and food technology, studying English as a foreign language at the Faculty of Agronomy, University of Kragujevac, Serbia. The obtained results indicate moderate level of communicative language ability within the sample. The levels of all elements of communicative language ability of engineering students of biotechnical sciences are influenced by the teaching/learning approach applied, particularly by communication-oriented approach.

Keywords: engineering profession; communication skills; communicative language ability; foreign language

1. Introduction

In order to broaden their knowledge and exchange ideas and experiences, engineering professionals need to communicate among themselves and among other professionals. In engineering, as a potent field of human activities, basic engineering skills are not the only key to professional development. Nowadays in the world of globally interconnected engineering activities communication skills in a foreign language become vital for engineers in the execution of their professional responsibilities. Given that English has been accepted as an international language throughout the world for both academic and professional purposes, being communication competent in English is valued as one of the requirements for graduates in the engineering sector. Communication in English as a foreign language has important roles in almost all aspects of the profession—manufacturing, marketing, quality assurance, post-sale maintenance, etc. [1–3].

English oral communication skills have been a potential problem for non-native speakers, particularly for engineering students, prospective engineers. In order to develop learners' communicative language ability the analysis of the specific language use and language ability of the language learners in the targeted contexts are needed. The aim of the research was to determine the levels of communication language ability in foreign language (English language) of engineering students-prospective engineers in the fields of biotechnical sciences (agronomy and food technology) as well as to gain insight into how the experience of learning English as a foreign language (EFL) for specific engineering purposes influenced students' English language communication. The research also aimed at emphasizing the difference between the students acquiring English communication skills in English for Specific Purposes education context and the students learning English language in a more conventional context of general-purpose English classes.

2. Theoretical framework

The concept essential for a communication-oriented approach in foreign language learning and teaching is known as communicative language ability. Communicative language ability can be described as consisting of both the knowledge, or competence, and a capacity for implementing or executing the competence in appropriate, contextualized communicative language use, which could be modified in accordance with specific context or professional situation [4].

The model of communicative language ability studied in this research is based on the concept of communicative competence initiated in the 1970s [5] within anthropology and sociolinguistics research context, emphasizing the fact that non-native interlocutors/speakers need knowledge of language forms as well as socio-cultural knowledge in order to use acquired forms in an appropriate manner. The concept of communicative competence was developed in the 1980s [6–8] as the synthesis of framework of knowledge and skills necessary for

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communication. It consists of the following components: (a) grammar competence—morphological and syntactic rules, vocabulary, semantic rules, phonologic and orthographic rules; (2) sociolinguistic competence—social rules and conventions as the basis of appropriate understanding and usage of language in various socio-cultural contexts; (3) discourse competence—knowledge and capability of utilizing cohesive tools and text rhetorical organization in order to create coherent language unit; and (4) strategic competence—knowledge of verbal and nonverbal communication strategies used in order to overcome communication breakdowns emerging as a result of an inadequate competence or competences. Simultaneously, another useful component was added to this model—the component of fluency [9] involving three types of fluency: semantic fluency (connecting propositions and speech acts), lexical-syntactic fluency (connecting syntactic elements and words), and articulation fluency (connecting sounds as segments of speech). This model had dominated almost a decade until the model of communicative language ability appeared, based on the empirical research [10–12] and insight in relevant references.

Communicative language ability [4] involves three components: (1) linguistic competence, consisting of (a) organization elements such as *grammar competence* (vocabulary, morphology, syntax, phonology/graphology) and *textual competence* (cohesion and rhetoric organization) and (b) pragmatic elements such as *illocutionary competence* (adequate usage and understanding of speech acts as well as functions of ideation, manipulation, heuristic function, rhetoric function) and *sociolinguistic competence* (sensitivity to differences in dialects, registers, sensitivity to naturalness, ability to interpret cultural references); (2) strategic competence referring to the interaction of series of metacognitive components such as goal setting (recognition of possible goals, selection of goals and decision whether to achieve the goal), assessment (means of connecting language usage context and other components), and planning (decisions how to use language competence and other components of language usage in order to achieve a targeted goal); and (3) psychophysiological mechanisms, essentially neurological and physiological processes, involving communication channels (visual and auditory) and means of communication (receptive and productive); in receptive language use auditory and visual skills are employed while in productive use the neuromuscular skills (articulatory and digital) are employed.

Another relevant model which is to be briefly presented is a model of communication language competence within Common European Framework of Reference for Languages: Learning, teaching, assessment [13]. Communicative language competence refers to three basic components: (a) linguistic competence (equivalent to Bachman grammar competence); (b) sociolinguistic competence (equivalent to Bachman sociolinguistic competence); and (c) pragmatic competence consisting of (1) discourse competence (equivalent to Bachman textual competence) and (2) functional competence which considers language macrofunctions (e.g. description, commentary, narration, explanation or instruction), microfunctions (e.g. seeking information, socializing, or structuring discourse), and an element of planning competence referring to message sequencing in accordance with interactional and transactional schemes; of course, two qualitative factors which determine the functional success of learners are necessary to be mentioned here—fluency, or the ability to articulate and keep going when one lands in a dead end, and propositional precision, or the ability to formulate thoughts so as to make one's meaning clear. Strategic competence is not considered as a part of communicative competence but as communication language usage and involves application of communicative strategies which can be seen as the application of the metacognitive principles: pre-planning, execution, monitoring, and repair action to the different kinds of communicative activity: reception, interaction, production, and mediation. Moreover, nonverbal communication is also considered as a segment of communication language usage and involves practical activities such as finger pointing, eye direction; paralinguistic elements, e.g. gestures, facial expression, body posture, eye contact, proxemics; nonlinguistic elements—the use of extra-linguistic speech-sounds, e.g. "sh" (requesting silence), "ugh" (expressing disgust), "tut, tut" (expressing polite disapproval), etc.; prosodic elements such as pitch, stress, intonation.

The models illustrated were the base for the model accepted in the research—this eclectic model consists of grammar competence [4, 7, 8], textual competence [4, 7, 8], functional competence [4, 13], sociolinguistic competence (4, 7, 8, 13], strategic competence [4, 7, 8], fluency [9, 13], and non-verbal communicative ability [13]. It was also determined that basic competences would be studied both as integrated and specific competences in oral communication.

3. Teaching/learning methodology and organization of research

Classroom activities were organized with three groups of participants (experimental groups) according to the teaching/learning approaches applied. Groups one and two were taught English

for Specific Purposes (ESP)—the approaches applied in these two experimental groups were communicative approach (CA) and content-based learning (CBL), respectively. The participants in the third experimental group were taught General English (GE).

Communicative approach employed in Group 1 (the third—and fourth-year students in the field of biotechnology, who had been learning English as a foreign language at university level for 3 and 2 years, respectively, before the beginning of the experiment) was based on the combination of the program oriented to acquiring language skills and strategies (reading for academic purposes, selection of important information during reading, business correspondence) as well as to developing cognitive and communication abilities and strategies (understanding written texts, oral presentation including control of mimic and gestures, understanding collocutors in interaction). The teaching/learning methodology applied was also under the influence of task-based learning, using various techniques such as classification, categorization, systematization of knowledge and information; then, discussions, simulations, role plays, case studies, problem solving, negotiating, conflict resolving. It is based on the development of students' integrated language skills (speaking, listening, reading, and writing), enhancing student autonomous learning. The teaching approach employed in Group 2 (the second-year students in the field of biotechnology, who had been learning English as a foreign language at university level for 1 year before the beginning of the experiment) was generally content-based learning approach where the teaching process reflects the contents, methods, tasks and procedures typical of the biotechnical engineering profession itself. The focus was also on the development of reading skills for academic purposes and oral presenting skills. The students were urged to acquire communication skills necessary for participation in a formal context such as a scientific conference.

The methodology applied in Group 3 (the second-year students, who had been learning English as a foreign language at university level for 1 year before the beginning of the experiment) was based on cyclic syllabus of developing integrated language skills for students in general-purpose English classes. The teaching context in this group was more conventional: knowledge of grammar and vocabulary was acquired guided by the rule discovery on the basis of the given examples; vocabulary was presented through individual lexical units and collocations reflecting the application of knowledge in everyday communication contexts. Developing reading skills, active listening, speaking skills, and writing skills were in the focus. The attention was also paid to pronunciation, stress, accent and intonation as much as grammar and lexical elements require.

Students' communicative language ability was analyzed considering the theoretical framework where the described competences were regarded as research variables. The studied variables involved: general communication ability in foreign language (cumulative factor of oral communication focused on general communication efficiency, performed task adequacy, self-correction strategy application, contents abundance, sophistication of language forms, effort of collocutors to understand the speaker), grammar (GC) and textual competence (TC), functional (FC) and sociolinguistic competence (SLC), strategic competence (STC), fluency (FL), and non-verbal communicative ability (NVCA).

The instrument used in the research was Communicative language ability scale. It is a complex instrument created to measure communicative language ability as a cumulative qualitative factor as well as its individual competences. The instrument is based on various measuring solutions created for individual competences by different authors [4, 13–15]. The scale consists of qualitative descriptors indicating the level for each competence (variable) measured. It is a Likert-type scale, ranging from 1 to 5—low end indicates low level and high end indicates high level of the measured competences.

It is assumed that levels of communicative language ability and its variables are influenced by characteristics of the teaching program applied in the classroom. The sample consisted of 60 university engineering students in the field of agronomy and food technology, studying English as a foreign language. The students were from the Faculty of Agronomy, University of Kragujevac in Serbia where the research was carried out. As the higher education system in Serbia still differs from the higher education systems of EU countries, the students did not need to pass any kind of access exam with a required English performance when entering university or university ESP courses in specific fields (B1 and B2 levels, according to Common European Framework of Reference for Languages).

The procedure involved the following steps: the students simulated participation in a scientific conference in the field of biotechnology with oral presentations; students' oral presentations were filmed by a camera; external evaluation of the students' filmed oral presentations was carried out employing Communicative language ability scale. The obtained data were analyzed using SPSS Package for Windows. Measures for descriptive and correlation statistics were used for data processing.

4. Main results/benefits of the approach followed for promoting professional skills

Communicative language ability as a central concept of the research was measured by applying the research instrument—Communicative language ability scale. The internal consistency reliability analysis shows that the instrument is highly internally consistent and reliable since the reported coefficient Cronbach's Alpha is 0.98. As external evaluation is reported to be reliable since the inter-rater reliability coefficient is 0.81, the obtained results of further analyses are also perceived as reliable.

The correlation analysis was conducted to determine relationships between students' general ability to communicate in English as a foreign language (EFL) and its competences. As shown in Table 1, positive and statistically significant correlations are determined among all the studied competences. Pearson correlation coefficients range from the lowest r = 0.73, referring to the relation between general communication language ability and nonverbal communicative ability (NVCA), to the highest r = 0.95, referring to the relations between general communication ability and textual competence (TC) as well as between general communication language ability and fluency (FL). Correlation coefficients are very high (the indicator of significance for all correlations is p = 0.000) indicating high consistency of the construct of communicative language ability and equally significant influence of all the measured competences on general ability to communicate in English as a foreign language.

The results of the descriptive analysis indicate that engineering students' general communication language ability is at medium level since the mean value is M = 3.15 (Table 2). The levels of respective competences are also at medium level, the highest being recorded for grammar competence (M = 3.17) followed by textual competence (M = 3.11), strategic competence (M = 3.04) and fluency (M = 3.02), and the lowest being recorded for sociolinguistic competence (M = 2.83); the exception is nonverbal communicative ability showing the tendency of decreasing mean value (M = 2.45).

The obtained results imply that engineering students, prospective engineers in biotechnical sciences are generally capable of communicating appropriately and efficiently, the communicating contents being adequate. On the other hand, the corrections made to compensate language weaknesses are significant and sometimes inappropriate and may demand certain level of effort to understand a speaker/collocutor. Students' oral skills have manifested broad but incomplete knowledge of morphology and syntax structures, vocabulary are developed at intermediate level, pronunciation with errors sometimes causing miscommunication; simple cohesive tools are present and usually marked, speech contains no details and ideas are sometimes developed in a confused way; language functions are sometimes clear, efficient and proper, though sometimes speaker/student may lack skills to select correct language forms to perform the task rationally; students/speakers are usually aware of the collocutors and context, they sometimes use grammatical but unnatural structures and appropriate cultural references, apply two registers (formal and informal) sometimes inadequately.

Table 1. Correlations between general communication ability in EFL and its competences

Communicative language ability	GC	TC	FC	SLC	STC	FL	NVCA
General communication ability in EFL	**0.93****	**0.95****	**0.91****	**0.89****	**0.92****	**0.95****	**0.73****

N = 60, ** **p = 0.000**

**Correlations are significant at the 0.01 level (2-tailed).

Table 2. Levels of communicative language ability measured in three teaching programs in a formal communication context

Communicative language ability Variables	Possible scores	M	ESP			F	Sig.
			CA	CBL	GE		
General communication ability	1–5	3.15	3.38	3.27	2.89	3.659	**0.032***
Grammar competence	1–5	3.17	3.33	3.31	2.91	3.578	**0.034***
Textual competence	1–5	3.11	3.35	3.24	2.83	4.658	**0.013***
Functional competence	1–5	2.95	3.13	3.06	2.73	2.497	0.091
Sociolinguistic competence	1–5	2.83	3.04	2.94	2.58	3.056	0.055
Strategic competence	1–5	3.04	3.29	3.19	2.72	4.973	**0.010***
Fluency	1–5	3.02	3.15	3.14	2.80	2.092	0.133
Nonverbal communicative ability	1–5	2.45	2.67	2.48	2.28	1.164	0.320

N = 60, ***p < 0.05**

Generally, speakers/students are capable of communicating main ideas using communication strategies despite the problems present in initiating interaction and reacting to conversation turns; speech is usually slow and hesitant, pronunciation is sometimes incorrect and interferes with communication. However, non-verbal behavior is characterized by often and inappropriate nodding and eye direction; gestures are sometimes used to solve language problems but often inappropriately and unsuccessfully.

Comparing the levels of competences between three teaching/learning programs applied in the classroom the presence of statistically significant differences between experimental groups are obvious (Table 2, Fig. 1, Fig. 2). The results of ANOVA analysis show that statistically significant differences are noticeable regarding the levels of general ability to communicate in English as a foreign language, grammar competence, textual competence, and strategic competence (for all the variables significance level is $p<0.05$, the mean difference being significant at 0.05 level). The levels of all the measured variables are highest in the context of communicative language approach (ESP classes) and the lowest in the context of cyclic syllabus (General English classes) (Fig. 1 and Fig. 2).

The application of post-hoc test (Dunnett T3) indicates that the most significant differences are recorded between the engineering students involved in communicative language teaching program (Group 1) and the ones involved in cyclic syllabus with integrated language skills in the context of learning English for general purposes (Group 3). The most prominent differences are recorded between these two teaching programs considering the levels of textual ($F = 4.658$, $p = 0.013$) and strategic competence ($F = 4.973$, $p = 0.010$) (Fig. 3), while the differences considering general communication ability ($F = 3.659$, $p = 0.032$) and grammar competence ($F = 3.578$, $p = 0.034$) are also obvious but less pronounced (Fig.1, Fig. 3).

Communication-oriented language teaching particularly enhanced students' general communication skills in English language, grammar competence, textual competence, and strategic competence. We should have in mind that communica-

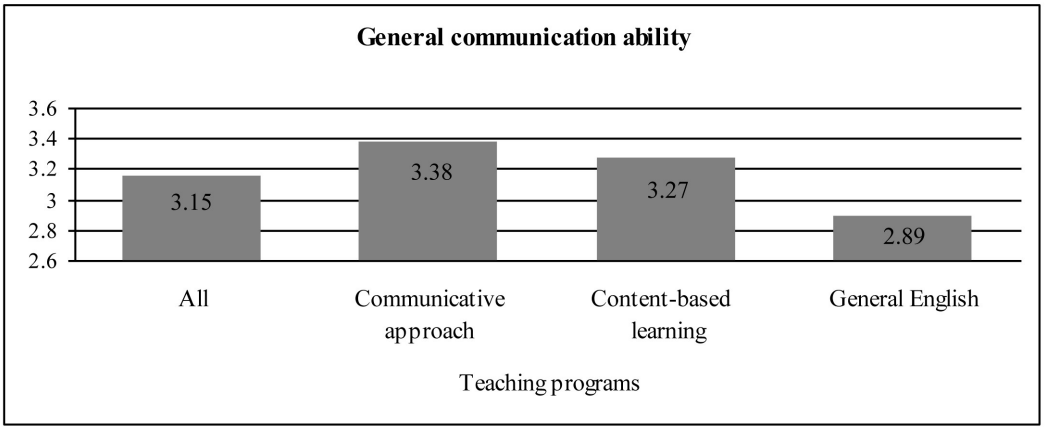

Fig. 1. Students' general communication ability in EFL in three teaching programs.

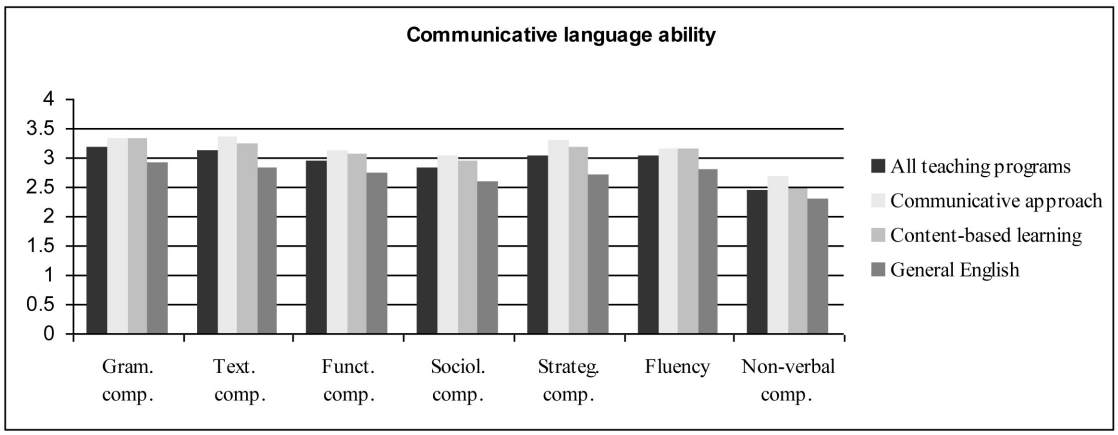

Fig. 2. Levels of students' communicative language ability in three teaching programs.

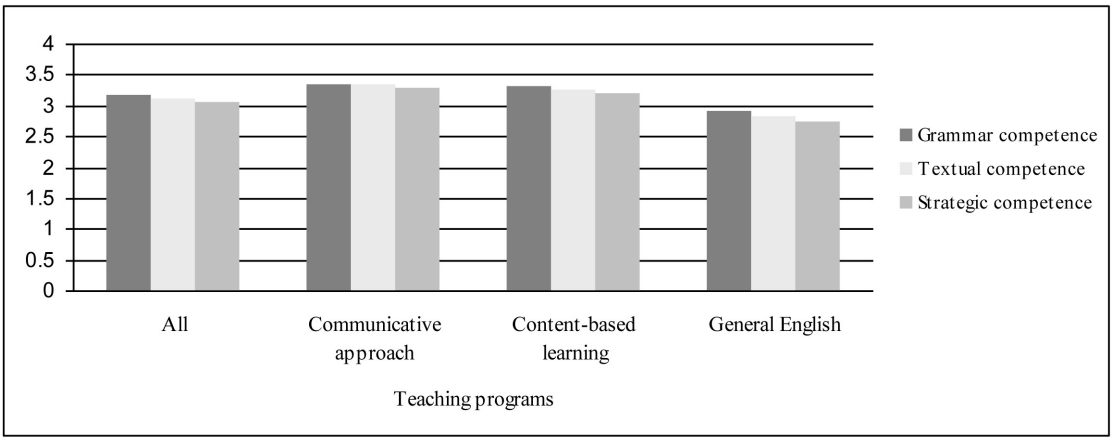

Fig. 3. Differences between teaching programs.

tion-oriented approach was applied with third-year and fourth-year students. This fact may be an indication that longer experience in engineering profession may also enhance higher level of foreign language communication skills. Acquisition of communication language skills is more successful with engineering students who experienced longer training both in their respective scientific fields and English as a foreign language for Specific Purposes compared with their peers whose training in their scientific fields was shorter (second-year students) and language training was more conventional (general-purpose English classes).

5. Conclusions and future issues

The engineering students, prospective engineers of agronomy and food technology, have manifested moderate level of communicative language ability in English language for specific purposes in the formal social context of participating in a scientific conference; the levels of the measured competences are also moderate with the tendency toward lowering the levels of non-verbal communicative ability. Efficient and appropriate communication in English language as a foreign language in communication contexts typical of engineering professions is influenced by continual, equal and simultaneous development of all the measured constituent elements of communicative language ability—grammar, textual, functional, sociolinguistic, strategic competence, fluency, and non-verbal communicative ability. The more communication-oriented teaching program is applied in such education and social context, the higher the levels of communication skills in English as a foreign language. This in particular refers to general communication ability, grammar, textual, and strategic competence, though the other four variables (functional, sociolinguistic competence, fluency, and non-verbal communicative ability) are at higher levels compared with the other two applied teaching programs.

The findings in this research suggest that higher levels of communication language skills in foreign language are the characteristic of engineering students who experienced longer training both in their respective scientific fields and English as a foreign language for Specific Purposes. Therefore, it may be assumed that the effectiveness of English for Specific Purposes courses has its peak at higher levels of academic engineering education when students are more profession-aware. Moreover, since nonverbal communicative ability is by far the least developed competence in all the three teaching programs applied with the future engineers in biotechnology and since it is supposed that it is generally the most neglected segment of communication skills in learning foreign language classroom context, it is important for teaching practice at university level to pay particular attention to rising students' awareness of necessity of adequate nonverbal behavior as well as developing appropriate methods and classroom techniques for building students' nonverbal communication skills.

It is obvious from the findings that students' communicative language ability was more facilitated by communication-oriented courses within ESP teaching context at higher academic education levels. If the students' communicative language ability and behavior in future professional environment is to be even more efficient, there is the need for a standardized required level of students' English language performance before entering ESP university courses at Serbian universities as the students commonly enter university with different language backgrounds and needs and, hence, different levels of English language performance. The creation of the national ESP curriculum for different disciplines is needed as a pedagogic and educational tool for Serbian higher education institutions which would

provide ESP core curriculum content focused on professional communicative language ability regarded as language behavior specific for academic and professional environment.

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