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Application of Mind Map-based abstracting technique in pedagogical strategy for ESP teaching/learning

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Abstract

The work presents some theoretical and practical results of the abstracting practice carried out by the teachers and cadets of Voronezh Institute of the Ministry of Interior of Russia. The sources used in the experiment were of British and American origin, equally authentic, and were mainly of engineering content because of the cadets' speciality. The main purpose of the experiment was focused on the primary source adequate abstract making as a product of a keen understanding of social and professional aspects, views, and anticipations of English-speaking nations. The authors analyzed a number of current approaches towards abstract making procedures and offered an original system of the education strategy by means of Mind Map building technique.

Key words: ESP teaching/learning, pedagogical strategy, abstracting, Mind Maps-based technique, engineering specialities, sci-tech sources.

Introduction

In the last two decades the onrush of technologies and the use of all kinds of communication means took place resulting in the necessity of general understanding between various nations. It is evident that a great part of relations, especially in the worldwide scientific community is carried out via mediated communication and, inter alia, indirect perception and reproduction in language learning: reading, translating and abstracting. The ever-growing information flow made scientists and professionals process a great deal of information in the course of their researches. That is why it is necessary to point out the significance of journals (books) of abstracts as a tool for retrospective knowledge search.

Russian universities offer a special course on foreign language abstract making only for post-graduate students or cadets (after a four- or five-year term of basic university studies). Nevertheless, the beginners are also supposed to take their examination in a foreign language, which consists of: 1) written translation and further discussion of a vocationally-oriented text (2500 printed characters); 2) unrehearsed speech activities in everyday and professional situations, and, finally:

3) descriptive annotation of an article after its quick scanning (1500 – 2000 printed characters). Hence, a second-year student should possess a great number of special language skills and satisfy a range of appropriate requirements.

Thus, *the main purpose of our research was to examine the efficacy of Mind Map-based technique in teaching/learning abstracting of sci-tech English texts*. The purpose of our research implied several substantial goals to be achieved: 1) to find out the nature of the abstracting process and pedagogical approaches to its implementation; 2) to reveal the problems that the second-year cadets encountered in the course of reading/abstracting process; 3) to coordinate learning/teaching according to up-to-date and reliable techniques of abstracting; 4) to check the results of our research by performing the experiment.

Nature of abstracting and Mind Mapping technique: theoretical concepts

The first question that arises in this case is: what is an abstract and abstracting? If abstracting is admitted as a 'set' of skills for making an abstract, it is necessary to focus on *abstract* definition. The abstract is generally defined as "a brief summary of a research article, thesis, review, conference proceeding or any in-depth analysis of a particular subject or discipline, and is often used to help the reader quickly ascertain the paper's purpose" (Blake, Bly, 1993, p.117) and also considered as "a notionally adequate, reformulated and relatively small-sized part of speech" (Grechikhin, Zdorov I. & Solov`ev, 1983, p.81). Hence, the abstract is assumed to be a short and paraphrased message accurately representing comprehended sense of the primary source and serving a special type of intellectual and creative activities for researchers and specialists. So, any abstract is a result of three interrelated activities: text comprehension, text compression and text reformulation or paraphrasing.

The psychological nature of the abstracting process, which is treated as a rethinking analytical-and-synthetic process, and which target is to look for semantic background through text compression, is thoroughly examined by Russian linguists (Novikov, Nesterova, 1991). Abstracting requires a high level of a source text understanding since an abstracter should comprehend all the text as a synthetic whole, but not only *catch* the sense of a sub-text fragment. To make the sense of the whole text is a necessary condition for an abstract-maker because only in this case he or she is ready to find the ultimate and *peripheral* messages of the original text (Novikov, 2007). The thing that happens in the mind of an abstracter during the abstracting process is practically the same that takes place in the mind of a translator. This process is treated is a sense interpretation (Seleskovitch, Lederer, 1985), when the translator is supposed to pass through three basic stages: *de-verbalization* or sense abstracting; *building "a mental structure"* of the text; and, finally, *re-verbalization* or lexical-and-syntactic paraphrasing. This opinion proves an avowed thesis that the information cannot simply be exchanged in the respective cognitive domains of the interlocutors because of the information construction. Text processing is always an active and constructive process in the cognition area of the message sender and the addressee (Meutsch, 1985), as verbalisation "externalise linguistically structured information available in short-term memory" (Kussmaul, Tirkonen-Condit, 1995, p. 180). Thus, it is concluded that the resulting abstract is the text interpretation and its further verbalization, but not a compilation of separate text parts. Hence, one can declare the existence of a certain 'mental formation' of the text which is, sometimes, not explicitly expressed.

One can say, that re-verbalisation process shouldn't be neglected during abstracting process, as vocabulary proficiency is one of the most essential components in foreign language learning (Mohseni-Far, 2008). One can partly agree with this opinion, but in the course of pedagogic process the teacher should first think about the learners trying to give the same to all of them, because, too often, their language level differs a lot. It is obvious that expressing of two language learners could be quite different while their source text understanding could be relatively equivalent. Likewise, if a student has some thoughts to be expressed, they should be verbalised, and it is very convenient to represent the ideas in a form of 'key points', 'edges', 'concepts', 'denotation points', etc. It is in this case that representation of the "mental structure" of the text, for instance, in graphic form, would be very useful for students with a language gap.

Graphical form of information representation may be different. Information retrieved from the source text, used to be presented in a form of 'mental maps' that nowadays have a number of styles and names: *Mind Maps* (communication diagrams) (Buzan, 1988), *Concept Maps* (Novak, Cañas, 2008), *denotation Maps and Graphs* (Novikov, Nesterova, 1991), *Concept-and-Network Model* (Andreyeva, 2000), *checklist* (Scriven, 1967), etc.

The term *Mind Mapping* was initially introduced by an English psychologist Tony Buzan in the 1970-ies of the XXth century (Buzan, 1988). Although this technique of logical structuring and reasoning was very successful with the workers of multi-national companies who applied it to enhance their understanding and creative use of information, it was poorly used in student's English workbooks, for example as an accurate representation of a sci-tech text meaning. Nowadays Mind Map-based techniques are continued to be used as a pre-reading task in English textbooks (Chin, Koizumi, (2012), and others) or as "an approximate representations of students' current state of knowledge" for writing skills formation (Villalon, Calvo, 2011). Thus, in both cases such Mind Maps are used as *brainstorming exercises* aimed to reflect the students' knowledge, and not as a tool for a source text *grasp* representation or a rapid assessment of students' conceptual understanding.

The problem is that Mind Map-based technique aimed to graphical representation of a 'comprehended text' wasn't widely used in foreign language teaching/learning. The main challenge one can expect is to change teachers' reluctance in changing pedagogical techniques they are accustomed to work with, and 'to change the school situational factors in the direction of teacher as coach and learner from the prevailing model of teachers as disseminator of information" (Novak, Cañas, 2008). Students should fulfill performance-based tasks that require students to demonstrate that they understand basic concepts and can use these concepts in novel problems solving and to modify their concepts and learn new concepts (Novak, Cañas, 2008). Mind Map technique is just oriented towards such a learning process helping students to 'retrieve' basic key points of sci-tech sources and to frame the extracted semantic structure by different language means according to students' language level.

Thus, abstract writing can be referred to as a creative process, despite the fact that it is a reproduction of *someone else's* ideas (Novikov, 2007). This process can be represented as a re-realization and discovery of the author's intentions, but formed as a result of the abstracter's realization and reformulation of the origin text by means of a medium between the origin text and the abstract, representing a semantic structure of the text, and expressed in graphical means.

Pre-questioning results: problems arising in the course of sci-texts reading

Abstracting and reading are closely integrated initially, at the first stage of a comprehension process. Most of all the integration takes place in the case of extensive reading, which is regarded to as "occurring when students read large amounts of high interest material, usually out of class, concentrating on meaning, »reading for gist« and skipping unknown words" (Long, Richards, 1987, p. 216).

In the course of pre-experimental questioning all the test subjects (184 in number) were identified as people planning to read sci-tech articles in the course of their professional activity; 138 of the respondents were motivated to read in English on the Internet; 19 of them communicated in English via *Facebook* or other social networking websites; 12 test subjects had the opportunity to speak English with foreigners in daily and professional situations.

Among the barriers interfering with adequate comprehension of technical texts in English the respondents mentioned the complexity of technical texts structures, the inability to look through the text quickly because of unfamiliarity with technical terms and lack of special reading skills. Thus, at the stage of pre-experimental questioning it was found out that:

1) all the respondents were highly motivated to take part in a special course of technical reading/abstracting;
2) some of the respondents occasionally used to read technical texts and needed to understand them, but the lack of special reading and abstracting skills, insufficient language competence, complexity of special structures and terms did not let them use English for professionally-oriented purposes.

The pre-experimental questioning carried out among the second-year cadets of Voronezh Institute of the Ministry of Interior of Russia in 2011-2012 showed that even rather high language proficiency of some cadets does not definitely assume abstracting skills. We can explain this phenomenon by the fact that for making a high quality abstract, i.e., for retrieving the semantics of the original text and changing the linguistic structures in the derived text, the learner must possess a wide range of skills:

1) he or she must know how to accomplish such complicated verbal and cogitative operations as abstracting, analysis and synthesis of the acqu-

ired information, i.e., he or she must know how to find the main structurally linked semantic components of the text;

2) he or she also must know how to represent the derived semantic structure by the distinct (according to original message) language means.

Hence, the main purpose of our investigation was to develop an abstract making education strategy by means of special pedagogical techniques of Mind-Mapping and paraphrasing, and to test our learning aid with an experiment.

Coordinating learning strategy

Graphical fixation of *mental points* of the text and their links representation is closely related with information compression and should certainly be one of the basic steps of abstracting as an intellectual and creative activity.

Thus, one of the main goal of our abstracting course was to teach our students to see similar ideas in standard texts, to extract *the right* cause-and-effect relations and to make roughly the same conclusions.

The first-step realization of the suggested pedagogical technology was organized as a pre-reading strategy: cadets were involved in intensive reading activities:

- The teacher presents and activates *key* text vocabulary, and basic grammar constructions of a macro-text (a series of texts united by one topic). The cadet, in his or her turn, acquires lexis-and-grammar reading skills (language competence).
- The teacher gives special tasks, invoking word formation models, co-occurrence models and international terms. The cadet identifies these models in profession-oriented texts (strategic competence), for example:
  - "Read the following international words and try to explain their meanings without looking them up in a dictionary.
  - Copy out from the text all the words with –ing ending and explain their role in the sentence.
  - Find in the text all the words with a root -duct- and translate them (for example: conductor, semiconductor, conduct, conductivity, conducive) (Choporova, 2012)".

Pictures and figures can serve as *clues* favouring guessing the text content:

- "Study the figure and make a written description of the computer structure. Compare your summary with your partner's one (Choporova, 2012)".

At this stage the learners gain the initial experience and get to know the strategy of intensive reading. They are also involved in a foreign language environment and profession-oriented topic of the whole macro-text or unit. In order to fulfill all the mentioned conditions, the teacher should use an adapted text.

The second step of our reading-abstracting learning strategy was divided into two substeps: *structural* and *reproductive*.

The *structural* step was aimed at a representation of the Mind Mapping technique by means of various graphic tools. A Mind Map or an Information Graph in pedagogy looks like a mathematical graph, where graph nodes correlate with *key words* (denotation names) of the text, and graph edges correspond to interrelations between these nodes. So, we can represent every written text or macro-text by means of information or denotation graph. In this case the stand-alone chains reflect the process of text comprehension, serve as a backbone for topic vocabulary memorization and define logics and subsequence of exposition while reading and speaking.

In our opinion the advantages of this pedagogical technique are based on the assumption that the perceptual speed of symbols and graphics is higher in comparison with verbal information perception. Moreover, graphic representation of the semantic structure of a text makes it possible to resolve many methodological problems and to optimize abstract making process at the stage of extracting 'key points'. These information graphs could be of any size and fashion, and could look like a handwritten or computer made Mind Maps. Our cadets made them by means of special computer programs that you can download free of charge on the Internet (*IMindMap, Mindomo, FreeMind MAPMYself, Text2MindMap, SpiderScribe).*

We believe that MindMapping via special computer programs makes it possible to resolve a great number of methodological problems.

The symbolic-and-colour representation of a computer-made graph provides tolerant association with special components of the text. For example, we can *label* a special colour to some common points of the texts with identical structure. According to compositional structure of the texts used in our experiment - text-description, text-narration, text-reporting - we gave the following colour notations to text key-points: devices and their components – light-green, definitions – light-blue, purposes and functions – yellow, main features and characteristics – orange, advantages – fawn-coloured, disadvantages and shortcomings – grey, ways of using – pink, development steps – brown. Such colour associations lead to an increased speed of information perception and interpretation and provide the use of logical accentuation approach consisting in stressing the most and the least important points of a text. In addition, representation of *key points* as icons sometimes facilitates the process of their *language filling*, i.e., every student is able to build a MindMap of the text regardless his or her language level. And, finally, by means of computer programs we can build a MindMap of several texts united by one topic (macro-text) by adding the map of a new text to the previously built ones.

But, despite a great deal of advantages the computer programs have, they cannot serve as the means of artificial intelligence helping a learner to find the proper word or define the main idea of a text – they can serve only as 'accessory tools' for semantic structure representation. Actually, the experiment showed that the semantic structure of the same text is differently represented by different students, although there are some identical nodes and edges in their MindMaps. This fact is explained by the adherents of anthropocentric approach (Lewis, 1969) who treat text abstracting, first of all, as a communication act with its addresser (the author), addressee (the reader) and the intermediary (the abstracter), who is necessarily a reader, and, partly, the second author. According to this point of view every person would interpret the text in his own way because of his or her background knowledge, outlook, age, social rank, professional affiliation, etc. But, nevertheless, we tend to believe that each scientific or popular-scientific text (especially technically-oriented) has some points evident for everybody.

Alongside the MindMapping technique presentation the learners should acquire sociolinguistic and discourse competences.

The teacher shows linking words and structures, draws learners' attention to various compositional models: text-description, text-narration, text-reporting, and demonstrates what syntactic constructions are used for each compositional model. The cadet learns to define the main idea and sub-ideas of a text comparing compositional and semantic structures of the text. The learner correlates each compositional structure with the appropriate semantic text structure and, therefore, with the appropriate MindMap type.

At this stage the cadets are involved in extensive, skimming and scanning reading activities, for example:

- "Read the text and try to *catch* the main idea of the text paying attention to underlined words and word combinations.
- Read the text one more time and underscore *key sentences* in each paragraph.
- Match the titles with the text paragraphs.
- Read the statements given below. Which of them are true, and which are false? Comment upon your choice.
- Make up a summary of the text using *key sentence* and linking words you know.
- Find the sentences telling about (for example): approaches to models representation before the algebraic coding invention.
- Read the text and fill in the table given below (Choporova, 2012)".

At the reproductive stage learners use the *analogy mechanism*, aimed at *building new* structures and language reformulation of MindMaps nodes according to acquired models. We can use the tasks like these:

- "Scan the MindMap for discussion. Complete the Map using information from the text. Report back to the entire class on your major conclusions.
- Scan the MindMap carefully. Before completing it look through the text. Report back to the entire class on your major conclusions.
- Make up a MindMap to the text using the figure.
- Using the 'colour labels', make a vertex coloration of the Map (Choporova, 2012).

The primary goal of the third (*creative or productive*) step is carrying the acquired skills over to new text material. The learner must know how to make a MindMap of the whole macro-text; he or she must be able to build a MindMap of a new text with familiar compositional structure; he or she must show creativity and build a MindMap of the text of an unknown genre.

Realization of the experiment

The experiment was performed in Voronezh Institute of the Ministry of the Interior of Russia in the course of 2011-2013. The thesis was: the abstract making process in general and the text semantics understanding particularly would be successful if the cadets were taught with the use of MindMap building technique as a main pedagogical technology. In total 184 cadets of Radio-Engineering

Faculty took part in the experiment: 62 cadets in 2011-2012 academic year, and 122 in 2012-2013 academic year.

The experiment included several stages:

- pre-experimental testing of reading and abstracting skills;
- in-experiment testing to check the degree of skills formation;
- end-of-experiment testing;
- statistical treatment of resulting findings;
- conclusions.

The count procedure to follow was:

1. To establish the equality of students' starting conditions in English proficiency via comparison of experimental and control groups.
2. To carry out abstracting skills teaching in experimental and control groups via an innovative technique (Mind Map-based learning), and in a classical manner, respectively.
3. To find out the differences in final states of the both groups after training.

All the cadets taking part in the experiment were divided into control and experimental groups – the latter were taught with the use of Mind Mapping technique. In the experiment some variables and constants were assumed. Among the variables we can name experiment conditions, pedagogical strategy and tactics. The number of hours given for language learning, the number of tests and their contents, educational resources (texts) and work activities were the same (constants) in control and experimental groups.

According to questioning data the test subjects were divided into 6 experimental groups: E1, E2, E3, E4, E5, E6 and 6 control groups: C1, C2, C3, C4, C5, C6 in such a way that at every step of the experiment we had an equal number of experimental and control groups.

Pre-experimental testing was carried out in the form of a written test, aimed to define the learners' initial language level and reading abstracting skills. The results of this test were suggested to compare to the results of end-of-experiment testing in order to estimate the efficiency of the offered pedagogical techniques. While interpreting the results we used qualitative and quantitative analysis of the trainees' answers. The qualitative analysis assumed various tasks in checking various types of reading skills in:

- *intensive reading* which "calls attention to grammatical forms, discourse markers, and other surface structure details for the purpose of understanding literal meaning, implications, rhetorical relationships, and the like" (Brown, 1994);
- *extensive reading* which is carried out "to achieve a general understanding of a text" (Douglas, 1994);
- *scanning* as "a quick reading to get to know the general meaning of a passage, to know how the passage is organized, that is, the structure of the text, to get an idea of the intention of the writer" (MacLeod);
- *skimming* as "a quick reading, focusing on locating specific information" (MacLeod).

The quantitative analysis allowed us to estimate the learners' reading skills and to reveal the difficulties coming across different types of reading.

Using quantitative analysis, we treated properly understood semantic units as units of measurements. Having made calculations we obtained the coefficient of reading skills formation depending on learners' abilities to retrieve information of different extent of complexity. The above-mentioned coefficient was obtained from the following formula:

$$Co1 = Co_i + Co_e + Co_{sk} + Co_{sc}$$

where:

Co_i – indicates the coefficient of properly understood semantic units in the course of intensive reading;

Co_e – indicates the coefficient of properly understood semantic units in the course of extensive reading;

Co_{sk} – indicates the coefficient of properly understood semantic units in the course of skimming;

Co_{sc} – indicates the coefficient of properly understood semantic units in the course of scanning.

Each of the coefficients was calculated as a ratio of properly understood units to the whole quantity of 'correct answers' in each type of reading.

We assumed that each coefficient of properly understood units, forming part of the integral *Co1* (*the total coefficient*), could not exceed 1, that is, the largest value of this coefficient equals 4.

The results of pre-experimental testing demonstrate that the test subjects in both types of groups (experimental and control) had virtually the same level of reading and comprehension skills before carrying out the experiment. The statistical significance of the obtained results in relation to experimental and control groups was verified by means of non-parametric Wilcoxon, and Mann-Whitney U-tests. These statistical tools were chosen because of a moderate sample volume (14 to 16 subjects), and also due to the fact that the findings are amounted to a number of right test answers, i.e., are measured in a ratio scale (Novikov, 2004). The estimation was performed at significance level p=0,05.

Comparison results of E_1 and C_1 pre-experimental testing are shown in a table 1. As the empiric value of Wilcoxon, and Mann-Whitney U-tests W_{emp}= 0,61 comes short of the critical value $W_{0,05}$= 1,96, one may state that the testing results are agreed (at p< 0,05).

Table 1. E_1 and C_1 pre-experimental testing Wilcoxon, and Mann-Whitney U-tests estimation results

№	Experimental Group (E_1)		Control Group (C_1)	
	Right Answers Number	Co_{basic}	Right Answers Number	Co_{basic}
1	12	2	10	1,67
2	10	1,67	11	1,83
3	11	1,83	13	2,17
4	14	2,33	12	2
5	8	1,33	9	1,5

№	Experimental Group (E_1)		Control Group (C_1)	
	Right Answers Number	Co_{basic}	Right Answers Number	Co_{basic}
6	9	1,5	13	2,17
7	13	2,17	15	2,5
8	12	2	11	1,83
9	11	1,83	13	2,17
10	13	2,17	8	1,33
11	12	2	12	2
12	7	1,17	11	1,83
13	11	1,83	10	1,67
14	9	1,5	12	2
15	10	1,67	11	1,83
16	12	2		
Basic value of the properly understood units coefficient		$\overline{Co_{basic}} = 1{,}81$	$\overline{Co_{basic}} = 1{,}90$	
Sample Size		$n_1 = 16$	$n_2 = 15$	
Rang Sum		$R_1 = 240{,}5$	$R_2 = 255{,}5$	
Wilcoxon Values		$W_{emp} = 0{,}61 < W_{0{,}05} = 1{,}96$		

Source: Author.

The same assessment was made to compare all the experimental and control groups, and it was statistically proved, that the results of pre-experimental testing of test subjects in the both types of groups were not quietly different (at $p<0{,}05$). That is to say, that the starting level of every student was practically the same.

Table 2. [1]Results of pre-experimental testing (reading and comprehension skills testing)

Group	Co_i	Co_e	Co_{sk}	Co_{sc}	*Co1*
E_1	0,26	0,58	0,55	0,42	1,81
E_2	0,33	0,53	0,51	0,38	1,75
E_3	0,32	0,56	0,57	0,40	1,85
E_4	0,23	0,48	0,47	0,34	1,52
E_5	0,28	0,53	0,54	0,33	1,68
E_6	0,40	0,69	0,67	0,47	2,23
C_1	0,28	0,61	0,57	0,44	1,90
C_2	0,36	0,56	0,53	0,40	1,85
C_3	0,28	0,55	0,56	0,41	1,80
C_4	0,25	0,51	0,45	0,36	1,57
C_5	0,29	0,52	0,50	0,35	1,66
C_6	0,42	0,70	0,68	0,48	2,28

Source: Author.

[1] the table gives the average values of the coefficients in the group of trainees.

Moreover, pre-experimental testing showed that the level of reading skills of some trainees was not sufficient and did not allow them to use sci-tech texts in their everyday and future professional activities. The qualitative analysis demonstrated that the learners found the tasks on intensive reading and scanning the most difficult, and the tasks on extensive reading and skimming less difficult.

After the pre-experimental testing the cadets of experimental groups proceeded with learning reading skills via the suggested technique of Mind Mapping, and cadets of control groups continued their studying as usual. The cadets of both experimental and control groups were informed beforehand about pre-experimental, in-experimental and end-of-experiment testing. The experiment lasted 34 weeks and that is why in-experimental testing was carried out in the middle of the learning period (after the 17^{th} week).

Table 3. In-experimental Wilcoxon, and Mann-Whitney U-tests values representing estimation differences of each of the group pair (experimental and control ones)[2]

Group	Pre-experimental Testing	In-experiment Testing	Final Testing
E_1, C_1	0,61	1,05	2,37
E_2, C_2	0,59	0,48	2,18
E_3, C_3	0,43	0,96	2,26
E_4, C_4	0,40	0,84	2,12
E_5, C_5	0,35	0,26	2,32
E_6, C_6	0,41	1,02	2,02

Source: Author.

The gross dynamics of variation of the understood units coefficient is given in table 4, illustrating the knowledge increment in all kinds of groups. Although the initial level of the learners' reading skills in experimental groups was a little lower than that of the learners' in control groups, the first ones were more successful: the gross increment of the coefficient made 70-102 %, and 51-87 % in experimental and control groups respectively. And we can observe a tendency: the lower was the initial level of a learner, the better results he or she had.

Table 4. Result indices of the properly understood units coefficient on experimental and control groups throughout the whole period of learning

Group	Co1	Co2	Co3[3]	Co3/Co1 (knowledge increment)
E_1	1,81	2,42	3,46	1,91
E_2	1,75	2,37	3,42	1,95
E_3	1,85	2,47	3,54	1,91
E_4	1,52	2,24	3,28	2,15
E_5	1,68	2,32	3,40	2,02

2 At significance level p=0,05, Wilcoxon critical value is $W_{0,05} = 1,96$

3 - estimation differences in experimental and control groups are reliable in case of p<0,05.

Group	Co1	Co2	Co3[3]	Co3/Co1 (knowledge increment)
E_6	2,23	3,00	3,80	1,70
C_1	1,90	2,30	3,06	1,61
C_2	1,85	2,32	3,04	1,64
C_3	1,80	2,33	3,14	1,74
C_4	1,57	2,14	2,93	1,87
C_5	1,66	2,30	3,02	1,82
C_6	2,28	2,87	3,45	1,51

Source: Author/

The coefficient of efficiency of suggested pedagogical technology, calculated as a ratio of the properly understood units coefficient in parallel groups, was equal to (E_1, C_1) 13,1 % for the first pair of groups, (E_2, C_2) – 12,5 % for the second one, (E_3, C_3) – 12,7 % for the third one, (E_4, C_4) – 11,9 % for the forth one, (E_5, C_5) – 12,6 % for the fifth one and (E_6, C_6) – 10,1 % for the sixth.

Apart from testing we checked the quality of the abstracts in order to double--check the suggested pedagogical technology of abstracting via Mind Mapping technique.

We analyzed a number of abstracts united by one profession-oriented topic: approximately three texts in a text block (macro-text). Herewith, the learners built an abstract of each macro-text. All the trainees reviewed the same texts in the same conditions.

To exclude subjectivity in results evaluation, the abstract quality was estimated by a group of experts in the field of information technologies and with proficiency in English.

In sum, each expert analyzed 736 abstracts (each learner made 4 abstracts, multiplied by 184 learners in sum).

And as shown in figure 1, the quality of abstracting in experimental groups was higher than in control groups.

Hence, the detailed analysis of tests and abstracting results showed that the suggested pedagogical technology of reading and abstracting based on Mind Mapping technique is really efficient.

And as it is shown in figure 1, the quality of abstracting in experimental groups was higher than in control groups.

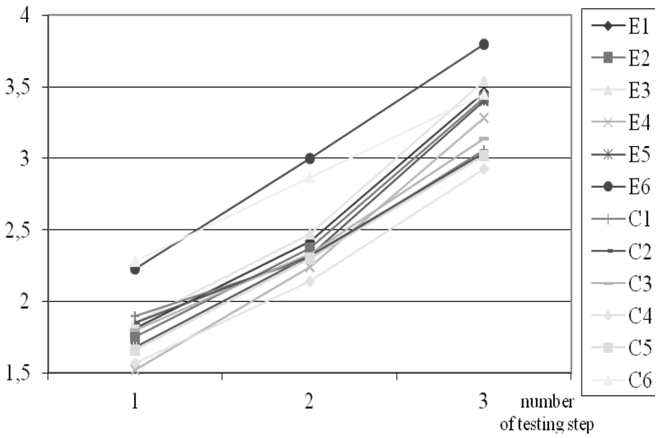

Fig.1. Total dynamics of the changes of the properly understood units coefficient.
Source: own chart.

Hereby, the detailed analysis of tests and abstracting results showed that the suggested pedagogical technology of reading and abstracting on the basis of the Mind Mapping technique is really efficient. The knowledge increment in control groups taught by the use of standard methods varied within 1,61 – 1,80, and in experimental groups it made 1,93 – 2,16. Thus the average value of knowledge increment in experimental groups was greater at 0,34. Therefore, we can claim that the experiment proved the efficacy of pedagogical technology based on the Mind Mapping technique as a basis of abstracting learning and a part of students' personal educational technology.

Conclusions and further studies

In summary, the following implications can be made:

1. Profession-oriented extensive reading and abstracting are closely interrelated, that is why abstracting can be even named *a creative reading*. According to our theoretical research there are three main stages of the abstracting process: understanding or de-verbalization of the text, making *the mental structure* of the text contents, and, finally, re-verbalization of the main idea.
2. Second-year cadets of Voronezh Institute of the Ministry of the Interior are supposed to demonstrate rather high language abstracting skills, while only post-graduate cadets are offered a special abstract making course. Thus, because of lack of special reading and abstracting skills second year cadets needed a different pedagogical strategy focused on retrieving and graphical representing the subject matter of a technical text.
3. *Mind Map building* provided the basis for our abstracting teaching/learning strategy as a special tool for key-points representation and sense compression and was one of the basic steps for the intellectual and creative abstracting.
4. Our experiment proved the efficiency of the Mind Map building procedure in a case of *the mental structure* representation by means of specific computer programs or in handwriting. Therefore, it can be stated that the experiment proved the efficacy of Mind Map-based pedagogical technology a fundamental of abstracting teaching/learning and a part of students' personal educational technology.

In conclusion, it should be noted, that to be good at abstracting, a person should not only know how to abstract *key words* and *key structures*, but also how to figure out the meaning of *comprehended passages*. Thus, our further task is to examine the present-day ways of paraphrasing to arrange them and to choose an optimal set of syntax and lexical transformations procedures for the second-year English learners in Technical Universities.

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