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The impact of rehabilitation programme on reading performance of persons with low vision

Kamila Ruzickova^{a*}, Department of Pedagogics, Faculty of Education, University of Hradec Kralove, 3405, Kralove, Czech Republic.

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Abstract

This specialized text deals with the increase of reading performance of adults and elderly adults with low vision in the Czech Republic. The aim of the research is to contribute to the verification of effectiveness of the rehabilitation programme 'Increasing visual performance in reading'. Evaluation of research data brings findings of verification of effectiveness of the adaptation of external conditions, which was used during the program. Measurable data are compared to the level of impact of the first part of the programme - environmental adaptation and modification of conditions for reading - to improve rehabilitation programme effectiveness. Based on the research results in the category of reading rate, environmental adaptation represented 42.8 % of overall increase in performance. In the category of linearity of reading, the proportion of increase within the observed part was 46.2 % of the overall increase in performance. In the category of reading comprehension, 14.3 % were achieved of the overall improvement. These data make it clear that in the categories of reading rate and linearity of reading, in relation to environmental adaptation, a slightly lower effectiveness was achieved compared to the educational part of the programme. The research results point to the high importance of the adaptation of conditions during the implementation of a rehabilitation programme. Therefore, this area of professional intervention should not be in rehabilitation process underestimated.

Keywords: Adults, low vision, visual rehabilitation, reading performance, adaptation of external conditions, research.

* ADDRESS FOR CORRESPONDENCE: **Kamila Ruzickova**, Department of Pedagogics, Faculty of Education, University of Hradec Kralove, 3405, Kralove, Czech Republic.

E-mail address: kamila.ruzickova@uhk.cz / Tel.: +420 493331391

1. Reading Performance as one of the Objectives of Vision Rehabilitation

‘Sight is the sense which enables vision, i.e. the ability to distinguish light, darkness, colours, shapes, positions and motions, three-dimensionality and depth of space. Vision is classified among remote analysers; it allows providing complete information in a minimum time interval with a minimal effort of the individual. It plays an important role in shaping the correct ideas, the development of memory, attention, thinking as well as emotional and volitional area.’ (Ludikova, 2003). A number of sociological researches on persons with low vision have shown that one of the most important subjective needs is maintaining a sufficient quality of reading. Achieving acceptable reading performance is also the most frequent objective of the prescription of optical devices and training how to work with them; therefore it is part of the basic content of vision rehabilitation (Corn, 1996). At the present time, the basic triad considered to be most important for maintaining reading skills is: *optimal magnifying devices or large print; environmental adaptations; and training of special reading techniques* (Dickinson, 2002). It is eligible to extend this triad by other means like visual hygiene and relaxation techniques.

A comprehensive evaluation of reading makes it possible to specify also other characteristics necessary for the needs of improving in reading performance as a part of the process of vision rehabilitation. The basic criteria of such an evaluation are: reading rate; number of errors; level of development of reading skills; quality of reading errors; level of comprehension of the content of text; eye movements during reading and other accompanying symptoms (Matejcek, Sturma, Vagnerova & Zlab, 1992).

1.1. Reading rate

The standards of reading rate can be expressed in two ways: by means of stents or by reading quotient (RQ). The average reading rate of undemanding texts varies between 125 and 225 words per minute. The level of socially acceptable reading concerning speed is about 70 words per minute. The high performance starts from the speed of more than 250 words per minute. However, the options of visual perception allow even a higher speed (approximately 330 words per minute). (Koenig, Holbrook, 1995) One of the objective reasons for deviation from the norm is reduced visual ability. For the above defined target group, only non-standardized reading performance classification is published on the basis of reading rate (Table 1). Lueck (2004) states that the minimum acceptable speed for ‘spot reading’ (short information messages) is 40 words per minute, while it is necessary to achieve the minimum speed of 80 words per minute for continuous reading.

Table 1. Classification of reading performance of persons with low vision

Groups	Reading rate per minute:
Partial sight	40 and less
Moderate to severe low vision	40 – 80
Performance after vision rehabilitation	80 – 120
Experienced reader with visual impairment	120 and more

1.2. Reading accuracy

Another important criterion of reading maturity is reading accuracy. It is not a very precise indicator. However, it develops diagnostic significance in case of excessive errors. Under normal

circumstances, the socially acceptable level is 7 - 8 per cent of erroneously read words.* The increased incidence of reading errors in persons with visual disorder acquired in adulthood can be considered clearly dependent on the limitation of visual abilities; thus the elimination of number of errors can be achieved through modification of conditions, education and training of reading skills with the use of optical devices. The diagnostic significance stems from a higher frequency of the recurrent type of errors. It is fitting to use the classification of errors by Matejcek, Sturma, Vagnerova and Zlab (1992) supplemented by the additional specific criteria: localization of error; quality of error; meaning of error; specific focus on errors caused by changing certain groups of alphabetic characters; errors in reading diacritical and punctuation marks or non-alphabetic characters. A significant milestone in the rate of errors is also the ability or inability to capture the whole word in a single fixation. The ability to use the technique of global reading contributes significantly to the use of past experience. Need to return to the analytic-synthetic method of reading words by parts associated with decreased visual ability and necessity of reading with optical devices causes complications and risk of increased number of errors and of slowing reading rate down. Quality of errors in reading is a diagnostic indicator important for the planning of rehabilitation exercises aimed at improving reading performance.

1.3. The level of comprehension

Comprehension of *text* is two different indicators. In adults, comprehension is linked with the level of the use of technical terms, foreign words, etc. or with the level of complexity of unwinding content line of the text. Information effectiveness is very closely linked with comprehension; it illustrates the extent of ability to interpret basic information data in the text; therefore it verifies the degree of attention to the essential content elements as well as memory during reading. The ability to maintain basic content elements of text in memory after finishing reading represents an opportunity to assess how much an individual can overcome the technical aspects of the process of reading and pay attention to the perception of the content. The relationship between the understanding of content and the degree of automation of reading process is indisputable (Sweet, 1994; Carver, 1990).

Persons, whose vision deteriorated in adulthood and who are forced to use optical devices with higher optical power for reading, lose in most cases temporarily or even permanently their original linearity of reading. This is also reflected in reduced performance in reading, which is originally stabilized at the level of stereotype. The person pays more attention to the technical aspects of reading. Even after a targeted training of visual techniques and reading with optical device, reading remains in most cases more difficult and slower. However, information effectiveness should gradually return to its original quality due to growing experience with the new reading technique.

1.4. Eye movements

The act of reading consists of fixations and eye movements towards the next sections of the text. Thus eye movements along the line are not fluent, but have saccadic character. The physiological abilities of properly sighted eye allow, with the normal reading distance from the eye (30 - 40 cm), fixation of an oval of the width of approximately 2.5 cm. During the time when the eye is fixated, new information is brought into the processing system. Depending on the type and size of font, half a word to three words can be perceived at the same time. Skilled readers move their eyes during reading, on average, every quarter of a second. The saccade lasts for 20 - 40 ms and, during this time, vision is suppressed so that no new information is acquired. (Silvestrone, Lang, Rosenthal, & Faye, 2000) The ocular motor skills apply in reading simple reflex responses as well as voluntary eye movements which can be positively influenced by learning. (Jošt, 2006) Ideally, individual saccades are smoothly linked and are not interspersed by uncoordinated movements or regressions. (Svoboda, 2003) Reduction of functional visual ability can cause problems in the continuity of eye movements because of several specific

* During the diagnosis of the quality of errors in reading, there is an alternative of discovering also other reasons of decrease in reading performance than reduced visual ability. It is therefore necessary to strictly distinguish the possible causes of making errors. (Matejcek, Sturma, Vagnerova & Zlab, 1992)

reasons. At the level of resolution of letters, modification of external conditions (prescribed type of optical devices, large printed text, environmental adaptation) should allow reader an unproblematic differentiation of characters which is a prerequisite for achieving the linearity of saccadic movements and eliminating regressive eye movements (Jost, 2006).

2. Rehabilitation Programme of Reading Performance of Adults with Low Vision in the Czech Republic

The programme seeks the involvement of the potential of the whole personality, object and social environment. It is built on a combination of diagnostic, therapeutic, technical and functional as well as educational and training strategies of intervention. The process of visual training seeks to achieve 'the best possible visual performance' through the use of modified or different methods and techniques of visual cognition and visual skills (often supplemented by the techniques of substitution). The basic determinant of reading of adults persons with low vision is limitation in the area of visual perception: insufficient visual acuity, visual field restrictions and imperfect visual motor skills. The former focuses on the achievement of optimal conditions and use of adaptive techniques in visual perception, i.e. the level of external and technical conditions and difficulties of visual task in relation to functional visual ability of each individual. The conditions for the resolution of characters in terms of their technical parameters are given in Jesensky (2007), font size; font proportions; spacing between characters; figure-ground contrast; colour and contrast; quality of the lighting of the text and reading area; arrangement of text; distance of text from the eyes. The latter area of vision rehabilitation aims at the motivation and training of the use of metacognitive techniques.

Three basic types of input data are used: *an assessment of visual abilities* achieved in clinical conditions, obtained on the basis of medical diagnosis; *an assessment of the degree of functional visual abilities* in common conditions and activities, effectiveness of the use of optical devices and non-optical aids and environmental adaptations; *an assessment of potential for further possible increase in visual performance*. Individual plan is made involving adaptation of conditions, selection of suitable rehabilitation (or assistive) aids, low vision training and supportive methods and techniques of vision rehabilitation. Training in adulthood must be conducted with respect to functional visual ability, age, motivation for further development, social and working environment, type of used equipment, difficulty of the text required for reading and level of reading performance. Before the completion of programme, rehabilitation strategies should be increasingly more directed to self-education methods, an increase in responsibility of the individual in the use of visual potential, self-development and practising the achieved level of visual performance. The primary consideration is to achieve the planned intent and individual's satisfaction concerning the level of knowledge, skills and habits and their application in practical activities and situations.

The actual experimental programme can be classified into relatively independent areas, from which the methods and techniques suitable for the individual can be chosen: training in the optimal use of external conditions for reading; selection of best form of information (font size, tactile or auditory form of substitution); training of basic visual skills in work with printed text; training of optimization of conscious eye movements (on line, page) and orientation in the text (in various types of text documents); training of differentiation of problematic alphabetic and non-alphabetic characters; training of basic visual skills with the prescribed near optical device; training of basic visual skills with middle-distance and long-distance optical devices; training of contextualization; training of compliance with visual hygiene and relaxation; training of reading skills to enhance performance in reading; training of the use of effective reading techniques; training in speedreading (suitable only in some cases).

Organization of reading skills programme is 10 weeks, with regular sessions of 1.5 hours per week, which is accompanied by individual training of already practiced techniques. The end of training takes place on the basis of consensus between the individual and the professional.

3. Methods

The aim of the research is to contribute to the verification of effectiveness of the rehabilitation programme 'Increasing visual performance in reading'. The aim of the research is to experimentally verify the level of effectiveness of environmental adaptation and modification of conditions for reading in the experimental rehabilitation programme.

The research question is: 'What proportion of the overall increase in reading performance is occupied by the technical part of the programme - environmental adaptation and modification of conditions for reading?'

The data were collected throughout the experiment with the use of combination of several research methods. *Qualitative*: method of comparison; method of theoretical processing of professional knowledge and study of professional literature; method of guided interview; method of qualitative observations; methods of analysis and synthesis, induction, deduction and comparison. *Quantitative*: the method of dialectical experiment was employed, specifically the educational natural two-factor experiment (in vivo). A quasi experimental research was organized with one experimental group and verified by the means of pre-test, post-test 1 and post-test 2. Quantitative measurements were planned for the verification of two situations: the first post-test verified the influence of external environmental adaptation on the increase of reading performance; the other post-test measured the degree of the influence of overall effect of the programme*. Data triangulation technique was used for the verification of selected essential information from multiple data sources. The measurement was carried out using standard techniques and equipment: stopwatch, digital MP3 recorder, experimental test, Recording Sheets. Another area addressed in the planning of research was the area of ethical issues. The first ethical issue was the necessity to use medical records. At the beginning of the research, each individual was informed about the conditions of participation. A high attention was paid to an ethical form of management of the programme and the privacy of each individual.

3.1. Characteristics of research group

Selection of the research group was made to meet in the best way the methodological requirements and to represent the most frequent target group of potential participants of the prepared rehabilitation programme. The control characteristics determining selection of individuals were: *age; level of visual abilities; and specific type of prescribed optical device* (based on the criterion of magnification). The research group was, in terms of age, limited to the category of adults. The research included young, middle aged and older adults; thus the entire spectrum of category of adults was covered. The largest group consisted of persons over 60 years of age.[†] In terms of the degree of disability, the selection criterion was following: all were persons with impaired visual acuity ranging from medium low vision to near-total visual impairment (6/36 - 1/60). Further characteristics for more precise clarification were developed: persons included in the research group were prescribed by the revision ophthalmologist special optical devices in the range of 5x-15x magnification and/or special optical systems. Another characteristic of the group was zero previous experience with professionally guided low vision rehabilitation training. All the individuals underwent a basic training in the control of prescribed optical devices in the form of one-time intervention of the specialized ophthalmologist. The last selection criterion was related to mental health. The research group consisted of the patients of the Ophthalmologic Department of University Hospital in Hradec Kralove. The observed group consisted of 10 persons (n = 10). This was mainly due to the restriction to one experimenter only, which ensured the unity of observation and evaluation of results for all the studied subjects. The research was recommended by the Ethical Committee of University Hospital in Hradec Kralove (Ref. N. 200502 S03L).

* Within the experiment, the technique of 'one group – before-after' was used. Even though this technique is not generally much respected, its application for the verification of the research is most appropriate.

[†] Similarly as in the Czech practice. (See for instance Moravcova, 2004; Skalicka, 2007)

3.2. Structure of the research

The research was conducted exclusively in the homes of the individuals. Optical devices were used which were personal property of each individual, prescribed to them by the revision ophthalmologist of Hradec Kralove University Hospital at least 6 months before the beginning of the experimental programme.

During the process of rehabilitation programme we considered the following areas: *diagnostic; assistive technology and environments for enhancing visual capabilities;* and *educational*. Phase of assistive technology and environments for enhancing visual capabilities utilized the means of adaptation and modification of external conditions for near-distance visual activities to increase visual performance and performance in reading (specific adjustments for each individual are recorded in the appropriate case study): Adaptation of lighting conditions to enhance visual capabilities (part of the experiment); Adaptation of environment, modification of information, visual hygiene and achievement of visual comfort (part of the experiment); Adaptation of conventional, modified and special rehabilitation aids as well as other aids and systems including the control of optimal way of their operation (part of the experiment).

4. Research results

This chapter provides an overview of the measurements results of the categories: reading rate, reading accuracy and reading comprehension.

4.1. Results in the category of reading rate

Statistical representation of results in the category of reading rate (descriptive statistics, Tab. 2)

Table 2. Comparison of the measured values of the average reading rate of entire experimental group

Groups	Total sum of reading rate (\bar{X} wpm)	Range ($X_{max} - X_{min}$)	Arithmetic average ($n = 10$)	Efficiency (%)
\bar{X}_{T_1S}	47.6	88.0 – 18.5	47.60	100
\bar{X}_{T_2S}	54.4	89.7 – 29.2	54.45	114.6
\bar{X}_{T_3S}	63.7	100.0 – 40.0	63.77	134.3
$\bar{X}_{T_{1/2}S}$	69.6	15.2 – 1.7	6.96	14.7
$\bar{X}_{T_{2/3}S}$	93.1	11.1 – 2.3	9.31	19.6
$\bar{X}_{T_{1/3}S}$	160.9	34.4 – 6.3	16.27	34.3
T ₁ S	Results in average reading rate achieved in the input reading test (pre-test);			
T ₂ S	Results in average reading rate achieved in the continuous reading test;			
T ₃ S	Results in average reading rate achieved in the output reading test (post-test);			
T _{1/2} S	Difference in the average reading rate results achieved in the first part of the programme;			
T _{2/3} S	Difference in the average reading rate results achieved in the second part of the programme;			
T _{1/3} S	Overall difference in the average reading rate between the input and output tests.			

Individual results demonstrate a level of the contribution of the both parts of the programme in all the cases (Fig. 1). The average performance of the research group in reading rate in the first test was 47.50 words per minute. In the second test, the average performance was 54.46 wpm (114.6 %). In the post-test, average reading performance was 63.77 wpm (134.3 %). By comparing the differences of average performance of the research group between individual tests, the summary results were achieved of the reading rate of the experimental group. Depending on the entire programme, the acceleration of reading was by 16.27 wpm (34.3 %), of which the performance increased by 6.96 wpm due to the adaptation part of the ERP (14.7 %) and by 9.31 wpm due to the education part (19.6 %). It

can be concluded that both parts of the ERP contributed significantly to the overall performance improvement in reading rate, with a slightly higher efficiency achieved through the educational and training part of the programme. (Fig. 2)

The highest level of individual performance improvement in reading rate is represented by the value of 34.4 wpm. The lowest value achieved in the correlation to entire ERP is increase in speed by 6.3 wpm. The extreme measured values reveal a high degree of variance in the effectiveness of the programme. As apparent from the analysis, the resulting increase in reading rate depends on the value measured in the input test (T1).

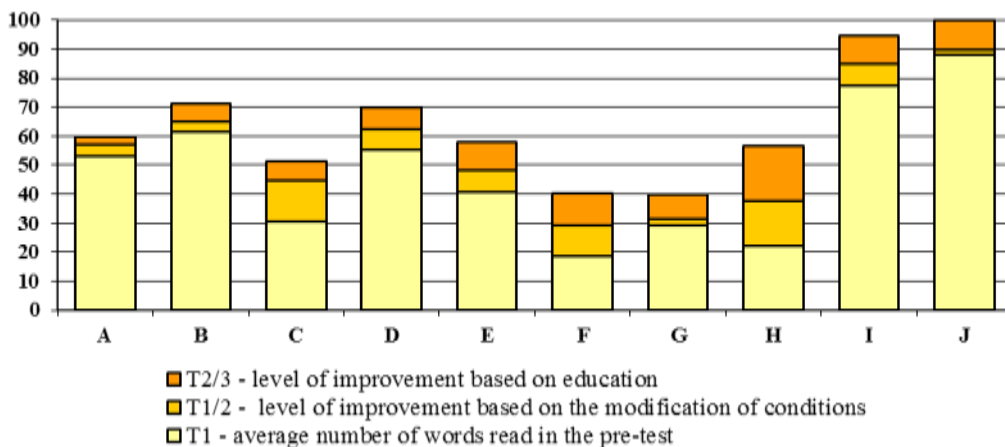
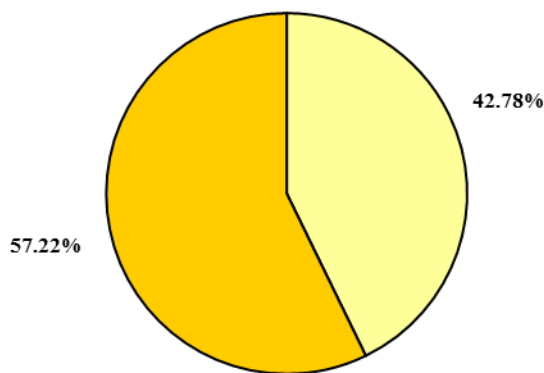


Figure1. Values of improvement of the individuals in reading rate achieved in all experimental tests (data given in average number of words per minute).



- increase of performance in reading speed in the first experimental part of the programme (T1/2)
- increase of performance in reading speed in the second experimental part of the programme (T2/3)

Figure 2. Efficiency of the programme in reading rate in both its experimental parts (%)

4.2. Results in the category of reading accuracy (number of errors)

The measurement of number of errors in reading is expressed by the number of errors per minute (epm). We consider for an error: incorrect reading of characters / syllables / words / parts of sentence, regressive eye movements and excessively long pauses in reading.

Statistical representation of results in the category of number of errors in reading (descriptive statistics, Tab. 3)

Table 3. Comparison of measured values of the average number of errors in the entire experimental group

	Total sum of errors \bar{X} (X epm)	Range ($X_{max} - X_{min}$)	Arithmetic average ($n = 10$)	Efficiency (%)
$\bar{X} T_1E$	21.7	7.8 – 0.7	2.17	100
$\bar{X} T_2E$	14.0	4.2 – 0.5	1.40	64.5
$\bar{X} T_3E$	7.4	1.7 – 0.34	0.74	34.1
$\bar{X} T_{1/2}E$	69.6	3.6 – - 0.16	0.77	35.5
$\bar{X} T_{2/3}E$	93.1	2.5 – 0	0.66	30.4
$\bar{X} T_{1/3}E$	160.9	6.1 – 0.2	1.43	65.9

- T_1E Average number of errors in the input reading test (pre-test);
- T_2E Average number of errors in the continuous reading test;
- T_3E Average number of errors in the output reading test (post-test);
- $T_{1/2}E$ Difference in average results achieved in the first part of the programme;
- $T_{2/3}E$ Difference in average results achieved in the second part of the programme;
- $T_{1/3}E$ Overall difference in average results achieved between the input and output tests.

From the measurements in the category of errors in reading, the following results could be drawn:

Based on environmental adaptation (the first part of the programme), the average reduction in the number of errors was by 0.77 epm (35.5 %). Depending on the educational part of the programme (the second part), the average number of errors was reduced by 0.66 wpm (30.4 %). During the entire programme, the number of errors was reduced by 1.43 epm (65.9 %) in the experimental group. These results indicate that both parts of the programme significantly contributed to the reduction of errors in the research group. Environmental adaptation contributed in this case to the overall performance improvement by 7.7 % more than education. (Fig. 4) A high level of dependence between errors in reading and the quality of external reading conditions can be assumed. Similarly, also the educational part represents an important potential of increase in reading performance through increasing the fluency of reading.

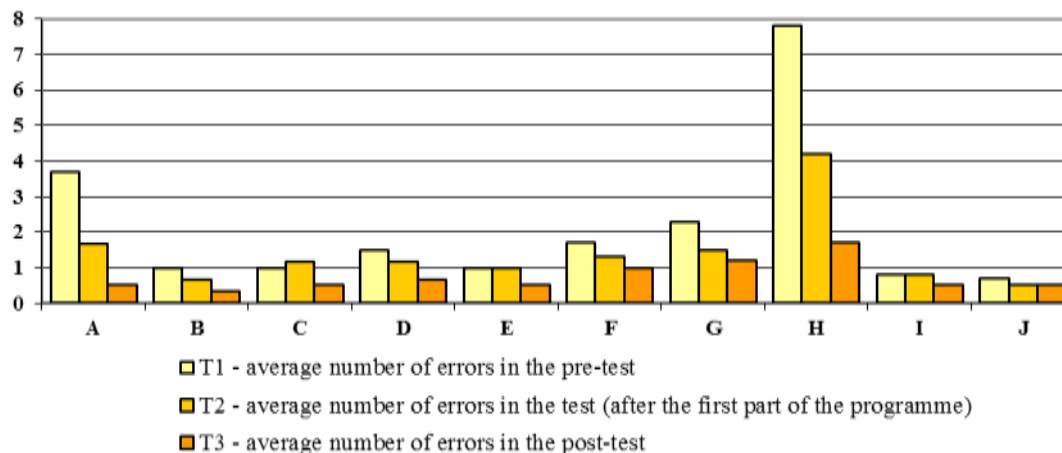


Figure 3. Values of improvement of all individuals in number of reading errors in separate experimental tests (epm)

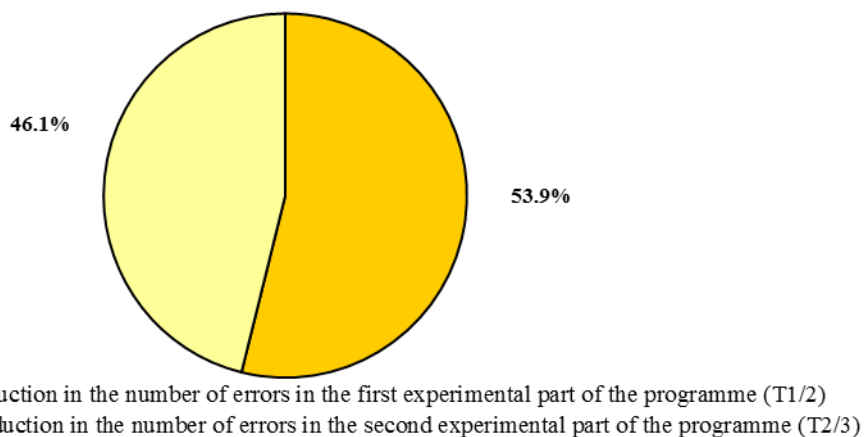


Figure 4. Efficiency of both experimental parts of the programme in the reduction of number of errors (%)

4.3. Results in the category of reading comprehension

The nominal values of number of correctly answered questions are related to the level of understanding of the read text.

Statistical representation of results in the category of reading comprehension (descriptive statistics, Tab. 4).

Table 4. Comparison of data of the average number of correctly answered questions in the entire experimental group

	Sum of correct answers	Range ($X_{\max} - X_{\min}$)	Arithmetic average ($n = 10$)	Efficiency (%)
\bar{X}_{T_1A}	26	4 – 1	2.6	100
\bar{X}_{T_2A}	30	4 – 2	3.0	115.4
\bar{X}_{T_3A}	54	6 – 4	5.4	207.7
$\bar{X}_{T_{1/2}A}$	4	1 – -1	0.4	15.4
$\bar{X}_{T_{2/3}A}$	24	3 – 1	2.4	92.3
$\bar{X}_{T_{1/3}A}$	28	4 – 2	2.8	107.7

- T_{1A} average reading efficiency achieved in the input reading test;
- T_{2A} average reading efficiency achieved in the continuous reading test;
- T_{3A} average reading efficiency achieved in the output reading test;
- T_{1/2A} average difference in reading efficiency achieved after the first part of the programme;
- T_{2/3A} average difference in reading efficiency achieved after the second part of the programme;
- T_{1/3A} overall difference in reading efficiency between input and output tests.

The calculation of arithmetic average provides the resulting values of increase in performance in the area of reading comprehension in the basic experimental group. Depending on the first part of the programme, there was an average increase in the number of correctly answered questions by 0.40 answers (15.4 %). Based on the second part of the programme, the average number of correct answers increased by 2.4 questions (92.3 %). The group achieved the average improvement in reading comprehension of 2.8 questions (107.7 % of the original performance) during the entire programme (Tab. 4).

The maximum performance improvement in reading comprehension is represented by the value of improvement by 4 correctly answered questions. This result was achieved by 2 individuals. The lowest rate of improvement (2 correct answers) was achieved by 7 individuals. One achieved the improvement of 3 answers. These results indicate that the overall efficiency of the implemented programme in the area of increase in reading comprehension reached fundamental values – more than one hundred per cent improvement. Due to the fact that 3 of the 10 individuals achieved maximum value (answered all questions correctly in the pre-test), it can be assumed that, in case of more detailed examination, the resulting values of improvement could be even more significant. For this reason, we believe that the evaluation of results achieved during the process of improvement – i.e. difference in the performance of individuals – is of more benefit. Even so, we can assume a certain degree of inaccuracy (Fig. 5).

The measured values show that the most frequent value of improvement in reading comprehension is the difference of 2 correctly answered questions. With a closer analysis of the obtained data, we can evaluate *the first part of the programme* as significantly less effective. Five individuals improved during this part by 1 correct answer, the performance of four individuals remained at the same level as in the pre-test, one person was even worse by 1 answer. The overall average of research group was therefore only improved by 0.4 questions (15.4 %). In the *second part of the ERP*, which included exercises aimed at the development of concentration on the basic information value of the text, significantly clearer results were achieved. Four individuals improved by 3 correctly answered questions, four individuals by 2 and two individuals by 1 correct answer. No less than a half of the group (5 persons) experienced an improved performance in this category solely in connection with the second part of the experimental programme. In the second part, all individuals achieved an improvement, which was on average by 2.4 questions correctly answered (Fig. 6).

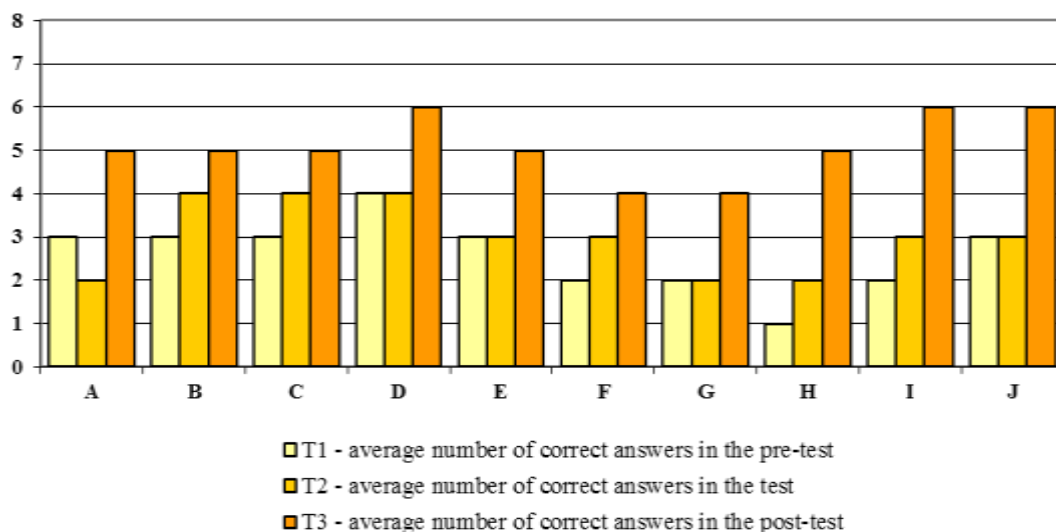


Figure 5. Values of the improvement of individuals in reading comprehension in individual experimental tests

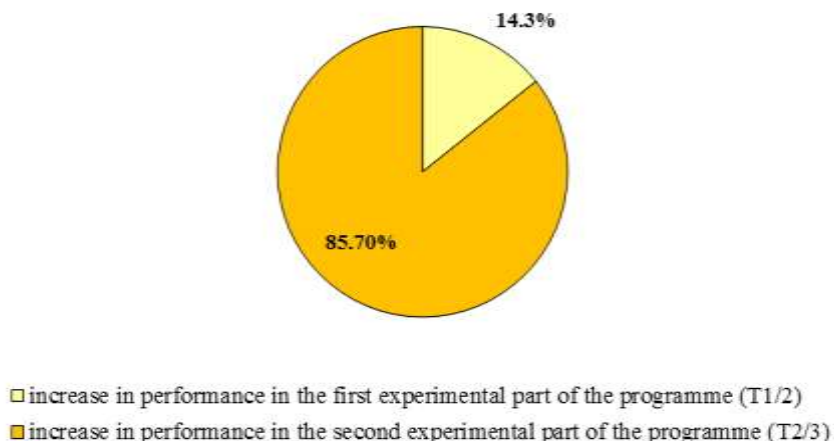


Figure 6. Ratio of the efficiency of the programme in the area of reading comprehension in both experimental parts

Based on the research question: ‘What proportion of the overall increase in reading performance is occupied by the technical part of the programme - environmental adaptation and modification of conditions for reading’:

In the category of *reading rate* and *linearity of reading*, environmental adaptation represented an important means of increase in reading performance (42.8 % and 46.2 % of the overall increase in performance). In the last category of *reading comprehension*, 14.3 % were achieved of the overall improvement based on the environmental adaptation and modification of conditions for reading. These data make it clear that environmental adaptation and modification of conditions for reading cannot be underestimated in the programme as it is a foundational stone for educational part of programme. It provides key results especially in individuals who are not sufficiently motivated for training reading as such. A slightly lower effectiveness was achieved compared to the educational part in the last category of reading comprehension. However, we can still talk about a very positive outcome.

5. Discussion

A higher degree of effectiveness of the ERP for reading rate category is predictable in persons who have reached low levels in the input test. Based on the data analysis, it is evident that individuals reached a high degree of improvement already due to environmental adaptation and modification (e.g. F, H, C). Based on the analysis of case studies, it can be further noted that external conditions for near-distance visual task in all the individuals with low initial performance were not adapted as to the requirements of visual comfort in reading. These persons reached comparable values of increase in performance both in the first and second parts of the programme. In contrast, persons, who achieved the environmental adaptation of external conditions independently (e.g. B, J), reached a higher improvement in reading rate predominantly through education and training.

The extreme values show that the range of efficiency of the programme in the category of reading linearity is wide. The lowest values of improvement in the number of errors belong, according to the analysis of case studies, to Individuals C and E who are part of the subcategory of older persons and experienced readers. This makes clear that, due to their reading experience, the number of errors was low in both cases already in the first test. Such a group has a higher potential to read without errors through the use of special aids and devices at the level of self-education. The last indicator is the effect of environmental adaptation in persons whose initial skills and external conditions were minimal (Individual F, G, H). In all these cases, the modification of reading conditions played an essential role in the overall improvement. These individuals belonged to the group of less experienced readers.

6. Conclusion

This research has demonstrated a high level of potential for the development of visual skills. This research also accentuated particularly the requirement to ensure a comprehensive approach to this problem. The main intention was to demonstrate the level of significance of the part of programme aimed at environmental adaptation and modification of conditions for reading. The present circumstances of the development of practice tend to underestimate the development of educational direction, thus degrading vision rehabilitation only to the training of the use of optical or non-optical devices. This, however, does not correspond to the current level of knowledge or needs of rehabilitation practice. Based on the achieved results, the part of the programme, focused on environmental adaptation and modification of conditions for reading, represents an essential means for the further development of reading performance. This part has an apparent effect especially in case of the group of less experienced and less motivated low vision readers.

The ability to read at all its basic levels is generally considered one of the core competencies of human being. Depending on the ability of effective manipulation with information mostly conveyed by reading, it belongs to the values of social status and freedom of information. Even if future holds epochal changes in the options of artificial replacement of vision, it is important not to miss any stage of development and provide comprehensive services for adults who are willing to achieve the effective use of partial sight to reach a high quality of independent life.

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