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E-studies and mastering of educational material for people with visual perception and visual – motor integration problems - topical issues and perspectives

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ABSTRACT

Today educational and study environment is no longer viewed separately from different electronic technologies – the educational system must comply with the tendencies of today electronic era, which also comply with modern people "electronic" daily routine. Educational and study processes must be assessed from the perspectives of use and the development tendencies of various electronic technologies in order to interest contemporary youth in the learning process. The modern educational process and the introduction of information technologies in the remote learning process cannot be viewed separately from the basic processes of the human body and visual perception. Modern technologies motivate to ease not only the learning process but also to analyze learning results in order to develop individual correction plan for every person. This article discusses the causes and possible solutions for ensuring the availability of e-studies and acquiring learning materials for people with visual-motor and visual perception integration issues.

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1. Introduction

The visual process is the dominant process in interpreting our world [1]. Looking at the processing of visual information, three subsystems that interact at the same time can be distinguished: sensor, motor and perception system. The visual perception and cognition of the world are active and coordinated. This is why on the order for the learning process to be successful, visual signals must be productively conceived, interpreted and integrated with incoming information from other senses [2].

It should be noted that visual perception is a generic term used to describe visual infor-mation processing techniques such as visual analysis, visual-spatial and visual-motor integration, and hearing-vision integration. Visual-motor integration (VMI) characterizes the level of coordination of visual perception and body movements. This process involves touch (sensory perception) activating muscles for smooth and productive execution of the task. Examples of such activities are catching the ball, writing down from the board at school [3].
In contrast, visual perception itself is a special way of perception that requires the coordinated action of visual, kinesthetic, and kinetic analyzers. It is the ability to perceive, recognize, analyze, systematize and remember visual information. If there is any disruption in the process, the pupil has difficulty in performing visual and visual-spatial analysis, differentiating visual perceptions, remembering visual images, orienting in space and plane, and other difficulties [4]. Disorders of visual perception are often very subtle; they are usually

not noticed until the child experiences difficulty in learning the subject at school. That is why it is important to perform visual perception development tests (The Developmental Test of Visual Perception, Second Edition or DTVP) in a timely manner, that combine two factors – both visual perception skills and visual-motor integration skills. Previous studies have shown that since the age of infancy people have been linked to the body's visual and mechanical systems [3], establishing a correlation between hand and eye coordination capabilities, learning abilities and social skills [5]. However, not all people visually motor integration is fully developed, but they cannot be considered disabled – it is one of the specifics of vision. Therefore, modern society, known for many years as a knowledge society, needs new tools and instruments, techniques to solve the problems of getting relevant information from the ever-increasing data flow and surrounding information. Even employers nowadays demand a workforce with a higher and higher level of knowledge [6]. Thus, it can be concluded that the visual-motor perception of people as well as learning aids, including e-studies, should be developed in order to not only identify the imperfections of visual motoric, but also to eliminate them as much as possible and also to facilitate the learning process for those whose visual-motor integration cannot be improved. Such a solution is considered feasible because, on the basis of visual-motor integration capabilities, it is possible to develop the most suitable ways of acquiring e-studies and specialized materials that would create suitable e-study conditions for learners. One should not forget about the assessment of visual perception itself with abilities of modern technologies computer technics as well. The most recent studies reveal that the mechanical skills of children's visual perception can also be fully assessed by computerized evaluation of mechanical skills of perception or the computer screening. This is both unique and perspective opportunity and a new method for evaluation of children's development level of visual perception in very early age. Along with the use of a computer program in such an assessment, the risk of the human factor, when something is subjectively assessed or overlooked, is completely excluded - a computerized and technical solution that can also be incorporated into e-studies excludes the possibility of incorrect evaluation of the students' performance and miscalculation of the final results of the tests. Computer-aided test processing significantly accelerates the collection and acquisition of test results - as we know, time is now a very important resource that everyone needs to spare [7].

2. Tools and methods

Nowadays, study tools and technologies are very diverse and are still undergoing continuous improvement, but basically, the use of text and textual information on the screen remains indispensable. [7]. Also, the results of many specialists (special educators, orthoptists and psychologists) surveys also suggest that such computer program should be developed that initially assesses the level of visual-motor coordination and visual perception and then identifies the types of representations that are applicable to each individual separately. Of course, it is also emphasized that the assessment of the level of vision-motor coordination and visual perception by existing methods - manually and with the subjective opinion and approach of the researcher - is a biasedly durative process that is inadequately long in the context of both material collection and subsequent processing and summarizing of the results. The author has previously researched and analysed, both manually and with the help of a computer program, the performance of pre-school and primary school children in the eye-hand coordination test and their depth perception. The study used the standardized DTVP-2 test - a psychophysiological test and it has been reported as a golden standard for evaluation of visual - motor and visual perception integration [8]. DTVP-2 has eight aspects, which should be studied in subtests, which include Eye-Hand Coordination,Copying, Spatial Relations, Position in Space, Figure-Ground, Visual Closure, Visual-Motor Speed, Form Constancy [9], results of which were summarized both manually and with help of developed computer program – ImageJ in order to identify the correlation between these indicators mentioned above. Based on the previous findings of the author, namely that the magnitude of the DTVP-2 test execution rate does not depend on cognitive processes, it is influenced only by visual or motor processes and that the DTVP-2 test execution rate is highly correlated with the threshold value of stereovision, the aim improve not only the e-studies themselves, but also the program used [10]. Also, it is important to understand which tests of DTVP - 2 or subtests exactly have been performed by various researchers and what conclusions they have come to, how they have summarized their results, did they used manual processing only or did they use other instruments for the processing and did not exclude the possibility to use computerized data processing.

3. Action plan and discussions

Taking into account other author's research with a computer pro-gram, the author proposes to improve and consummate the previ-ously developed ImageJ computer program in such a way [10] that it can be used before the e-studies commence. This program analysed the tasks of the eye-hand coordination test of the DTVP-2 test (Exercises 1-16). When working with this program, for the processing of the test results, the children draw-ings/test pages had to be scanned first and converted from PDF format to JPG format and with coloured dots had to mark the be-ginning and end of the work field. Each task has its own Macros (.txt format). The obtained results allow evaluating the degree of curvature of the line and its deviation from the optimal direction. In tasks from 1 to 6, the Macros-1 is used. Macros of each task are able to find coloured dots in the image, then draws a line between these points on one side and the other, but then summarizes pixels and divides with the length of the line to obtain a scale-independent variation coefficient - the integral deviation to be calculated by the following formula (l):

$$I = \frac{\mathrm{E}}{\mathrm{L}} \tag{1}$$

where: E - Sum of line area (in pixels), L- Length of line (in pixels).

The obtained results allow evaluating the slope othe line and its deviations from the optimal direction. The higher the number, the less accurate is the line drawn by the child. Such an approach is reasonably applicable to both vertical and horizontal lines. It should be noted that, before using the drawing, it had to be prepared, that is, to put small red ovals at the beginning and end of the drawing and to save it. This is necessary for the program to work correctly. Images representing the results obtained can also be saved to be used for further research and work, but it should be remembered that the image should be kept with a different name so that the output data does not disappear. In tasks from 7 to 16, the Macros 7-16 draw vertical lines and find their crossing points with the lines of the drawing. The resulting coordinates are entered into the data array and processed. Formatting vertical lines are not considered because they distort results. Similarly, certain points and a small type of succession in the form of text are also not taken into account. It should also be noted here that the shapes that do not fit in succession, unfinished lines and other like that are not taken into account. Large deviations and gross errors had to be assessed manually by human vision. When data arrays were completely cleared of inter-fering factors, a step of figures was calculated for each vertical line, which is the mean square value of all y-values. In the next stage, the deviations of the drawing lines from the ideal values were calculated. The higher dispersion of lines, their scope and curvature, the higher the square value of the average deviations. The resulting value is reflected on the image next to each line. Then, at the end of the calculation, the program at the bottom of the image represents the total square value of the average deviation. The higher this value, the less qualitative is the drawing. It should be reprogrammed in such a way that it can be used in smart devices that provide instantaneous image processing that will enable to establish the person's visual - motor and visual perception integration capabilities. Based on these obtained test results, e-studies would already have pre-prepared and customized learning material for the subject. For example, people with weaker visual information perception and memorization should be provided with additional video or audio materials. In turn, for the people with eye-hand coordination problems the individual e-study courses should also be offered to develop their eye-hand coordination, which will, in turn, facilitate their future learning process as well as life in general.

4. Conclusion

All figures, tables and photos must be clear and sharp. The examples of figure and table numbering and titling are given below. E-study materials should be diversified according to the way they are taught. Relevant diversification parameters would be those that should be experimentally tested first and, on the basis of them, specialized material adaptation algorithms in e-study technologies and tools should be introduced. The diversity/variety of teaching materials will be reflected in the fact that e-study materials will be adapted to the students' perception and cognitive abilities - with different forms of presentation, such as visual materials, video materials, recorded lectures and others. It is necessary to provide a learning material that is easier to understand or the students who have some visual perception problems. Computer-aided evaluation and analysis, in turn, can be used to assess visual perception and eye-hand coordination/visual and motor

interdependence, not excluding standard evaluation methodology as well. Importantly, computerized assessment provides a much more accurate and faster interpretation of results, which in turn gives professionals the opportunity to devote more time to the necessary correction work and development of specialized e-study materials.

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