

PhD dissertation review

MA Gerda Delaunay

Title: Application of local vibration to stimulate cognitive functions in adolescents

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The research problem undertaken by the Author is the scope of physical culture sciences, including the issue of the impact of physical activity with the use of local mechanical vibration on changes in the level of selected cognitive functions among adolescents between 15 and 16 age. The knowledge obtained as a result of the research is very valuable and has application values and potential.

Formal research evaluation

The doctoral dissertation submitted of evaluation for 91 pages of standard typescript. It consists of six main chapters: "Introduction", "Research Aim", "Materials and Methods", "Results", "Discussion" and "Conclusion". At the end of the PhD dissertation there are abstracts in Polish and English, References and Appendixes. In my opinion, the structure of the work does not raise any major objections and is consistent with the methodology used in the science of physical culture, typical for the experiment.

The dissertation begins with an extensive sixteen-page introduction to the subject taken up by the Author. The introduction is organized in two sections. These chapters contain exhaustive descriptions of issues related to physical activity, its relationship with cognitive functions and a subchapter on mechanical vibrations, including local mechanical vibration considered in the work. The PhD dissertation directly concerns the verification of the impact of local mechanical vibration about cognitive processes, I would like the Author to explain during the dissertation why in the introduction Author focused on the general description of the impact

of physical activity on cognitive functions and not on the impact of mechanical vibration on cognitive processes.

The next chapter of the dissertation entitled "Research Aim" contains the aim of the work and research questions. The main aim of the PhD dissertation was to find differences in the level of cognitive functions of students who participated in two different exercise intervention programs. The goal was formulated in an understandable way, which clarifies the Candidate's research intentions. In my opinion, the introduction and justification of the goal should be included in the previous chapter. Four research questions were formulated in the work. It was also done correctly, but the author formulates the questions in such a way that Author asks the question "Is there a difference" and does not ask questions about the nature of these differences, which is crucial. The work is a pre-post experiment, so it would be good practice to define the main research hypothesis. The formulation of the hypothesis is always debatable, but in empirical research it is very desirable and complement the scientific quality of the research problem.

The next chapter of the work presents a detailed protocol of inclusion in the study with clear figures presenting the recruitment stages of the surveyed people (Figure 8) and a flowchart presenting study enrollment (Figure 9). As a consequence, the material consists of three groups of subjects: control group n=20, exercise group n=22 and vibration exercise group n=27. In my opinion, there is no table describing the study group, which would present the basic somatic characteristics, the exact age structure and the sex of the subjects. Please justify the lack of information on the structure of the study group. The subchapter "Study procedure" describes in a detailed and clear way the protocol of the entire experiment. The author of the work provides the information the exercises were presented by certified teachers. I would like the Author to develop the thought and explain during the public exam what certificates were meant. Additionally, this subsection describes the device used to generate mechanical vibrations of the smovey neuroVibe. The next subchapter is a detailed description of the tests used in the work. All six tests measure the level of cognitive processes. The tests used are: 1) d2-R Test of attention and concentration; 2) Controlled Oral Word Association Test; 3) Verbal working memory and attention IFRW test; 4) Numeric memory test DSRN; 5) Acoustic Test AT and 6) Sense of touch ST.

I believe that it would be very valuable to use "motor cognitive tests" as well. Tests like this could help a lot. An analysis of the changes in reaction times, movement times and the speed of making the correct decision would be very interesting in the context of interventions

using local mechanical vibrations. I would like to ask the Author to refer this remark during the public exam.

The methodological part ends with a subchapter describing statistical methods. In my opinion, the statistical methods have been selected with great care and their use allows to answer the research questions posed. The research was approved by the relevant committees and was carried out in accordance with the Helsinki Declaration. I rate the entire methodological part very well, which confirms the scientific maturity of the Author.

The "Results" chapter is organized into three subchapters. The author of the work presents the results using 14 tables and 14 figures. The first part of the results concerns the characteristics of changes in cognitive processes in individual research groups. It is worth noting that the Author correctly used the post-hoc test analyzing the differences between groups of adolescents and the tests of the significance of the changes between measurement before and after intervention. The obtained results are not unambiguous. For four variables, significant changes were noted in each analyzed group, which makes it difficult to confirm the impact of physical activity with local mechanical vibrations. For only three variables, significant changes were noted only for the VEG group. In my opinion, a technical error is also connecting the average values in the figures presenting Means and 95%CI with the lines. The combination of mean values may suggest that successive categories on the x-axis form a time series, while in fact they are disjoint groups and the results are not related. I would drop the lines connecting the averages or use a dashed line. The presentation of standardized values in Figures 15 and 16 is also noteworthy. However, I would place a description of the meaning of individual quadrants in the subchapter statistical analysis. The next subsection of the results concerns the analysis of the interdependence of individual tests for the pretest and post test measurement, the Author rightly chose the Spearman correlation method. I would like the Author to justify the advisability of analyzing the interdependence between individual tests during a public exam. Which research question is this analysis related to? The last subsection of the results is an analysis using stepwise regression. Using this method, optimal predictors for Concentration Performance (for each group for each trial) were determined. The weights of individual models are presented in the form of a table together with the evaluation of the model in the form of the R^2 indicator. I would also ask the Author to justify the use of stepwise regression and indicate the purposefulness of the analysis in the context of the research questions posed.

The next main chapter is the nine-page Discussion. This chapter is also divided into three parts, two of which are numbered and named. The first part of the discussion is a general introduction and a reminder of the importance of the research problem. In the second part of

this chapter, the Author develops the topic of stimulating cognitive processes, citing works in this field. The last part of the discussion is a synthetic description of the results obtained, in which the Author cites only a few papers. Most of the third part of the discussion could have been included in the results chapter. The topic is an innovative one, which makes it difficult or even impossible to compare the results obtained. So I guess that this is the nature of the discussion, which includes a very large part summarizing the results. The last main chapter is the presentation of conclusions, which are basically the answers to the research questions.

Analyzing the editorial side of the work, it should be emphasized that the text is uniform and logically coherent. Despite minor technical and stylistic faults, the work is written well. Minor defects include, among others, the lack of a description of the y axis in graphs 17, 18 and 19, and the end of some subsections with a graph or table. These comments in no way affect the substantive level of the work and my assessment.

Summing up the formal assessment, the reviewer evaluates the submitted doctoral dissertation very well.

Final conclusion

In the doctoral dissertation presented for review, an original research problem is undertaken, which is significantly related to the shaping of cognitive processes with help. The dissertation has many advantages and is a valuable contribution to the knowledge of cognitive processes. In conclusion, I state that the doctoral dissertation submitted for evaluation indicates a thorough knowledge of the problem addressed by the Candidate, the correct use of statistical methods and the ability to discuss and draw conclusions. I declare that the doctoral dissertation of Gerda Delaunay, MA, entitled “Application of local vibration to stimulate cognitive functions in adolescents” meets the requirements for doctoral dissertations set out in Art. 187 sec. 1 and 2 of the Act of July 20, 2018. Law on higher education and science (Journal of Laws of 2022, item 574). As a result of the positive opinion, I am applying to the Senate of The Wrocław University of Health and Sport Sciences to admit Gerda Delaunay to the next stages of the doctoral procedure.

dr hab. inż. Krzysztof Przednowek, prof. UR

