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The Contribution of Direct Hands-On Instruction Relative to Indirect One on Primary Students' Achievement in Science[2]

Extended summary

The need for determining and providing an optimal level of instructional guidance during the application of hands-on experiments is a current topic in the scientific education of students in integrated natural sciences. In recent years, questions, which include elements of direct and indirect hands-on instruction: demonstrating activities or involving students in practical work, as well as providing answers or retaining them (students' independent search for them) are particularly represented. In general, the results of the research, as well as the views of the researchers are not harmonized when it comes to the advantage of applying one type of hands-on instruction over another in teaching integrated natural sciences. This study aims to expand the research topic, i.e., to examine the difference in the contribution of indirect hands-on instruction in relation to the direct hands-on instruction to the achievements of third grade students about the content on motion and properties of materials at all cognitive levels. Research on this topic has not been realized so far. $N = 94$ students (ages 9-10) from two primary schools participated in the research. Students are arranged in two groups: E1 within which students learned the content about motion and properties of materials with the use of indirect hands-on instruction and E2 within which students learned the same content with the application of direct hands-on instruction. For the purposes of this research, the method of theoretical analysis, descriptive-analytical method and experimental method were used. Research technique is

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testing (pre-test, post-test and re-test). Each test contained 12 tasks - two tasks at each cognitive level. The data were analyzed statistically using SPSS version 23. The results of this research showed that the instructive hands-on approach affects the quality of the students' knowledge and retention of what has been learned about the contents on motion and properties of the materials. When we analyzed the number of points at cognitive levels: *I know*, *I understand*, *I apply* and *I analyze* it, it was concluded that the students of the E1 group had achieved a higher number of points at each cognitive level than the students from the E2 group, but this difference is not statistically significant. However, the significant contribution of indirect hands-on instruction in relation to the direct hands-on instruction to the quality of student knowledge about these contents is visible at the cognitive level *I evaluate*. It should be noted that both hands-on instructions have insufficiently contributed to students' adoption of the knowledge required to solve items at the highest cognitive level *I create*. After two months, it was observed that the advantage of indirect hands-on instruction in relation to the direct hands-on instruction to the student knowledge weakens. Although the students of the E1 group achieved slightly better results when compared to the E2 group students at all cognitive levels on the re-test, the results show that there is no statistically significant difference in the knowledge of both groups at each cognitive level. Indirect hands-on instruction had a greater impact on the uniformity of students' knowledge on the post-test and re-test at all cognitive levels than direct hands-on instruction. Also, the difference between the results of students achieved at the pre-test compared to the post-test, it is higher in E1 in relation to the E2 group, while the difference between the results of students achieved at the post-test compared to the re-test, it is smaller in the E1 group compared to the E2 group, which further points to the higher achievements of the E1 group students in relation to the students of the E2 group at both tests. The results of this research show that they are in line with the constructivist point of view, which emphasizes the independent construction of knowledge through personal experience as the key for successful learning. Indirect hands-on instruction to a somewhat greater extent contributes to the development of more quality and more lasting knowledge about the content of motion and properties of materials of third-grade students compared to direct hands-on instruction. Although the previous research claimed that retaining answers and involving students in practical work at the same time could make learning more difficult, the results of this research show the opposite. It is these elements that make up the basic features of indirect hands-on instruction that encourage student activity, interest, clear awareness, and contribute to the development of more quality and more lasting knowledge about the motion and properties of materials in relation to the approach based on providing answers and demonstrating pre-prepared actions (i.e. direct hands-on instruction). From this research, recommendations for further research work on this topic arise. It would be desirable to determine the contribution of the same approaches to other contents of integrated natural sciences. In addition to the above, it is recommended to examine the same issues in a larger population. Also, it is recommended to determine the contribution of the application of these instructive hands-on approaches in relation to other innovative approaches in the teaching of integrated natural sciences.

Keywords: direct and indirect hands-on instruction, integrated natural sciences, student achievement, first cycle of primary education

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