063
Attractiveness of Learning Physics by Means of Video Analysis and Modeling Tools

P. Hockicko
University teacher
Department of Physics, Faculty of Electrical Engineering, University of Žilina
Žilina, Slovakia
hockicko@fyzika.uniza.sk

Conference Topic: Physics and Engineering Education
Keywords: Video analysis, key competencies, engineering education

Exploring the laws of nature by means of video analysis can be amazing for the students because this method of learning is illustrative, interactive, inspires them to think creatively, improves their performance and it can help in studying physics. Video analysis using program Tracker (Open Source Physics) or Coach in the educational process introduces a new creative method of teaching physics, makes natural sciences more interesting for the students. With the help of a high-speed camera and video analysis and modeling tools the students can study certain motion in detail. The video analysis gives the future engineers simple and easy way to understand the process of movement. The computer modeling enables the students to relate the results of measurements to theory showing relations between graphs obtained using a model and a measurement. Through direct visual comparison of the video images and model overlays the students can explore different model parameters and equations in real-work context, find differences and similarities between an idealized object and the reality.

A comparison of the traditional teaching methods with the method of the video analysis using integrated ICT (information and communication technology) tools has revealed that the latter method is easier for the students, they have fun when recording and analyzing their own videos, they can set individual pace for their work. We can confirm that the competencies and knowledge of the students are developed and increased by working with video analysis and modeling tools. These tools help them to understand the natural sciences principles and phenomena more deeply, develop skills of abstraction and projection, awake curiosity towards nature and surrounding world and make physics a lot more fun.

This paper deals with increasing of key competencies in engineering education as a result of using video analysis of real life situations as physical problems and the modeling tool programs Tracker (Open Source of Physics) and Coach. We found that education based on principles of pedagogical construc-

tivism, use of managed discovery methods, and students' application of knowledge through experimentation, proved more effective than the use of the transmission methods (Krupová, 2009).

Standardized questionnaires (Krišťák, 2010) were used to determine the degree of knowledge of the students at the beginning (pretest) and at the end (post-test) of the semester. Our hypothesis was that the students who are taught using video analysis learn more actively and effectively than the students who are taught traditionally. We tested the hypothesis H0: The mean of the successfulness of the experimental and the control group is the same: H0: $\mu 1 = \mu 2$ (versus H1: $\mu 1 \neq \mu 2$). The assumption on the differences of the degree of knowledge were applied with the probability 95% ($\alpha = 5\%$). Kolmogorov-Smirnov test (one-sample test) of normality at the level $\alpha = 5\%$ was used for comparison of normal (Gaussian) distribution of generated histograms. First of all, we used an F-test for the null hypothesis that two normal populations (experimental and control groups) have the same variance (H0: $\sigma 12 = \sigma 22$ versus H1: $\sigma 12 \neq \sigma 22$). After this hypothesis had been confirmed we used independent two-sample Student's t-test for unequal sample sizes and equal variances. The statistical testing using the t-test confirmed the significance of the differences in the knowledge of the experimental and control groups, which were caused by using the video analysis.

We confirmed that the competencies of the students were developed and their knowledge was increased by working with Tracker and Coach compared to the group that was taught by using traditional teaching methods. We saw that the video analysis helps the students to understand the natural sciences principles more deeply and develops skills of abstraction and projection. ■

ACKNOWLEDGMENTS

This work was supported by the Slovak Grant Agency KEGA through the projects No. 002KU-4/2011 and 035ŽU-4/2012.

REFERENCES

[1] Hockicko, Peter (2010), Nontraditional Approach to Studying Science and Technology. *Communications*, Vol. 12, No. 3, pp. 66 – 71. ISSN 1335-4205.

[2] Heck, André, Uylings, Peter (2010). In a Hurry to Work with High-Speed Video at School. *The Physics Teacher* Vol. 48, No. 3, pp. 176 – 181. ISSN 0031-921X.

[3] Krišťák, Ľuboš & Němec, Miroslav (2010). Innovation of Physical Education at Technical University in Zvolen, *Journal of Technology and Information Education*, Vol. 2, No. 2, pp. 40 – 45, ISSN 1803-537X.

[4] Stebila, Ján (2011). Research and Prediction of the Application of Multimedia Teaching Aid in Teaching Technical Education on the 2nd Level of Primary Schools. *Informatics in Education*, Vol. 10, No. 1, 105 – 122. ISSN 1648-5831.

[5] Krupová, Ivana (2009). The Development of Natural Science Literacy in Pupils in the First Stage of Basic School Using the Method of Managed Discovery. *Pedagogika*, Vol. LIX – 2009, No. 3, 259 – 268. ISSN 0031-3815.

[6] Hockicko, Peter (2011). Forming of Physical Knowledge in Engineering Education with the Aim to Make Physics More Attractive. *Proccedings of International Conference* Physics Teaching in Engineering Education PTEE 2011, Mannheim, Germany, 2011, ISBN 978-3-931569-18-1.