The digital repository for physics and science teaching

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Abstract. The digital repository of 96 experiments for physics and science teaching was created with the intention of organizing e-content realized at the Faculty of Physics (University of Rijeka, Republic of Croatia) during the pandemic period as part of two courses for primary education and physics teacher studies. The content enables the application of innovative teaching methods in a virtual environment (e.g. the station rotation model - the inclusion of all students in the rotation of online and classroom activities and the flipped classroom model). The repository is aimed at pupils, students and physics teachers in primary, secondary and higher education.

Introduction

The digital repository of 96 experiments for physics and science teaching ([1], in further text Repository) was created with the intention of organising e-content conducted at the Faculty of Physics, University of Rijeka, Croatia, during the pandemic period as part of two courses: Extracurricular Science and Mathematics Activities (in further text IPMA) within the Integrated undergraduate and graduate study of Primary School Education at the Faculty of Teacher Education, University of Rijeka, and the Demonstration Experiments for Physics Teachers Training (in further text MPF) within the (educational) Graduate Study Programme Physics and Mathematics at the Faculty of Physics, University of Rijeka. The repository was created as part of the educational research and development project UNIRI CLASS - programme line A2: Digital citizenship - Innovations in Learning and Teaching. The project included the conversion of two existing face-to-face courses (f2f) into hybrid courses. The hybrid courses were developed by applying innovative teaching methods in a virtual environment. The aim of the Repository is to: a) encourage future primary school teachers to develop scientific and mathematical competences of pupils through the use of active forms of learning and teaching; b) develop future physics teachers' awareness of the importance of using experiments, as well as train them to be able to methodically and didactically prepare and demonstrate them.

Methods and findings

In creating the Repository, practicum exercises/experiments were recorded by students enrolled at two courses during two academic years 2020/2021 and 2021/22 and then reviewed and edited by physicists from the academic community. The recordings were structured in a prepared website [1], and methodological - didactic texts with a description of the practical exercises/experiments based on [2-5] were created. In the winter semester of the academic years 2022/2023 and 2023/2024, IPMA and MPF courses were held with new elements of hybrid teaching. The aim of this presentation is to present the newly created Repository, although a detailed analysis of the effectiveness of the teaching methods used has not yet been carried out. Only a student satisfaction survey (N = 26) was conducted, which included two questions about their experience with the Repository: 1) impression of the recordings (technical and “artistic": direction, scenography, narration, dynamics of the videos), comparison of the results with their previous expectations, and 2) encouragement to use active learning and teaching (using Repository or not) in their future

teaching. Approximately 88% of students had a good overall impression of the recordings (interesting, high quality, clear, concise, well designed and presented); 23% wrote that the results were better than expected, 31% of students indicated some possible future improvements (e.g. better sound, better focus on details, more dynamic videos), and all indicated that this content would encourage them to use active forms of teaching and learning in their future teaching.

Conclusion

In view of the findings, we believe that the goals of the Repository stated in the introduction have been achieved. The sustainability of the Repository is reflected in the possibility of its multiple use long-term application in: a) teaching in two courses (IPMA, MPF); b) teaching physics in primary and secondary schools; c) teaching physics in other physics study programs in the Republic of Croatia; d) primary school education as complementary content in science. The potential of the Repository lies also in the professional development of primary and secondary school physics teachers. The training of primary school teachers in the field of science and/or physics is very important because, according to Figure 4 in [7], they are the most common group of non-professional substitutes teaching physics in elementary schools in the Republic of Croatia. Also, considering the fact that teachers express their dissatisfaction with the unsecured financial resources for professional development and the quality of in-service training programs [8], professional development becomes more accessible through the completely free Repository. The main challenge solved by using the Repository, due to the transfer of some of the demonstration experiments to the e-environment, is solving the problem of lack of equipment to conduct the experiments in schools (see Table 1 in [8]). Conducting experiments is one of the basic teaching methods in physics and science education [2,6] and increases an interest in STEM.

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