Teacher Professional Development for Integrating Robotics Activities into Science Education Using the Task-Centered Instructional Strategy (Poster)

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Abstract

One of the possible innovations in the Professional Development (PD) of science teachers is the development of their competencies to use robotics as an educational tool (Anisimova et al., 2020). Science teachers should find innovative ways to integrate scientific practices, crosscutting concepts, and core ideas in their classrooms to achieve the Next Generation Science Standards (NGSS) dimensions (Ziaeefard et al., 2017). These practices, for example, using models that serve as a basis for discussions and integrating engineering design, can be developed using robotics (Bybee, 2014). Robotics in STEM education contributes to developing engineering and computational thinking and 21st-century skills (Ziaeefard et al., 2017), and helps learners understand abstract content tangibly (Chen et al., 2017).

This study followed up on the PD program for sixteen teachers from the Israeli Arab Sector. Eleven teachers did not have previous experience in using or teaching robotics and coding before the PD program. We explored the use of the Task-Centered Instructional Strategy (Merrill, 2007) for integrating robotics activities in middle-school science classes. The strategy combines the progression of real-world tasks that serves as the backbone of instruction with explicit instruction. The program was centered on enhancing teachers' competencies to develop lesson plans by utilizing robot kits for science curricula. Three tasks in the program integrated learning of robotics, pedagogy, and science knowledge (Mishra &

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Koehler, 2006; You et al., 2021), with an increasing level of complexity and decreasing level of support.

The first task included laboratory sessions in which teachers, through physical experimentation, built and programmed robotics models suitable for scientific education (e.g., testing the kinematics of the robot's straight-line motion and accelerated motion). The second task included the development of science lessons with robotics activities. Teachers prepared lesson plans that included developing building instructions and programming the robotics models suitable for scientific education for students. The third task included the implementation of robotics activities in the science classroom, evaluation of the results, and presentation of them to peers in the program. Thus, teachers were also exposed to a collection of science lessons in robotics environments presented by their peers.

Overall, our preliminary research findings indicate a positive effect of the Task Centered Instructional Strategy for training science teachers to operate with hardware and software and integrate robotics-based hands-on activities in their teaching practices. The study demonstrates how this strategy can be used for the development of coding and robotics competencies in science teachers with no programming background.

Keywords: Educational Robotics, Professional Development, Science Teachers, Task-Centered Instructional Strategy.

מילות מפתח: רובוטיקה חינוכית, פיתוח מקצועי, מורים למדעים, אסטרטגיית הוראה מכוונת משימות.

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