ISSUES ON IMPLEMENTING ROBOTICS COURSE IN UKRAINE

Yehor PYROZHKOV, Ph.D. student
T.H. Shevchenko National University "Chernihiv Colehium"
Chernihiv, Ukraine
https://orcid.org/0000-0003-2022-9606
pirozhkov_ep@ukr.net

CZU: 37.02:007.52(477)=111

DOI: 10.46727/c.15-11-2024.p84-89

Abstract: Robotics has reliably taken its rightful place in all areas of human activity. Without it, it is now difficult to imagine the development of industry, astronautics, medicine, etc. In this regard, much attention is paid to it in education. Not being a separate subject, but an interdisciplinary course, it is taught in schools and extracurricular educational institutions of Ukraine. The author poses problems and suggests ways to solve them based on his own experience of conducting robotics classes in one of the city's clubs. Even during a short period of work, he saw those features of conducting classes that need to be taken into account at all levels of the functioning of the education system. This includes material support, training of teaching staff, and organizational forms of educational activities. It is interesting that he managed to pay attention to the age and psychological characteristics of students who expressed interest in studying robotics.

Keywords: robotics, learning, learning problems, results.

Theoretical framework

Robotics in Ukraine is an interdisciplinary integrated course that combines the technological educational field and the information technology field. It must also meet the requirements of the Concept for the Development of Science and Mathematics Education (STEM Education) [2] and the Concept for the Development of Digital Competencies [3].

Model programs have already been developed for teaching this course, which are focused on engaging students in programming, prototyping, using artificial intelligence, mastering new technologies for future professional activities, etc. This course should

help realize the goal of the natural sciences, computer science, mathematics, and technology fields, strengthen their practical orientation, and increase students' motivation to learn.

Existing model programs [4, 5] are focused on the formation of competencies relevant to the labor market, cognitive skills, data analysis and information evaluation skills, prototyping, the use of artificial intelligence, the development of new technologies for future professional activities, research skills, algorithmic thinking skills, etc.

The implementation of the programs envisages the formation of students' persistent interest in natural and mathematical subjects and technical creativity, in the integration of knowledge in natural science, mathematics, informatics and technologies. The expected learning outcomes are also familiarization with the capabilities and use of microelectronics, sensors created on its basis, smart devices, etc.

Additional programs and organizational forms of classes in after-school educational institutions and private clubs have also become widely popular among students and their parents. These programs sometimes have a somewhat narrower focus. In such groups, students immediately start designing various technical devices for performances at certain competitions.

It is worth noting that if students are introduced to the basics of robotics in state extracurricular educational institutions, they have programs approved, at least by local education authorities. If the group operates outside of educational institutions, its activities are subordinated to the goal of making a profit. The students' parents pay for their education. In a significant number of cases, such circles have a goal: to occupy students' free time with an interesting type of activity for them.

In the classes of the clubs, regardless of their affiliation, various LEGO constructors are used. Work with the constructors is supported by resources that contain appropriate instructions [6].

Research questions and objectives

When delving into the content of any activity, we involuntarily pose some questions to ourselves. In this case, they concern education.

I have already written above about the purpose of the interdisciplinary course

"Robotics". It, indeed, as noted in the model educational programs, must meet educational goals. And first of all, - the learning and development of students.

But is this really so? Will it not turn out that this course is one that works on its own? Does its implementation solve serious problems that arise during the implementation of the educational process in physics, technology (including computer science), mathematics, biology, chemistry? Does it contribute to the motivation of students to learn? Does it develop the creative abilities of students?

If all this can only be answered with the word "no", then what is its real role? To continue the students' childhood, that is, to give them the opportunity to return to assembling toys from new parts?

At least some of the questions posed were the ones I intended to find answers to during the research.

Research methodology

The basis for my research was the robotics group of one of the private institutions, the charter of which provides for the provision of educational services to the children of Chernigov (Ukraine). The head of this enterprise is a recent graduate of the Faculty of Radiophysics, Electronics and Computer Systems of Taras Shevchenko National University of Kyiv, so he is well versed in technology and programming, which prompted him to start a robotics club.

After purchasing several suitable LEGO sets and laptops, a recruitment of students for robotics classes was announced.

Training was carried out according to the program, which consisted of ready-made modules of the Instructions for assembling models [5]. In fact, it was a sequence of laboratory works, the complexity of which increased over time.

It is worth noting that the group recruited students of different ages. This, of course, created significant difficulties in organizing the work of the group. The difference in age and knowledge did not allow organizing work in stable groups, and I, as a teacher, later had to switch to individual teaching.

The data on the basis of which it was possible to draw certain conclusions about the effectiveness of training were obtained during the classes. Photos and videos taken

during the training made it possible to return to those moments of work with students that should have been taken into account in organizing further work.

At the same time, I studied the progress of robotics implementation in general and specialized schools. To obtain objective data, a survey of science and technology teachers was conducted.

Research results

Robotics has become the technical field that has brought real positive changes to almost all areas of production, medicine, transport, agriculture, etc. We see how the assembly lines of automobile factories work, how robots work in many technical devices, in particular in aviation and astronautics. Therefore, the interest in robotics is justified and students are motivated to study it. We are witnessing how robotics is integrated into school education. This became even more noticeable when STEM approaches began to be introduced into the educational process. For the educational process, for example, in physics, the engineering component of STEM is important, as noted by the well-known specialist in physics didactics and STEM approaches in education, Professor Andrey Davidenko [1]. And robotics is suitable for the implementation of this component. Therefore, its use in the educational process in physics is appropriate.

The same can be said about the technological educational field. It is expected that the design and creation of technical devices, together with programming, will give us the result that is foreseen by the implementation of the Concept of the development of digital competences [3]. However, real life shows us specific obstacles that hinder the introduction of robotics into the educational process in science subjects, in particular physics. And this is confirmed by our research.

One of the main problems, in my opinion, is the limited resources. Most of the equipment, including computers with the appropriate software, as well as designers and sensors, is quite expensive.

Another problem, which at first glance does not require material costs, can be called insufficient training of teachers. They must have not only the appropriate knowledge of technology, but also the basics of programming. A situation has arisen

when the level of development of technology and technology is significantly ahead of the level of training of teachers. Although this should be taken for granted, because a similar situation was observed when electronic tubes were replaced by semiconductor devices (diodes, transistors, thyristors, etc.).

The way out of the current situation, in my opinion, can be as follows. Pedagogical universities will be training specialists capable of teaching robotics for a long time, so the system of postgraduate pedagogical education should organize advanced training courses in this area for already working teachers. To conduct such ourses, specialists with relevant knowledge and experience in teaching robotics should be involved. It is also necessary to ensure the publication of appropriate methodical literature, the creation of educational films, etc.

Conclusions

Robotics has taken its rightful place in education. However, its introduction often has elements of spontaneity, which, in my opinion, is the result of an insufficient level of forecasting the development of education.

The lack of adequate funding and trained personnel significantly affects the teaching of robotics in schools and extracurricular educational institutions.

To solve this problem, it is necessary to organize advanced training for teachers in the system of postgraduate pedagogical education.

It is necessary to pay attention to robotics classes in private clubs. The charter of a private institution, according to which it carries out educational activities, must comply with state requirements for education.

Learning about robotics or simply using it requires deep concentration, analytical thinking, and patience from both the child and the teacher. Creating a robot or programming it involves a significant number of sequential steps, often requiring correction of errors during programming. This can be frustrating and negatively affect student motivation.

In addition, some students may have problems with coordination of movements when working with small parts, in particular, when assembling mechanisms from them.

Difficulties are quite common when working in a team. Joint assembly of devices

or programming can lead to conflicts due to the division of responsibilities, different attitudes towards the work being performed, etc. This can become a source of stress and even a factor in reducing interest in robotics in general.

At the same time, children may feel pressure from parents or teachers, especially in cases where they are expected to make rapid progress, which will cause additional anxiety and fear of anticipated failure.

All of these factors highlight the importance of a supportive and gradual approach to learning to help children and teachers adapt to new demands and develop an interest in robotics.

References

1. ДАВИДЕНКО А. А.__Інженерний складник STEM. Нові технології навчання: збірник наукових праць. ДНУ «Інститут модернізації змісту освіти». Київ, 2024. Вип. 98. С.50-57. https://doi.org/10.52256/2710-3560.98.2024.98.06 [In Ukrainian].
2. Концепція розвитку Концепція розвитку природничо-математичної освіти (STEM-освіти) [Електронний ресурс]. - URL:
3. https://zakon.rada.gov.ua/laws/show/960-2020-%D1%80#Tex [In Ukrainian]. Цифровие компетентности. Схвалено розпорядженням Кабінету Міністрів України від 3 березня 2021 р. № 167-р https://zakon.rada.gov.ua/laws/show/167-2021-%D1%80#Text
4. Модельна навчальна програма «Робототехніка. 5–6 класи» для закладів загальної середньої освіти (авт. Сокол І. М., Ченцов О. М.) URL: https://drive.google.com/file/d/1bJkI1tn8Z5VHIQDi758Bazyg6HLVS8g_/view [In Ukrainian].
5. Модельна навчальна програма «Робототехніка. 7-9 класи (міжгалузевий інтегрований курс» для закладів загальної середньої освіти (автори Сокол І. М., Ченцов О. М.). URL: https://drive.google.com/file/d/1F-EzHLhQ3uol0IaJEjhPFbCseKiOK9cH/view [In Ukrainian].
6. Ресурсы и поддержка по продуктам LEGO® MINDSTORMS® Образование EV3. Инструкции по сборке моделей из базового выпуска. URL: https://education.lego.com/en-us/product-resources/mindstorms-ev3/downloads/building-instructions/.