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Pupils Design Competence Formation Using Lego Technology [Anna I. Traktirnikova]

Key words: *the structure of learning activities, design competence, lego technology*

Annotation: *Engineering and design competence of students is one of the most important components in the structure of learning activities, which laid the ability for professional work, aimed at establishing a design thinking.*

*«Истинная цель просвещения не в том,
чтобы сообщить людям определенную сумму
сведений по различным наукам,
а в том, чтобы пробудить в каждом человеке творца,
духовно активную личность, - и в этом счастье»
М.В.Ломоносов*

There are rapid changes in the whole society today, which require new human qualities. First of all, it means the ability to think creatively, autonomy in decision-making, initiative. Tasks in the formation of these qualities are put on the teaches, including assigned to education. The teacher should now be a technologist in the educational process, which guides the process of obtaining knowledge, he is at the same time researcher, educator and consultant for students. Innovative development of the country requires that all curricula and teaching methods have been updated with the competency approach to education. That is the focus is the implementation of research and design methods, involving students in practical and scientific - research activities.

Competence-based approach in education and objectively meet the requirements of social expectations in education, and the interests of participants in the educational process. Competence approach is an approach that focuses on educational outcomes and the result of education is considered not assimilated amount of information, but the ability to operate in a variety of problem situations.

LEGO-use technologies in the educational process allows one to organize the creative, design and research work of students, creates the conditions for the application of knowledge, skills in solving various problems in the real world, thereby creating the preconditions for the formation of design competence, that is preparedness effectively in various situations in the future.

LEGO Mindstorms allow designers to organize training activities on various subjects and carry out integrated studies. It can be highly motivated organization training activities on spatial design, modeling and automatic control using these sets.

Lego construction is fastly becoming an integral part of the learning process, because it fits easily into the school curriculum in technical subjects. Key experiments in physics and mathematics can be demonstrated using the Lego robots.

Robotics encourages children to think creatively, to analyze the situation and apply critical thinking to solve real problems. Teamwork and cooperation strengthens the community, and rivalry in the competition provides an incentive to learn. Ability to make and correct errors in their own work forces students to find solutions without losing the respect of their peers. The robot does not make estimates and does not give homework, but mentally and makes us work constantly.

Design and engineering competence in education is associated with student-centered and current approaches to education as it relates to the individual student and can be implemented and tested only during the execution of a set of specific actions discipline.

Students' design and engineering competence is one of the most important components in the structure of learning activities, which laid the ability for professional work, aimed at establishing design thinking. A prerequisite for the success of design competence in innovation is to hold specialist modern design techniques of competitive products, which include the development of alternatives, analysis and synthesis, forecasting the dynamics and trends of the object, the ability to use formalized models, etc.

Effectiveness of learning the basics of Lego robotics depends on the organization of classes conducted using the following methods:

- explanatory - exemplary is the presentation of information in different ways (for an explanation, story, conversation, coaching, demonstration work, including maps, etc.);
- Heuristic is a method of creative activity (creation creative models, etc.);
- Problematic is statement of the problem and its solutions, help with independent learning;
- Programming is a set of operations that must be performed in the course of practical work (forms: computer workshop, the project activity);
- Reproductive is reproduction of knowledge and ways of life (forms: picking patterns and designs on the model, conversation, exercise by analogy);
- Partially - search is solving problem tasks using the teacher's help;
- Searching is independent problem solving;
- The method of problem presentation is posing problems for teachers, the decision by her teacher, participation of students in the solution.

The main thing in the formation of design competence is ability to help students to master the methods of information collection and storage, as well as technology understanding, processing and practical application. Most often, Lego design is inused project-oriented learning. For efficient generation of design competence in the classroom for Lego robotics system developed educational problems (Table 1).

Table 1 The system of educational problems on the formation of design competence

The structural unit of design competence	Developed tasks in the formation of structural units
Formation processes of information processing	To develop students' ability to analyze incoming information. Teach students to formalize compared, collation, synthesis of the information received with the available knowledge bases. Form a sequence of actions to develop options to use information and forecasting implications of the solutions of the problem situation. Develop students' ability to generate and predict the use of new information and its interaction with existing knowledge bases. Understanding the need to lay the most rational organization of storage and retrieval of information in long-term memory.
Formation of students' motives and values	To create conditions that favor students' entry into the world of values, assisting in selecting important value orientations.
Students' understanding the principles of operation, capabilities and limitations of technical devices for automation and mechanization of human activities in various sectors	To form students' ability to classify the types of tasks for subsequent decision and choice of certain technical means, depending on its key feature. An understanding of the essence of the technological approach to the implementation of activities. To familiarize students with the features of information technology tools to search, processing and storage of information, as well as the identification, creation and forecasting of possible process steps for processing information flows. To form students technological skills of information flows (in particular, by means of information technology).
Communication skills, ability to communicate	To form students knowledge, understanding , developed skills in the use of languages (natural and forma) and other types of sign systems, technical means of communication in the process of transmitting information from one person to another through a variety of forms and methods of communication (verbal, nonverbal).
The ability to self-analyze activities	To form students' ability to implement reflection, evaluation, and analysis of their design activity and its results. Reflection design activity requires the ability to analyze different types of tasks. Only in this case we can speak about understanding the design activity, the possibility of human use of its content in different situations and dialogue.

Project-oriented learning is a systematic training method, involving students in the process of acquiring knowledge and skills with the help of wide research activities based on complex, real-world issues and address detailed tasks.

Main stages of development Lego project are:

1. Designation of the project themes.
2. The purpose and objectives of the presented project.
3. To develop a mechanism based on the Lego model NXT (RCX).
4. Establishment of the program to work in an environment mechanism

Lego Mindstorms or RoboLab.

5. Testing the model, the elimination of defects and malfunctions.

In developing and debugging projects students share their experiences with each other that very effectively affect cognitive development, creative skills, and independence of pupils. Thus, we can see that Lego, as an additional tool in the study of science and technology courses, allows students to decide on their own, apply to this case, given the surrounding features and the presence of auxiliary materials. And that is important - the ability to coordinate their actions with others, i.e. work in team.

Formation of design competence of pupils by means Lego design is based on the basic core competencies:

- Information Competence is willingness to work with the information. Formed ability is to independently produce, organize, critically evaluate and analyze the information received from the position of the problem, make reasoned conclusions, use the information in the planning and implementation of its activities, to represent it.

- Communicative competence is willingness to communicate with others, i.e. some system requirements for the person associated with the process of communication: literate speech, knowledge of public speaking techniques, the ability to show an individual approach to the interlocutor, etc. Communication skills are the skills of verbal communication, taking into account the person with whom we are talking, where we speak and, finally, for what purpose. Expressed in their own abilities to make contact with the person of any type (by age, status, degree of proximity and familiarity , etc.), considering its features to keep in touch in communication, respecting the norms and rules of communication , listen to the interlocutor, showing respect and tolerance the opinions of others, to express, to argue and defend their own opinions, to encourage the continuation of dialogue.

- Cooperative competence is a willingness to cooperate with other people. Determined to carry out a collective goal-setting skills, allocate tasks and roles of the members of the group; act as leaders or executor, and coordinate actions and to exercise collective debriefing, including self-evaluation and presentation of the product of the group.

- Problem competence is a willingness to solve problems, expressed in the ability to independently identify problem situations redundant information; formulate objective; find alternative ways and means of solving problems, implement the chosen path, to bring the problem to the end, to publicly report the results.

Significant role in the formation of pupils' design competence is played by projects and mini-projects of various orientations. Consider the example of one of the training projects aimed at establishing the competence of design students through core competencies.

Example training project:

Project title is "Sumo"

Project objective is to create a model of the robot, simulating the basic techniques of sumo wrestling.

Project purpose is the formation of pupils' design competence through skills of key competencies (Table 2).

Table 2. Example training project "Sumo"

Key competence	Key competence forming method	The example of competence forming method
Informat ive	Searching and collecting the information, information processing	Transmission of information. Finding information on the robot "sumo" in the Internet. Finding samples of models and analysis of their structures. Preparation on the topic found realizable designs, introducing new elements.
Commu nicative	Methods focused on verbal communication	Preparing messages of individual students or groups of students (see above); brainstorm general comment of the project implementation.
Coopera ting	Methods in the context of group work	Group project work , including roles / areas of responsibility of each group member
Problem atic	Project activities of researching character	Creating a model for the conditions: designing and programming an autonomous robot that can most effectively push the robot enemy beyond the black line of the ring. Demonstration of finished models, conducting a contest between robots and determination of winners and to identify good solutions and design flaws.

Unique projects based on Lego construction are the models construction of the devices allows the student to comprehend the relationship between the different areas of knowledge that contributes to the integration of teaching computer science, mathematics, physics, drawing, science, the development of engineering thinking through technical creativity.

Thus, Robotics, which is one of the most innovative areas in the field of children's technical creativity, combines classical approaches to the study of the foundations of modern art and directions: information modeling, programming, information and communication technologies. Incorporation of elements into the educational environment makes learning effective and productive for all participants, and a modern school competitive.

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