

## **Stem Education Determines Interdisciplinary Integration**

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**Abstract:** The abbreviation "STEM" (S – science, T – technology, E – engineering, M – mathematics) for the first time offered American bacteriologist R. Colwell. But STEM began to be actively used in 2011 by initiative biologist Judith Ramali. It is known what at first used abbreviation SMET, and then came STEM. Judith A. Ramali notes that “STEM education is teaching and learning in science, technology, engineering and mathematics.” Germany, as the country that first announced the era of the fourth industrial revolution to the world, is doing a lot to implement STEM technologies in educational institutions. Germany has chosen its own acronym for STEM: MINT. Translated, it means “mathematics, computer science, natural sciences and technology.” The national German MINT portal presents strategic development vectors: digital transformation of schools, digital competences of youth, MINT for girls, MINT technology. Germany ranks one of the first places in preparing STEM graduates. The country is implementing the initiative "MINT Zukunft schaffen" ("creating the MINT future"), within the framework of which all indicators related to the implementation of MINT are measured: competencies, the number of graduates in this area, the percentage of women participants in this sphere and that similar. Interesting experience implementation technologies STEM through the active method of constructing technical toys, which is introduced in Vietnamese schools. The main focus of STEM implementation in Vietnam is the idea of developing active cross-curricular learning through the development of technical toys.

**Keywords:** STEM education, practice, the science, study, strategy, vector development.

### **Introduction**

Compliance with the requirements of new times presupposes a person's ability to be competitive not only along with others experienced specialists but and with artificial intelligence. This requires a creative workforce, namely those who will be prepared to innovatively solve real-world problems, develop their own abilities throughout life, those who are able to quickly and flexibly adapt to new requirements, criteria, assessments, values of society and, if necessary, will be able to radically change the scope of professional activity, since the speed of change in industries, in the context of the rapid development of science and technology significant (Konyushenko, 2019).

Among most promising modern approaches preparation specialists a new generation focused on innovative activities in modern conditions of social mobility, worldwide globalization, economic, political and cultural integration in most developed countries of the world, the concepts of STEM - and STEAM - education are recognized, which are recognized as pedagogical innovations of the 21st century.

The concept of “teaching technology” is defined as a set of methods and means for implementing certain learning content within one subject or certain types of educational activities (Shalashova, 2017). Taking into account the above, “innovative teaching technologies” will be understood as the targeted, systematic and consistent introduction into the practice of pedagogical activities of original, innovative methods and techniques of pedagogical actions and means that cover the

holistic educational process from the definition of its goal to the expected results. To implement innovations in the educational process, pedagogical innovation provides for the integration and implementation of a variety of original approaches based on philosophical, psychological, pedagogical research, new achievements IT - technologies, defining strategy training And are being implemented V system scientifically - methodological activities.

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### **Materials and methods research**

Despite on That, What relevance STEM - education already proven problem Providing a future labor market and innovative industries with a workforce still remains unresolved (Xu, 2020). According to many experts and employers, the STEM approach cannot produce fully successful results because it lacks some key components that are critical to the development of an innovative economy in the post-industrial era:

- along with With quality, efficiency And manufacturability on front plan such important aspects as the human need for convenience and pleasure from using a certain product/products;
- creative industries (show projects, art practices, happenings, performance, computer technologies, music, fashion, architecture, gallery business, etc.), the basis of which is creativity and intellectual capital, are becoming important areas of the innovative economy;
- Considerable attention is paid to the implementation of the intellectual part of various projects - at the level of ideas, inventions, patents, since this turns out to be many times more profitable in comparison with the manufacture of the final product.

So, the trend of the creative direction of development of the innovative economy becomes obvious , and therefore, there is no doubt about the need to introduce creative and humanitarian disciplines into the STEM system in order to develop the artistic, creative and leadership qualities of future specialists in all industries who are capable (except for solving purely technological issues) participation V various team events, manifest initiative, creative solve current ones Problems, With taking into account changes circumstances, generate And implement new ideas, perceive And use constructive criticism, commit good deep presentations (Sad, 2019).

### **Results and discussion**

IN Russia implementation STEM education, according to mentioned Concepts, carried out taking into account the following principles: personal approach, constant updating of content, continuity, patriotism and social orientation, productive motivation, integration, development And problematic education (Anisimova, 2018).

It (STEM education) being implemented through All kinds education, A exactly: formal, informal, informal (on online platforms, in STEM laboratories), through excursions, competitions, olympiads, festivals. In addition, it is mandatory to attract specialists to develop software and computer programs for each STEM subject.

Together with the concept of STEM education, the concepts of STEM specialties, STEM equipment and STEM toys are often used. According to research from Changethe Equation, United Apparel has an average of 1.7 open jobs in STEM fields per potential employee. At the same time, competition in other industries is about 4.1 candidates per position (Musina, 2020).

Such trends are also observed in other developed countries, in particular the UK and Germany, where there is also a noticeable shortage of specialists in areas such as mathematics, natural sciences, computer science and technology.

According to the results of analytical studies, out of 10 specialties that have a high level relevance, 9 require exactly STEM knowledge.

In particular, the demand for such specialties as chemical engineers, software developers, petroleum engineers, computer systems analysts, mechanical engineers, civil engineers, roboticists, nuclear medicine engineers, underwater architects, aerospace engineers and the like is expected to increase.

Among the 5 STEM specialties in the USA are the following: software developer (Software Developer), statistician (Statistician), insurance analyst (Actuary), mechanical engineer (Mechanical Engineer) And IT manager (IT manager) (Nguyen, 2020).

In Russia, the project “STEM: professions of the future” has been implemented for students of general education institutions.

The goal of the project is to familiarize students with STEM professions, namely to introduce them to the world of new concepts, in particular such as innovation, engineering, reengineering, creative industry, mechatronics, nanotechnology, fundraising, scientific literacy, educational robotics (ORT), project activities, facilitation, etc. (Chervonny, 2017).

To form and develop STEM skills from early childhood, STEM toys are used to develop which directed whole industry.

These are robot toys, lotto, dominoes, puzzles, jigsaw puzzles, moving cars and the like. For example, a high-tech robotic ball (Sphero Mini), which can be controlled using a smartphone or tablet via a mobile application. The toy has a built-in gyroscope and accelerometer. This toy develops the child’s motor skills and logical thinking (Obukhov, 2020).

For each educational industry developed certain STEM equipment. For the mathematical education industry, using LEGO constructors, you can create an exciting, practice-oriented educational process aimed at developing students' STEM competencies.

LEGO bricks and robotic platforms help tap into children's natural curiosity and develop critical communication, creative thinking, collaboration and critical thinking skills in math lessons. You can use LEGO to explore parts and fractions, arithmetic laws of addition and multiplication and the like (Havenson, 2020).

Geometric material is used in kits for modeling 2D and 3D objects, 3D printers, 3D glasses, mobile applications For studying spatial figures, cards with augmented reality and the like. For example, Google is used to study three-dimensional figures VR services.

Based on the Cardboard application, you can create and customize your own 3D glasses, with which you can watch videos with augmented reality elements.

For studying units measurements use models mechanical hours, stopwatch, various scales, tools for measuring length, width (ruler, caliper, tape measure, compass, protractor).

For natural educational region Also offered big kit STEM equipment: sets dummies fruits, vegetables, vegetables root vegetables, mushrooms, animals, kits tables “structure of the human body”, human skeleton, anatomy cards with augmented reality, globe, maps, microscope, digital microscope, tellurium, nature calendar, world maps (political, physical).

In particular, this is the “Anatomy” encyclopedia in augmented reality, with the help of which the study of the human body becomes visual and understandable. The student points his phone or tablet at pages books And sees How she comes to life.

He Maybe consider Images with everyone sides, study And remember basic terms. Coloring books from QuiverVision help you study science and mathematics subjects with interest. First, students color the coloring book.

It promotes fine motor skills, reduces stress and allows for creative expression. Students then bring the coloring pages to life in animated 3D and explore the items or objects. For example, in the picture on the right is the coloring of an animal cell.

After coloring, it is “brought to life” using the Quiver mobile app and examined from different angles. At the end, you can take an online test to test your knowledge (Nguyen, 2020).

Consequently, there is a sufficient number of scientific developments, special digital resources, methodological recommendations and appropriate equipment for the successful implementation of STEM in the educational process.

One from strategic tasks project "Intelligence RF" is implementation STEM education starting With primary schools, V in particular:

- in mathematics lessons: conducting creative lessons (every fifth), where students are offered solutions to problems of increased complexity on the topic studied, which are presented in notebooks under the headings “Page of Champions”, “Steps to Mathematical Olympus”; mathematical games and competitions (fight with the Dragon, lotto, dominoes, travel);
- in the lessons “Man and the World” and “I Explore the World”: conducting research lessons, mini-research, projects; application of a set of research tasks (the “Star Race” section), virtual travel (the “Traveling the World” section), etc.;
- in Eureka lessons: conducting non-traditional lessons in which students solve combinatorial problems, problems on graphs, on the Dirichlet principle, on transfusion and weighing, which V printed notebooks presented rubric "yours discoveries";
- extracurricular activities: participation in mathematical Olympiads, competitions, creation of creative workshops, auctions of creative ideas, exhibitions of student inventions, debates, etc.

The author’s educational subject “Eureka” deserves special attention, consisting of two meaningful lines “I - researcher” and “I am inventor”, the goal of which is to develop students’ research competence in the field of natural sciences, engineering and technology as a unity of conceptual (understanding of natural science and mathematical concepts, operations and relationships), strategic (ability to formulate and solve scientific, technical and technological problems), cognitive (the ability to think logically, explain, argue, A Also ability To reflections), operating room (ability carefully And flexible fulfill operations), axiological (ability consider an object How useful simultaneously with ability to believe V own efficiency) (Echmaeva, 2019).

Development abilities To creativity carried out by use systems open type problems based on the theory of inventive problem solving (TRIZ) by G. Altshuler. Students decide inventive tasks By algorithm: analysis text tasks → identifying contradictions between the actual state of the object and the desired one → formulating the ideal final result → identifying several options for achieving the ideal final result → choosing the best solution.

Let's give samples inventive tasks For students 4 class.

Task 1. To repair the water pipeline, they dug up a road in one place and exposed a pipe through which water flows. To quickly find the place where the water is leaking, you need to know in which direction she flows. How This define?

Problem 2. Railway rails expand when heated, and contract when cooled. This leads to the appearance of dangerous cracks in the rails, which threatens railway accidents. How to reduce heating of rails?

Task 3. It is known that icicles that form on the roof in winter pose a danger to people. Therefore, special workers climb onto the roof and knock off the ice. Such work is dangerous, difficult and also time-consuming. How to get rid of icicles without a threat to health or at all prevent their appearance on roof?

Working above content tasks, aimed on development at students creativity and critical thinking, we took into account the powerful potential of international research tasks TIMSS and PISA,

regional, all-Russian and international mathematics olympiad tasks for primary and basic school students to develop their creative intellectual abilities.

Exactly That's why To content educational subject "Eureka" was included complex tasks of applied orientation and increased complexity, which was developed taking into account general didactic principles, as well as the basic provisions of the theory of the gradual formation of mental actions.

## Conclusion

The future of economic growth largely depends on the availability of qualified STEM specialists, the formation of which should begin at the primary school level, and then in basic and specialized schools through the active introduction of STEM education. Its development must be supported through the development of new academic disciplines, electives And circles, based on active attracting students To "learning through opening".

Promising directions research we see V analysis Internet resources For organizing STEM lessons And preparation methodological recommendations For teachers, students And parents.

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