Formation of Orientation Gifted Students at Enhancing Engineering Thinking

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Annotation

The article deals with the problem of children's gifts, educational opportunities Theory of Inventive Problem Solving (TIPS) in the development of creative activity of students, with a focus on engineering thinking. Currently, for the successful implementation of the goals and objectives of education in higher education is necessary to work on the preparation of technically gifted school students to enroll in the technical departments. Based on our experience in the implementation of such work on the identification and training of gifted students to the educational process in higher education is carried out, in particular, engineering and technology faculty of Kazan (Volga) Federal University of Yelabuga Institute (UOM K (R) FS). Examples of some of the creative tasks on the basis of TIPS for students of different classes offered to students in the framework of the VI Inter-regional competition for “Creative work of students’ technology held since 2009.

Keywords: children's giftedness, creative activity, theory of inventive problem solving contest for technology, educational opportunities, engineering thinking.
**Introduction**

One of the priority directions of the Russian education development in recent years became the development and perfection of conditions for identification and support of talented, exceptional children. In the conditions of innovative economy creation, modernization of the Russian society the system, effective work with exceptional children and youth task becomes especially timely. The problem of children's endowments, development of school students creative thinking is timely for modern school education. Today the requirement of society for education of the creative people having a non-standard look, being able to work with any information streams, to adapt quickly to the changing conditions is designated especially sharply [2, 3].

Relevance of this direction is emphasized in such document of federal level as the Concept of long-term social and economic development of the Russian Federation for the period of 2020 (the order of the Government of the Russian Federation as of 11/17/2008 No. 1662-r).

It is known that social and economic development of any society considerably depends on its creative potential, creative abilities of citizens. Recognizing that the talent is the only reference point for society which does not stand still, assumes consideration of exceptional children issue in Russia as an issue of the country's future [4, 5].

Modern society does not need simply competent, but also creative specialists who will be able to show flexibility of thinking, originality of decisions when performing a task.

In this regard development of school students creative activity needs to pay special attention to engineering thinking development.

**Research objective.** Efficiency of cogitative and especially creative activity of pupils, unfortunately, leaves their creative activity far behind their potential opportunities and not fully answers problems of modern training. Today the formation problem of creatively active personality capable to make choices independently, to put and realize the tasks beyond ordered by standard requirements, to analyze the activity is timely. The creative person is not only ready for continuous changes, but also for acceptance of these changes as possibilities for receiving satisfaction of need for the creative tasks solution [6, 7].

**Research Materials and Methods.** Possibilities of specific methods application for promoting creative thinking in development of pupils creativity were investigated by G. S. Altshuller, V. N. Danchenko, V. Zusman, T. V. Kudryavtsev, A.P.Lyalikov, S.A.Novoselov, V. M. Odrin, V.P. Parkhomenko.

E. N. Yakovleva considered development of creative potential of the school student personality to be the pedagogical opportunities of the theory for solution of inventive tasks in development of pupils creative activity [6].

Originally TIPS was created for the solution of inventive tasks in technical systems. Today this theory is used for the solution of tasks in various areas, for example: business, natural sciences, pedagogics, literature, art.

We will dwell on TIPS pedagogics.

TIPS pedagogics., as the scientific and pedagogical branch, was created in our country in the late eighties. The theory of the inventive tasks solution for domestic (i.e. Russian, and even more precisely Soviet) has been its basis for the school of G.. S. Altshuller [8]. She sets the purpose of forming the engineering thinking and education of the creative person prepared for the solution of complex problems in various spheres of activity. Her difference from the known means of problem training is in use of the international experience which is saved up in the field of creation of the inventive tasks solution methods. Of course, this experience is processed and coordinated with the pedagogics purposes.
Methods of the inventive tasks solution, first of all, are meant as the receptions and algorithms developed within this theory and also such known methods as brainstorming, synectics, morphological analysis, a method of focal objects and their version.

The modern TIPS pedagogics includes the courses devised by age groups, from preschool children to students and adult experts. Features of work with each age group are the choice of inventive activity objects corresponding to the age. Thus, preschool children and younger school students invent toys, riddles, proverbs, outdoor games, etc.

For developing creative skills by teachers the fund of educational inventive and research tasks has experience in such areas: physics, biology, ecology, art, equipment and business.

Algorithmic procedures, techniques are developed for each age group. They allow pupils to invent new things, to self-actualize in creativity. A specific place is held by the course of creative imagination development intended for overcoming of solver stereotypes, development of ability to work with uncommon ideas.

In modern children's psychology and pedagogics experience with children of school age on development of the general endowments is saved up, the main approaches to it are developed [9].

**Research Results and Discussion**

As one of the means to form and develop endowments of school age children in the engineering and technological faculty (ETF) of the Yelabuga Institute of the Kazan (Volga) Federal University the TIPS technology based on situation is chosen: all systems develop under certain laws which can be learned and applied. This technology promotes entering of new ideas into development of contents and methods of the school students endowments development.

Development of endowments is provided due to the use of elements of the offered theory forming the necessary level of intellectual working capacity manifestation and informative activity, as well as engineering thinking orientation enhancement.

On the basis of engineering and technological faculty of EI KFU since 2009 the interregional competition "Constructive Labor of School Students" for pupils of 6-11 classes which includes advance protection of creative projects on technology developed by school students in house conditions and the solution of the creative tasks of school course data technology developed at faculty and offered by pupils (mainly, on processing of materials, electrical equipment) with use of the inventive tasks solution theory elements is regularly held.

Participants of a competition submit the design folder on the project and a finished product.

The following table gives an idea of the Interregional competition in the Constructive Labor of School Students technology for 2009-2015:

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of participants</th>
<th>Number of teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Technical work</td>
<td>Service work</td>
</tr>
<tr>
<td>2009</td>
<td>24</td>
<td>37</td>
</tr>
<tr>
<td>2010</td>
<td>45</td>
<td>85</td>
</tr>
<tr>
<td>2011</td>
<td>56</td>
<td>143</td>
</tr>
<tr>
<td>2012</td>
<td>33</td>
<td>68</td>
</tr>
<tr>
<td>2013</td>
<td>75</td>
<td>99</td>
</tr>
<tr>
<td>2014</td>
<td>62</td>
<td>71</td>
</tr>
<tr>
<td>2015</td>
<td>47</td>
<td>57</td>
</tr>
</tbody>
</table>

Not only representatives of Tatarstan, but school students from other regions of the Volga region – Bashkortostan, Udmurtia, Chuvashia, Mari El participate in the competition. Participation of school students in the listed above actions, formation of orientation to engineering thinking...
significantly affects the number of the entrants arriving on engineering and technological, physical and mathematical institutes.

We will give examples of some creative tasks on the basis of TIPS for pupils of different classes and contents of the tests offered to pupils within the VI Interregional competition on the Constructive Labor of School Students technologies (November, 2015).

VI Interregional competition in technology
"Constructive labor of school students"

Creative task in the direction "Technology. Technical work", 8th class

Task: To develop a design, to define technical requirements and to give an economic production justification for the footwear shelf.

To solve a technical problem, using the TIPS morphological analysis method.

The method of the morphological analysis is applied to improvement, modernization, redesigning of already existing technical devices. Its essence consists of the following: the designed product is considered and analyzed. In it several the most important morphological features are allocated. For each sign the list of options (alternatives) of technical parameters, properties, characteristics, etc. is formed. Then for each sign the most suitable are chosen, from the designer point of view, option of parameter, property, characteristic, that is a certain combination of possible executions of the object parts is chosen.

Options of signs are convenient to have in the form of table – "a morphological box" by which it is convenient to define design option.

For example: to develop a bread box design

<table>
<thead>
<tr>
<th>No. s/c</th>
<th>Attribute</th>
<th>Alternative options</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>Case material</td>
<td>Wood</td>
</tr>
<tr>
<td>2</td>
<td>Case form</td>
<td>Round</td>
</tr>
</tbody>
</table>

Assessment criteria

<table>
<thead>
<tr>
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<th>Number of points</th>
</tr>
</thead>
<tbody>
<tr>
<td>The formulation of design-technology or other creative task for the offered product</td>
<td>5</td>
</tr>
<tr>
<td>The theoretical solution of the task by the offered designing method, identification of the existing analogs, development of own designs</td>
<td>10</td>
</tr>
<tr>
<td>Choice of an optimal design</td>
<td>5</td>
</tr>
<tr>
<td>Material selection</td>
<td>5</td>
</tr>
<tr>
<td>Planning of technological process</td>
<td>5</td>
</tr>
<tr>
<td>Development of design-technology documentation (drawings, sketches, schemes, flow and instructive charts, etc.)</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
</tr>
</tbody>
</table>

Creative task in the direction "Technology. Technical work", 9 grade

Task: To develop a design, to define technical requirements and to give economic production justification for the stand for traffic regulations studying.

To solve the technical problem, using algorithmic method of designing – the inventive tasks solution algorithm (ITSA-56).

The the inventive tasks solution algorithm in the simplified look can be presented in the form:

1. Explanation of the problem statements.

1.1. To study statements of the problem.
1.2. What interacts in the developed object according to the problem statement?
1.3. What difficulties arise simultaneously?
1.4. What are reasons of these difficulties?

2. **Definition of the device design.**
2.1. To find out how the available difficulties are eliminated in nature.
2.2. How these problems are solved in equipment?
2.3. Draw a picture, the device design sketch for the device you constructed.

3. **Practical work.**
3.1. What materials are necessary for production of the device?
3.2. What tools, devices, equipment will be needed?

4. **Assessment of the task solution.**
4.1. What shortcomings you see in the made product?
4.2. Whether it is possible to apply a product for some other purposes, in other areas of equipment?

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<td><strong>Total</strong></td>
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</tr>
</tbody>
</table>

Tasks are developed by department teachers of the general engineering training and the theory and technique of professional engineering and technological faculty education.

**Summary**
This technology promotes entering of new ideas into development of contents and methods of the school students endowments development. Development of endowments is provided due to the use of elements of the offered theory forming the necessary level of intellectual working capacity manifestation and informative activity, as well as engineering thinking orientation enhancement. The gifted person is, first of all, the gifted personality. For development of the exceptional child ability to realize the gift, a child needs to be provided with the special conditions allowing him or her to study and develop. Here we speak about creating educational process on the basis of the TIPS technology, as well as about creation of conditions for the individual, differentiated training, with orientation to engineering thinking which has to be carried out by the trained teacher, well understanding specifics of exceptional children training [10].

**Conclusion**
Work with use of elements of the inventive tasks solution theory tasks the teacher with developing new forms of carrying out occupations, special tasks and exercises of substantially-logical and non-standard character, tasks demanding application of knowledge in the new certain system conditions given.
Acknowledgments

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