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CONFORMITY OF THEORY AND PRACTICE WHEN DESIGNING CYLINDRICAL GEARS

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Abstract: The article analyzes the aspects of using the conformity of theory and practice in the process of studying the didactic possibilities of conformity of theory and practice in improving the quality and effectiveness of teaching.

As a result, the relevance of ensuring the conformity of theory and practice in the design of cylindrical gears for the organization of the educational process for the courses "Machine parts", "Technical Mechanics", "Applied Mechanics", which plays a leading role in the preparation of competitive and qualified engineering personnel.

The importance is indicated, in order to ensure the conformity of theory and practice, in theoretical and practical literature it is necessary to ensure the unambiguity and composition of formulas, designations of quantities, calculation methodology, as well as the presentation of calculation and other tables and state standards, and during lectures to highlight their meaning, as well as rules for their use.

It also outlines the need for the development of highly effective didactic materials conformity with theory and practice, as well as the eliminated shortcomings, the achievable successes as a result of their application in the educational process, as well as the requirements and guidelines for the implementation of their application. They also emphasize their importance in the preparation of promising ideologically and politically mature, systemically thinking professional designers.

Guidance is given on the application of conformity between theory and practice in technical training. It is recommended to use the conformity of theory and practice: as a didactic condition that solves specific problems in the educational process; as a didactic condition that ensures an increase in the level of a technical project carried out by students; recommended as a didactic condition that improves the design direction of technical training.

Keywords: cylindrical, transmission, constructor, project, education, conformity of theory and practice, didactic opportunity, didactic condition.

Formulation of the problem

In the "Concept for the development of the higher education system of the Republic of Uzbekistan until 2030" approved by the decree of the President of the Republic of Uzbekistan № UP-5847 dated October 8, 2019, in the second chapter "The current state of the higher education system and existing problems", it is especially emphasized that "The content of the current qualification requirements, curricula and programs are not aimed at the formation of practical skills in graduates".

The current State standard of education in the direction of "Automotive and Tractor Engineering" provides that students should perfectly know the implementation of design and verification calculations of the mechanical engineering structure and ensuring their performance [O'. R. DTS.

2020. c. 12]. Hence, based on the above opinion, we can say that the problem of training competitive personnel should be considered as always an urgent problem awaiting its solution.

Monitoring of the scientific analysis of theoretical and practical literature on the course "Machine parts" showed that they require a study of the security of the conformity of theory and practice. Because students, not only during the lecture but also during practical and laboratory classes, are supposedly exposed to all the new educational material. This completely contradicts the definitions for the formation of knowledge, skills and abilities in pedagogy.

Scientific exposition

The limited systems engineering and thinking skills of students are one of the obstacles to be overcome in industry and school [Gerrit Muller 2015. pp. 679 - 688].

The process of individual thinking is also a practice [Kanke V.A. 2003. p. 236]. Thus, the course project is of practical importance for improving thinking skills and abilities.

The question of how to strengthen the connection between theory and practice using reflective tasks has been and remains a major problem in education [Lily Orland-Barak, Hayuta Yinon. 2007. pp. 957-969].

At the same time, when performing computational-graphic, term papers or a project as a reflective task from the above basic technical disciplines, students face great difficulties in the process of designing cylindrical gears. There are several factors as the main reason.

In particular, the lack of skills in the correct use of tables to start designing, choosing materials for transmission, performing design and verification calculations, individual and systems thinking when designing transmissions, finding the right solution based on industry standards, and using literature correctly.

It can be seen from this that at the heart of the appearance of the first pending problem is the following second problem.

According to the results of studies to eliminate the above deficiencies, it was revealed that the full provision of the conformity of theory and practice increases the quality and effectiveness of training, as well as improves the level of formation of design skills and abilities.

Therefore, the purpose of this article is to identify shortcomings in ensuring the consistency of theory and practice in the process of designing cylindrical gears, to eliminate them, to study the didactic possibilities of applying the consistency of theory and practice.

Analysis of existing methodological approaches to solving this problem.

The conformity of theory and practice pursues a single goal - for the creation and formation of the necessary set of knowledge, it combines scientific concepts related to the content of theoretical and practical literature in a single synthesized learning object, that is, within the framework of a reflexive task, provided by the subject and requires a solution.

The uniformity of formulas and designations corresponding to the content of subjects, ensures the unification of the content through the conformity of theoretical and practical studies, synthesizes, systematizes and, by strengthening, ensures the integrity of knowledge and skills related to professional competencies, improves the formation of skills for the integrated application of embodied knowledge.

Despite this, in the course of our scientific research, it was determined that to this day, in some scientific and pedagogical literature, there is no talk about ensuring the conformity of theory and practice.

Based on the above, it can be stated, despite the relevance, to this day the problem of ensuring the conformity of theory and practice has not been the main problem of any scientific research.

Research part

Fair criticism is caused by the complexly composed methods of teaching the exact and natural sciences, the lack of connection between theory and practice, the sequence of curricula, unsatisfactory content and the quality of textbooks [Sh.M. Mirziyoev. 2020. №207 (7678) p. 2].

Our research, providing for the aforementioned complaints, shows that ensuring the conformity of theory and practice, along with improving intra-subject theoretical and practical connections, leads to an increase in the didactic efficiency of inter-subject connections.

Students, based on the knowledge, gained, must learn how to perform strength calculations of machine parts connections, make design and test calculations of various gears, select and calculate shaft and axle supports, design units and parts using intersubject information [Alekseeva N.A. 2006. - 104 p.].

Interdisciplinary knowledge is an independent area of didactic knowledge, which has a psychological and pedagogical rationale and is characterized by an integral structure of principles, methods and teaching aids, with the help of which a new type of knowledge is formed [Guryev A.I. 1998. p. 204].

Based on the above proposals, we can say that the conformity of theory and practice is a multifaceted phenomenon, and has a different character and function.

Our research is one of the aspects of the conformity of theory and practice, the problem of improving the effectiveness of learning. We have structurally studied the form of communication of the content.

1. Existing deficiencies in ensuring conformity theory and practice

Modern didactics interprets conditions as a set of factors, components of the educational process, ensuring the success of training [Sinkina E.A. 2012. pp. 121-126]. Therefore, ensuring the conformity of theory and practice in teaching the course “Machine parts” is one of the problems pending in the higher education system.

The gap between theory and practice in education is an ongoing problem [Gerrit Muller. 2015. pp. 679 - 688]. For example, when designing cylindrical gears, the determination of their geometric dimensions begins with calculating the centre distance a_w, this is a formula, in theoretical literature it has two varieties, and it has a theoretical nature, therefore it cannot be used in practical calculations, they are given below.

$$a_w = 0{,}85(u \pm 1)\sqrt[3]{\frac{E_{kel}T_2K_{H\beta}}{[\sigma_H]^2u^2\psi_{bd}}}.$$

Below is a practical formula which is for practical calculations

$$a_w = K_a(u \pm 1)\sqrt[3]{\frac{T_2K_{H\beta}}{[\sigma_H]^2u^2\psi_{ba}}}.$$

In theoretical literature [Ivanov MN, Finogenov V.A. 2000, pp. 113-150, M. Kurganbekov, A. Moydinov. 2015. pp. 25-70] both formulas are given, in the theoretical literature [Shoomidov Sh.A. 2014. pp. 131-170] only a theoretical formula is given. In these formulas, there is a coefficient - $K_{H\beta}$, its value is in tabular form, but this table is not given in the theoretical literature [Sulaymonov I. 1981. pp. 124-157, Ivanov M.N., Finogenov V.A. 2000, pp. 113-150, Shoomidov Sh.A. 2014. pp. 131-170], cited [M. Kurganbekov, A. Moydinov. 2015. pp. 25-70] in practical literature [Chernyavskoy S.A. 2005. pp. 27-46]. There is a formula for the practical determination of the permissible contact stress:

$$[\sigma_H] = \frac{\sigma_{Hlimb}K_{HL}}{[S_H]},$$

and in this formula, the contact endurance limit at the base number of cycles$-\sigma_{Hlimb}$, its values, as well as the mechanical characteristics of the materials used for the manufacture of gears, are given in a tabular form, these tables, as well as the method of practical determination of the allowable stresses for the selected material, are not given in any valid to date the above theoretical literature.

The value of the distance between axes a_w, the gear ratio u, the ratio of the crown width ψ_{ba} is given in accordance with GOST 2185-66, the value of the module m is given in accordance with GOST 9363-60 and standardized, these values are given in the theoretical literature [Ivanov MN, Finogenov V.A. 2000, pp. 113-150, Shoomidov Sh.A. 2014. pp. 131-170, M. Kurganbekov, A. Moydinov. 2015. pp. 25-70], but in the theoretical literature [Ivanov MN, Finogenov V.A. 2000, pp. 113-150] distance between axes, the ratio of the width of the crown, as not of great importance, is written in small fonts.

The formula for determining the modulus value, $m_n = (0{,}01 \div 0{,}02)a_w$, the formula for determining the number of teeth of helical gears

$$z_1 = \frac{2a_w \cos\beta}{(u+1)m_n},$$

the formula for determining the angle of inclination of the teeth

$$\cos\beta = \frac{(z_1 + z_2)m_n}{2a_w},$$

Shoomidov Sh.A. 2014. pp. 131-170, M. Kurganbekov, A. Moydinov. 2015. pp. 25-70] the formula for determining the ratio of the width of the gear by diameter ψ_{bd} is not given in any of the above theoretical literature. The formula for determining the width of the gear b_1, the width of the wheel b_2 is not given in the theoretical literature [Ivanov MN, Finogenov V.A. 2000. pp. 113-150, Shoomidov Sh.A. 2014. pp. 131-170, M. Kurganbekov, A. Moydinov. 2015. pp. 25-70].

To determine the value of the constituent load factors when checking the teeth for contact endurance $K_H = K_{H\beta}K_{H\alpha}K_{Hv}$, and the load factor when checking the teeth for bending stresses $K_F = K_{F\beta}K_{Hv}$, a table is given in the practical literature. These tables are also not given in any of the above theoretical literature and it is stated that the value of these values is determined graphically or calculated using a formula. The formula for determining the strength of teeth by contact stress in many theoretical literatures is given in the form

$$\sigma_H = 1{,}18Z_{H\beta}\sqrt{\frac{E_{kel}T_1K_H}{d_{w1}^2 b_w sin2\alpha_w}\left(\frac{u \pm 1}{u}\right)} \le [\sigma_H],$$

and in the practical literature [Chernyavskoy S.A. 2005, pp. 27-46] is given in the form

$$\sigma_H = \frac{270}{a_{w_t}}\sqrt{\frac{T_3 K_н (u+1)^3}{b_4 u_2^2}}.$$

The formula for determining the value of the allowable bending stress has the form $[\sigma_F] = \sigma^0_{Flimb}/[S_F]$, where σ^0_{Flimb} – is the endurance limit, its values are given in the tables, as well as the value of the coefficient taking into account the shape of the tooth Y_F, is given in the form of a graph, taking into account the displacement coefficient x according to GOST 21354-75, however, there is a number series depending on the number of teeth for cylindrical helical and spur gears, as well as bevel spur gears, this number series, formula $[\sigma_F]$, the value of σ^0_{Flimb} is not given in any of the above theoretical literature.

In addition, this coefficient in the theoretical literature [Ivanov MN, Finogenov V.A. 2000. pp. 113-150, Shoomidov Sh.A. 2014. pp. 131-170] is designated as Y_{FS}, in theoretical literature [Sulaymonov I. 1981. pp. 124-157, M. Kurganbekov, A. Moydinov. 2015. pp. 25-70] and practical literature

[Chernyavskoy S.A. 2005. pp. 27-46] is expressed as Y_F. In our opinion, to prevent this case, you need to designate Y_F.

The formula for checking the bending stress of cylindrical helical gears is given in the theoretical literature [Ivanov MN, Finogenov V.A. 2000, pp. 113-150, Shoomidov Sh.A. 2014. pp. 131-170] in the following form.

$$\sigma_F = \frac{Y_F Y_{F\beta} F_t K_F}{b_w m_n} \leq [\sigma_F].$$

In the theoretical literature [M. Kurganbekov, A. Moydinov. 2015. pp. 25-70] is given in the following form

$$\sigma_F = \frac{Y_F Z_{F\beta} F_t K_F}{b_w m_n} \leq [\sigma_F].$$

In practical literature [Chernyavskiy S.A. 2005, pp. 27-46] has the form

$$\sigma_F = \frac{F_t K_F Y_F Y_\beta K_{F\alpha}}{b_2 m} \leq [\sigma_F].$$

This means that in the current literature the same formula is expressed in different ways. These varieties mislead students, so here it is advisable to apply the "Appropriateness of theory and practice" in teaching.

2. Ensuring conformity of theory and practice

The purpose of education, notes its content and methods [Tursunov I., Nishonaliev U. 1997. 232 p.]. Higher education didactics is an educational measure aimed at improving the quality of education in higher education [Thumser-Dauth K. 2007. 248 p.]. The implementation of the relationship between theoretical and practical training at a university is possible by developing organizational and pedagogical conditions and didactic teaching aids [T.I. Shamova, T.M. Davydenko, G.N. Shibanova 2006. 384 p.].

Therefore, in order to prevent the aforementioned shortcomings, which is the reason for the difficulties of students, it is important to develop and immediately introduced into the educational process didactic material under conformity with theory and practice, which improves the formation of skills in the design of cylindrical gears.

As the educational material refers to the academic subject, so educational and cognitive problems refer to the educational material [Umurov Z. L. 2020. pp. 54-56]. And so, to ensure the conformity of the content of theory and practice in the course "Machine parts" in the theoretical and practical literature on each topic, it is necessary to ensure the uniqueness and composition of the calculation formulas and designations of quantities. The methodology of design and verification calculations, as well as calculation tables, graphs and state standards, in theoretical and practical literature, should be fully described in the same way, and during lectures, they should highlight their practical significance, as well as the rules for their use.

3. Didactic possibilities of conformity theory and practice.

The perfection and scientific validity of the results of design and design work in the process of designing mechanical transmissions of machines are reflected in the conformity of theoretical and practical components of general educational and general technical disciplines [Nabiev A.N., Karimov K.A., Karimov B.T. 2020. pp. 39-42].

Therefore, in our study, the didactic possibilities of using the conformity of theory and practice in the process of improving the technical training of students were studied.

In our opinion, the pedagogical basis for the application of the conformity of theory and practice in the course "Machine parts" requires a meaningful study and analysis of three aspects:

- conformity of the application of conformity of theory and practice to the requirements for graduates of higher educational institutions;
- course “Machine parts”, as well as the conformity of theory and practice;
- the conformity of theory and practice, as well as a course project.

3.1. Correspondence of the application of conformity of theory and practice to the requirements for graduates of higher education institutions

According to the current state educational standards, the following requirements are imposed on graduates of technical universities: to create schemes for the general layout of machines and a diagram of units, to determine the acting forces and direct them, to perform design and verification calculations with high quality, and to use GOST intelligently and intelligently. It should also be noted that ensuring conformity between theory and practice does not affect the number of teaching hours devoted to a subject in the curriculum. It follows that these requirements and provisions are fully consistent with the first aspect.

3.2. Course “Machine Parts”, as well as the conformity of theory and practice

The fourth chapter of the Concept says: "The introduction of advanced standards of higher education, in particular the gradual transition from education, whose curricula are aimed at obtaining theoretical knowledge, to an education system aimed at developing practical skills based on international experience".

In this regard, when studying the aspect of the course “Machine parts”, as well as the conformity of theory and practice, to determine the place and role of conformity of theory and practice in the formation of practical skills in the course “Machine parts”, we will analyze the conformity between the theoretical and practical content of the course “Machine parts” “To determine where, how and when it is appropriate to apply the theory and practice in the course “Machine parts”.

The program of the course “Machine parts” involves the development and deepening of technical thinking, acquaintance with the general scientific foundations and principles of organizing modern production. Analysis of the tasks solved by the course project in technical universities allows us to highlight the main areas of application of the conformity of theory and practice.

In our opinion, the conformity of theory and practice in technical training, in particular in design training, can be applied as follows:

1) As a didactic condition that solves specific problems in the educational process;
2) As a didactic condition that ensures an increase in the level of a technical project performed by students;
3) As a didactic condition that improves the design orientation of technical training.

Let's take a closer look at the implementation of each of the directions we have indicated.

1. Thus, as a didactic condition that solves specific problems in the learning process, you can use the consistency of theory and practice to effectively solve problems within the course project, which must be performed according to the program of the course “Machine parts”. Above, the problems encountered in the design of cylindrical gears were studied and presented, and ways to prevent these problems by ensuring conformity of theory and practice were indicated.

The purpose and task of the conformity of theory and practice in the educational process is the deep mastering of theoretical knowledge and the improvement of the formation of practical skills [Karimov B.T. 2020 pp. 17-21].

Therefore, we tried to improve the efficiency of the educational process, ensuring the conformity of theory and practice. For this purpose, didactic material has been developed, which ensures the conformity of theory and practice. The essence of the didactic material:

- firstly, the lectures provide a practical table of the mechanical properties of materials used for the manufacture of machine parts, and also study its importance and rules of use;
- secondly, the uniformity of the formula and methodology of design and verification calculations is ensured, as well as the designation of quantities, in lectures and practical classes, as a result, theoretical knowledge is confirmed in practice, this fully corresponds to one of the principles of pedagogy “unity of theory and practice”;
- thirdly, all the above-mentioned shortcomings are eliminated, in lectures, i.e. theoretical literature, the completeness of the method of practical calculations is provided, and calculation tables and state standards are provided, their practical significance and rules of use are explained;
- fourthly, it creates conditions for deep mastering of design and verification calculations. As a result, in the process of studying the course “Machine parts” in accordance with theory and practice, the student develops the skills and abilities to assess the quality of the newly created machine by calculation. This will improve the professional training of future bachelors.

The above opinions show that the use of the conformity of theory and practice in the lesson process increases the quality and effectiveness of teaching and is a didactic condition that solves specific problems in the learning process.

2. Before revealing that the conformity of theory and practice is a didactic condition that ensures an increase in the level of a technical project carried out by students, it should be noted that a term project for the course “Machine parts” is understood as a technical project.

For the successful implementation of the course project, students must fully master the methods of design and verification calculations, know the practical meaning and rules for the effective use of calculation tables and state standards, be able to use the literature correctly, have independent and systematic thinking. Ensuring the consistency of theory and practise creates conditions for the successful and full-fledged fulfilment of the above requirements, increases the quality and efficiency of information use, this leads to an increase in the level of the technical project.

Therefore, it is advisable to use the conformity of theory and practice as a didactic condition that provides an increase in the level of a technical project carried out by students.

3. Conformity of theory and practice, as a didactic condition that improves the design directions of technical training, develops design skills and abilities of students:

- firstly, in the process of completing a course project, students are required to strictly adhere to the design rules, based on purposeful knowledge gained in theoretical and practical lessons. Students will learn how to fulfil all the requirements step by step, without violating the methodology, and as a result, a deep mastering of the stages and design methodology is realized;
- second, by ensuring conformity, the relationship between theory and practice improves. The practice has shown that this relationship is reflected in improving the quality of the course project, for example, when designing belt or chain conveyors, in particular, in determining the geometric dimensions of drive parts, performing design and verification calculations, as well as developing general and working drawings.

The results obtained are the basis for important conclusions that ensuring the conformity of theory and practice improves the design directions of technical training.

Conclusion

Errors and difficulties leading to a violation of the correct relationship between theoretical and practical actions are rooted in the imperfection of teaching methods [Kudryavtsev T.V. 1975. p. 179].

If so, to solve the first problem that is raised in this article, that is, to ensure the full consistency of theory and practice, the following is required:

a) to prevent fluctuations in the design of cylindrical gears, the design and test formulas of which are used in practice should be cited on topics in theoretical literature;

b) to prevent knocking down during the calculation in the design process, it is not allowed to designate the same value with a different letter in the theoretical and practical literature;

c) to facilitate the adjustment of calculations, reduce the waste of time and labour, improve the formation of skills, it is required to teach how to find the values of the necessary coefficients in an easier way when studying the theory;

d) based on the requirements of the concept, it is necessary to ensure the convergence of the calculation methodology in the theoretical and practical literature, that is, to ensure the conformity of theory and practice.

The didactics of higher education is understood as a study, the purpose of which is a theoretical analysis of the processes of teaching and learning in higher education based on scientific knowledge to make appropriate changes to improve the quality of education at the university [Piterskova T.A. 2012. pp. 942-944.].

So, in our opinion, the prevention of the second problem raised in this article is achieved by introducing the following:

a) To form the skills to apply the knowledge gained in general education and general technical disciplines into practice, it is necessary to ensure the conformity of the theory and practice of both disciplines;

b) For a thorough formation of skills on the correct selection of materials for the design of gears, the necessary training materials should be given in the theoretical literature and studied in lectures;

c) the formation of the skills of independent systemic thinking in the design of cylindrical gears is achieved by preventing factors leading to fluctuations and knocking down, that is, ensuring the conformity of theory and practice;

d) the ability to find the right solution based on the industry standard is provided by knowledge of the types, understanding of the essence and content, as well as the sufficiency of their use by students in the design process, that is, ensuring the consistency of theory and practice.

e) For the formation of a sufficient level of skills, for the correct use of literature, it is advisable to send consultations, rely more on literature when performing term papers and projects.

The above opinions are the basis for the conclusion that the conformity of theory and practice is a didactic condition that summarizes theoretical and practical knowledge, as a result of improved integration, increasing and systematizing the quality and effectiveness of teaching, as well as optimization of the educational process.

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