



Application of The Method of Confused Logical Chain to Determine The Level of Students' Knowledge

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Article History	Abstract
<p>Received: 06 June 2023 Revised: 05 Sept 2023 Accepted: 30 Nov 2023</p> <p>CC License CC-BY-NC-SA 4.0</p>	<p><i>This article deals with the issue of fair determination of students' knowledge level and increasing their activity in classes using the method of interactive confused logical chain. Using the method for the topic, section and whole part of theoretical mechanics, it is shown that it is possible to evaluate the level of students' knowledge fairly, transparently and quickly.</i></p> <p>Keywords: <i>theoretical mechanics, statics, friction force, friction cone, friction force in sliding, friction force in rolling, couple force, moment of force, Poinot's lemma, balance equation, oscillatory motion, center of parallel forces, theorem, moment of inertia, flat farm.</i></p>

1. Introduction

Today, significant positive changes are being made in the field of education in our country. The number of students studying in higher educational institutions and the number of educational fields is constantly increasing and expanding, the financial resources allocated to education are increasing, educational institutions are undergoing major repairs, new educational buildings and student accommodation are being built. the task of wide use of pedagogical and information technologies in teaching is set. The increase in the number of students requires the use of fair, quick and transparent methods of assessment of their level of education, along with providing them with quality education. It is known that the problem of using the method of confused logical chain, which is effectively used in institutions recently, in the training of theoretical mechanics.

"Confused logical chain" method is used as one of the effective methods to determine the level of students' knowledge of theoretical mechanics. There are opportunities to use the method within the subject of theoretical mechanics, in the process of conducting intermediate evaluations in the subject, and at the stage of conducting final evaluations. When this method is used, the student should be able to match the correct information to each other when the information related to several topics, such as formulas, key words and phrases, definitions, and theorems related to the subject, are confused. In this case, the collection of facts related to the topic is presented to the attention of students in a case where the chronological order of cause and effect is confused (broken). Students should be able to correctly place the assigned task in order.

Let's see the application of the proposed method in the teaching process of the topic "Friction force" of the statics department of theoretical mechanics. Based on the method of confused logical chain, information is presented in the form of expressions, quantities and formulas on the subject. The teacher distributes a copy of the table to the group of students, corresponding to the number of students in the audience. After studying the given table in detail, the students of the group write down the answer number for each question listed on the left and the corresponding number on the right. The teacher collects the answers from all students, checks them and announces the results. Below is a chart on the topic of friction force.

Determine compatibility:

1	The formula for calculating the friction force in rolling	1	$F_{ish} = f \cdot N$
2	Direction of frictional force in sliding.....	2	$\vec{R} = \vec{N} + \vec{F}_{ish}$

3	Complete reaction force formula	3	always opposed to action
4	A friction cone is a	4	a formula that takes into account the friction force is added to the series of balance equations
5	The formula for calculating the force of friction in sliding	5	$F_{\text{ish}} = \frac{\delta}{R} \cdot N$
6	How to solve the problem by taking into account the force of friction	6	figure drawing in space the equal effector of friction force and normal reaction forces
7	How is the coefficient of friction found?	7	Asphalt leveling roller
8	Give an example of rolling friction	8	It is found through experience

Correct answers (5,3,2,6,1,4,8,7).

Consider the application of the perturbed logic chain method to the statics branch of theoretical mechanics. The obtained results of this score can be used to test student knowledge in a non-traditional way, to quickly determine the level of mastery of the studied section by the student, or to obtain intermediate evaluation scores. In this case, the number of questions in the table is more compared to the assessment of one subject. The reason is that the higher the number of questions, the higher the level of objectivity and fairness. At the beginning of each academic year, professors-teachers of the department form a bank of questions on the subject, and they are regularly filled and improved. Below is the table covering all the topics of Statics of Theoretical Mechanics:

Determine compatibility:

1	Poinsot's lemma is...	1	in order to treat a non-free body as free, the bond must be replaced by the bond reaction force
2	When is the moment of the force about the axis equal to zero	2	a problem in which the number of unknowns in the considered problem is equal to or less than the equilibrium equations
3	The amount of the couple force is equal to 10 n, the force shoulder is equal to 2 m. Find the torque.	3	22 H
4	Analytical equilibrium conditions of a system of forces meeting in a plane	4	$\sum F_{kx} = 0, \sum F_{ky} = 0, \sum m_o(\vec{F}_k) = 0$
5	The formula for finding the radius vector of the center of parallel forces	5	$x_c = \frac{\sum l_k \cdot x_k}{\sum l_k}, y_c = \frac{\sum l_k \cdot y_k}{\sum l_k}, z_c = \frac{\sum l_k \cdot z_k}{\sum l_k}$
6	Axiom of unbinding	6	when the force acting on the body is moved parallel to itself, the force equal to the force at the point of displacement and the added double product
7	Analytical equilibrium conditions of a system of arbitrary forces in a plane	7	$\sum F_{kx} = 0, \sum F_{ky} = 0$
8	What is the direction of the moment vector of the force relative to the axis	8	force modulus is obtained by multiplying the force shoulder with the appropriate sign
9	Show the definition of moment of force about a point	9	along the axis, when viewed from the end of this vector, the force rotates the body counterclockwise
10	What kind of problem is called a static definite problem	10	when the force and axis lie in the same plane
11	A 22 n mass is suspended from a rope hanging from the ceiling. Find the tension in the rope	11	20 HМ

12	The formula for finding the coordinates of the center of gravity of a line	12	$\vec{r}_c = \frac{\sum \vec{F}_k \cdot \vec{r}_k}{\sum \vec{F}_k}$
13	What do we mean by a flat farm account?	13	depending on the hanging point
14	What is the direction of the tension force of the string?	14	To find base reaction forces and stresses in all struts

Correct answers (6,10,11,7,12,1,4,9,8,2,3,5, 14,13).

As a result of application to determine the level of knowledge acquired by students in the field of theoretical mechanics, it is possible to quickly, transparently and fairly evaluate their level of knowledge. Materials are selected from the bank of questions compiled by the professor-teacher from the departments of statics, kinematics and dynamics of science. Below is a table covering all sections of the subject. It is natural that the number of questions offered to students increases with the increase in the weight of the material. However, after a certain number of questions (25-30), using the fuzzy logic chain method causes a number of inconveniences. For this reason, it is recommended to use this method without increasing the number of questions from 20 to 25 when conducting the final evaluation of the subject.

Determine compatibility:

1	Differential equation of free oscillating motion	1	$\ddot{x} + 2b\dot{x} + k^2x = 0$
2	Analytical equilibrium conditions of the system of meeting forces in space	2	$\vec{R} = \sum \vec{F}_k = 0, \vec{M}_0 = \sum \vec{m}_0(\vec{F}_k) = 0$
3	Theorem about the change in the amount of motion of a material point	3	The point of intersection of the vertical lines transferred to the velocities is the instantaneous center of the velocities
4	What formula is used to determine the work done by the force of friction?	4	$I_{Oc^1} = I_{Cz} + md^2$
5	An example of complex motion of a point	5	given the mass of the body and the law of motion, the force acting on it is found
6	The axiom of reaction to influence	6	A light bulb hanging from the ceiling, a teapot on the table
7	In the plain $x=5\cos 20t-4\text{ m}$, $y=3\sin 20t+2\text{ m}$ find the trajectory of a material point moving according to the law	7	$\vec{a}_{ab} = \vec{a}_r + \vec{a}_e + \vec{a}_{kor}$
8	The first question of dynamics	8	Movement of a man's wristwatch hand in motion
9	How to find the equation of trajectory when the point law of motion is given in a plane	9	to a force that alone can show the effect of a system of forces on a body
10	Formula for circular motion with uniform acceleration	10	smooth circular motion
11	Conditions of geometric equilibrium of a system of forces with an arbitrary location in space	11	$\sum F_{kx} = 0, \sum F_{ky} = 0, \sum F_{kz} = 0$
12	Damping oscillatory differential equation of motion	12	$\ddot{x} + k^2x = 0$
13	How to find the instantaneous center of velocities if the directions of the velocities of two points of a flat shape are known	13	The change in the amount of motion of a material point in a finite period of time is equal to the impulse of the force acting on the point
14	Give an example of a body in a bond	14	The effects of two objects on each other are equal in magnitude and opposite in direction.
15	The formula of Huygens Steiner's theorem	15	$A(F_{ish}) = -f \cdot N \cdot s$
16	An equal acting force is a	16	time is clearly lost from the given equation of motion

17	What kind of rotary motion is the movement of the clock shaft?	17	$\varphi = \varphi_0 + \omega_0 \cdot t + \frac{\varepsilon \cdot t^2}{2}$
18	Show the expression of the theorem of addition of accelerations in the complex motion of a point	18	$\frac{(x+4)^2}{25} + \frac{(y-2)^2}{9} = 1, \text{ эллипс}$
19	What is the direction of the velocity vector	19	Don't turn and focus
20	State the theorem about three forces	20	If a body is in equilibrium under the action of three forces lying in the same plane and not parallel to each other, the lines of action of these forces intersect at a point
21	How is the acceleration of a point in circular motion divided into components	21	An attempt at a point trajectory

Correct answers (12,11,13,15,8,14,18,5,16,17,2,1,3,6,4,9,10,7,21,20,19).

In conclusion, as a result of using the method of the confused logical chain in the course of the lesson, the students have the ability to organize the topics they have studied in science, to divide them into components, to compare them with other parts of the subject, to understand information about the newly studied topic. Regular use of this method in lectures gives students the opportunity to systematically study science materials, organize, divide and differentiate what they have learned. As a result of the above facts, the level of knowledge of students will increase significantly. As a result, the activity of students in classes increases. The teacher will have the opportunity to objectively determine the level of students' knowledge in a quick way, to conduct intermediate and final evaluations successfully.

When it is planned to evaluate students' knowledge using the method of confused logical chain in the course of teaching in the department, the following should be paid attention to:

- the bank of science questions should be expanded and compiled by topic.
- a bank of questions should be prepared separately for each subject, chapter and part of the subject.
- it is necessary to create a bank of logical, relatively easy-to-solve examples and problems related to the topics.
- to determine the level of mastery of the subject, table options of 5-10 questions are recommended to the students of the group.
- in order to evaluate students' knowledge in mid-term control, they are offered the option of tables with 10-20 questions.
- Samples of the question bank and example-problem bank and the order of execution are regularly published on the website of the department.
- the bank of questions and the bank of examples are updated every academic year.

In short, the method of confused logical chain is one of the modern and convenient methods for determining the level of students' knowledge, it is proved by the pedagogical experiences of professors and teachers of the department in recent years. This method is distinguished from other evaluation methods by its high effectiveness in checking the knowledge of students on the topic of the subject, on the chapter of the subject and during the midterm control.

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