

USE OF INFOGRAPHICS IN STUDYING THE FORCE OF FRICTION

<https://doi.org/10.5281/zenodo.18719810>

Talipov F.M.¹, Nurmatova S.B.², Azatbaeva A.K.³, Makhmudov A.O.³

1. Doctor of Physical and Mathematical Sciences, Professor

2. Candidate of Technical Sciences, Associate Professor

3. Students

National Pedagogical University of Uzbekistan named after Nizami, Tashkent Perfect University.

Abstract

The article examines the use of infographics as an effective visualization tool in studying the topic “Force of Friction” in the physics course. It is noted that the application of active learning methods, particularly the creation of educational infographics, contributes to the development of students’ cognitive activity and creative abilities. The paper presents infographics devoted to three types of friction forces (static friction, sliding friction, and rolling friction), developed by students of the “Computer Engineering” program in collaboration with a physics instructor and with the use of artificial intelligence tools. It is shown that the visualization of physical processes promotes a deeper understanding of the nature of friction forces, their characteristics and methods of reduction, as well as the formation of systemic thinking. The presented infographics can be used both in the educational process and in independent work of pupils and students.

Keywords

infographics, visualization, force of friction, mechanics, physics education

Modern physics education requires the use of active learning methods aimed at increasing students’ motivation and forming strong subject knowledge. The wide application of such methods as compiling crosswords (1), creating structured outlines and reference cards (2–4), solving non-standard problems (5–7), as well as developing educational infographics (8–17), contributes to the development of students’ creative abilities and cognitive activity.

A special place in the mechanics course is occupied by the topic of friction force, since it is closely connected both with the theoretical foundations of classical physics and with numerous practical applications in nature and technology. When solving dynamical problems, it is necessary to consider all the forces acting on a body, among which the friction force plays a key role. However, the abstract nature of the concepts related to different types of friction often causes difficulties for

students. In this regard, the task of presenting physical phenomena in a clear and accessible manner becomes particularly relevant. Infographics, combining textual and graphical information, make it possible to visualize complex processes and relationships between physical quantities, thereby facilitating their understanding and memorization.

The purpose of this work is to analyze the possibilities of using infographics in studying the topic “Force of Friction” in the physics course. To achieve this goal, the following objectives were defined:

- to consider the main types of friction forces studied in the mechanics course;
- to develop educational infographics reflecting the features of static, sliding, and rolling friction;
- to analyze the pedagogical effect of applying infographics in the educational process;
- to assess the role of visualization in forming a systemic understanding of physical phenomena.

The work on creating educational infographics was carried out with students of the “Computer Engineering” program within the framework of studying the section “Mechanics.” Special attention was paid to the topic of friction force as one of the fundamental and, at the same time, difficult topics in both school and university physics courses.

At the first stage, students were asked to review the theoretical material related to the main types of friction forces: static friction, sliding friction, and rolling friction. The physical nature of friction, the direction of the friction force, the relationship between the friction force and the normal reaction force, as well as the role of the coefficient of friction depending on the type and quality of the contacting surfaces were considered.

At the second stage, students began developing infographics. The work was carried out in the form of active discussion, analysis, and step-by-step refinement of the content and visual elements. In the process of creating the infographics, modern digital tools were used, including artificial intelligence technologies, as well as consultations with the physics instructor. This approach made it possible to combine the accuracy of physical content with the clarity and aesthetic expressiveness of the graphic design.

As a result, infographics in Russian on the topic “Force of Friction” were created, each reflecting the students’ individual approach to presenting the educational material (Fig. 1, 2, 3).

The created infographics clearly demonstrate the features of different types of friction forces. They reflect the direction of the friction force relative to the velocity

of the body, the dependence of friction force on the normal reaction force, the differences between

СИЛА ТРЕНИЯ

Внутренним трением – называется трения между слоями жидкости

Чтобы уменьшить трение используют смазку, то есть заменяют внешнее трение на внутреннее трение

• Если тело движется по наклонной плоскости:

• При движения тела возникает сила трения скольжения и она равна: $F_{тр} = \mu mg$

• Если тело движется по горизонтальной поверхности:

Существует 3 вида сил трения:

- сила трения покоя
- сила трения скольжения
- сила трения качения

Сила трения — это сила, которая возникает при соприкосновении двух поверхностей и препятствует их относительному движению

Причина трения

- шероховатость поверхности
- молекулярное взаимодействие

Формулы:

$F_{тр} = \mu mg \cos \alpha$ $F_{тр} = \mu N$

- $\cos \alpha$ = угол наклона
- N – сила реакции опоры
- $F_{тр}$ — сила трения
- μ — коэффициент трения
- m — масса
- g — ускорение свободного падения

Fig. 1

Сила трения

Основные виды силы трения

- Сила трения покоя
- Сила трения скольжения
- Сила трения качения

Причины трения

1. Шероховатости поверхности
2. Молекулярное взаимодействие

Чтобы уменьшить трение используют смазку, то есть заменяют внешнее трение на внутреннее трение

Внутренним трением называют трение между слоями жидкости

Виды трения

$F_{ск} > F_{тр}$

В этом случае тело скользит вниз с ускорением

$F_{ск} = F_{тр}$

В этом случае тело покоится или равномерно движется

$F_{ск} < F_{тр}$

В этом случае тело покоится на наклонной плоскости

Fig. 2

Сила трения

$F_{\text{тр}} - \text{Сила трения}$

$F_{\text{тяги}} = F_{\text{тр. покоя}}$ $F_{\text{тяги}} - \text{Сила тяги}$

$F_{\text{тр}} = \mu \cdot m \cdot g$ $F_{\text{тр}} = \mu \cdot N$

Трение покоя:
действует между неподвижными телами, когда к ним приложена внешняя сила, пытающаяся сдвинуть их с места. Оно всегда равно этой силе по величине и противоположно по направлению.

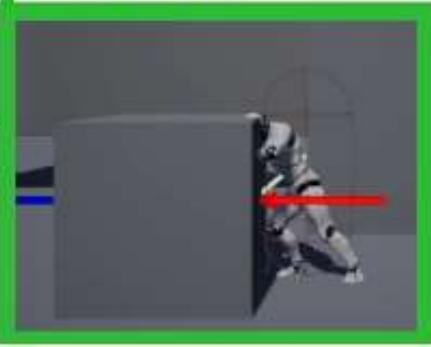
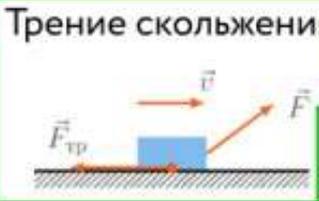
$v_{\text{отн}} = 0$

Трение скольжения:
возникает, когда одно тело движется по поверхности другого. Оно обычно меньше максимальной силы трения покоя.

$F_{\text{тяги}} > F_{\text{тр. покоя}}$

Трение качения:
возникает, когда одно тело (колесо, шар) катится по поверхности другого. Сила трения качения значительно меньше силы трения скольжения.

$m - \text{масса тела}$
 $g - \text{ускорение свободного падения (9.8)}$

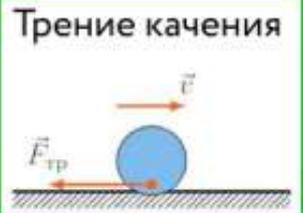



Fig. 3

static, sliding, and rolling friction, as well as methods of reducing friction in technical devices.

The analysis of students' work showed that the use of infographics contributes to a deeper understanding of physical processes. Visual representation allows students to better comprehend the causes of friction, the role of surface roughness and molecular interaction, as well as the significance of friction in nature and technology. Special attention was paid to considering methods of reducing friction, such as the use of lubricants, replacing sliding friction with rolling friction, and the use of wheels, rollers, and bearings. During the discussion and revision of the infographics, students actively asked questions, clarified the physical meaning of the presented relationships, and made corrections. This indicates the formation of a conscious attitude toward the studied material and the development of systemic thinking. Infographics contributed to the integration of theoretical knowledge and its practical comprehension.

Conclusion

The use of infographics in studying the topic "Force of Friction" is an effective pedagogical tool that enhances the clarity and accessibility of educational material. The visualization of physical processes facilitates understanding of the relationships between physical quantities and contributes to forming a holistic view of the nature of friction forces.

The experience of creating infographics has shown that active learning methods increase students' interest in studying physics, develop their creative abilities, and improve their skills in working with educational information. The presented infographics can be recommended for use in the educational process when studying mechanics, as well as visual material for independent work of pupils and students.

REFERENCES:

1. Talipov F.M., Juraev M.B., Perik D.A. Mastering physics concepts and developing cognitive interest among 7th grade students through creating their own crosswords. *American Journal of Education and Learning*, 2025, Vol. 3, Issue 10, pp. 303–307.
2. Талипов Ф. М. О внеаудиторной работе студентов. *Fizika, matematika va informatika. Ilmiy-uslubiy jurnal*, Тошкент, 2023, № 3, с. 133–137.
3. Талипов Ф. М. Самостоятельная работа студентов по физике и формирование человеческого капитала. *Mehnat iqtisodiyoti va inson kapitali*, 2025, № 2, с. 214–219.

4. Талипов Ф.М. О роли самостоятельной работы студентов – будущих учителей физики – в наращивании человеческого капитала . Inson kapitali va mehnatni muhofaza qilish, 2025, № 3 , с.484-489.
5. Talipov F. M., Abdukhalilova O. Sh., Sobitova M. F. Solving Non-Standard Problems on Mechanics. Science and Innovation: International Scientific Journal, 2023, Vol. 2, № 4, pp. 158–161.
6. Talipov F. M., Abdukhalilova O. Sh. Solving Selected Tasks Problems in Electrostatics. Science and Innovation: International Scientific Journal, 2024, Vol. 3, № 3, pp. 24–26.
7. Talipov F. M., Djuraev M.Kh., Abdukhalilova O. Sh. Solving non-standard problems in physics and independent work of students. American Journal of Multidisciplinary Bulletin, 2025, Vol. 3, Issue 5, pp. 217–221.
8. Jaleniauskiene, E. & Kasperiuoene, J. Infographics in higher education: A scoping review. E-Learning and Digital Media,(2023), 20(2), 191-206. DOI: 10.1177/20427530221107774.
9. Талипов Ф. М., Серебрякова М. Х. Внедрение инфографики в процесс обучения физики и подготовка педагогов к её использованию на уроках. Fizika, matematika va informatika: Ilmiy-uslubiy jurnal, Тошкент, 2024, № 3, с. 53–59.
10. Serebryakova M. Kh., Talipov F. M. Using infographic resources in physics lessons. Science and Innovation, 2024, Vol. 3, Issue 2, pp. 178–180.
11. Талипов Ф. М., Кабилжанова И. К. Инфографика при изучении физики в школе. American Journal of Education and Learning, 2025, Vol. 3, Issue 3, pp. 181–183.
12. Talipov F. M., Djuraev M., Slamov A. Infographics and Improving the Efficiency of Students' Independence. Science and Innovation: International Scientific Journal, 2025, Vol. 4, № 2, pp. 100–103.
13. Talipov F. M., Djuraev M., Slamov A. Infographics in teaching the topic Newton's laws at school. American Journal of Education and Learning, 2025, Vol. 3, Issue 7, pp. 311–317.
14. Talipov F.M. . On the cooperation between teacher and student with artificial intelligence in creating infographics in the topic vector and scalar quantities, American Journal of Education and Learning. 2025, Vol. 3, Issue-7, pp.499-503.
15. Талипов Ф. М. Инфографика на тему «Линзы» к школьному учебнику физики. Fizika, matematika va informatika. Ilmiy-uslubiy jurnal, Тошкент, 2025, № 5, с. 112–117.

16. Талипов Ф.М. Самостоятельная работа студентов с использованием искусственного интеллекта и инфографики в контексте формирования человеческого капитала . Inson kapitali va mehnatni muhofaza qilish, 2025, № 4 , с.501-507.

17. Talipov F. M., Mansurova M.Z., Ismailov F.N., Nurmatov R.R., Using infographics in studying Coulomb's law by students of the "Software engineering" Program: pedagogical experience. American Journal of Education and Learning, 2026, Vol.4, Issue-1, 7-13.