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Applying Practical Approaches in Teaching General Physics – Mechanics to Enhance Students' Engagement At the Vietnam–Korea University of Information and Communication Technology

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Abstract
This article introduces one of the teaching methods that is very meaningful in enhancing the students' positivity: using practice, practical questions to connect the lesson content with life to stimulate students' interest in the subject of General Physics. Through the article, the author presents the use of practical problems, practical questions in the Applied Mechanics section in the teaching of General Physics, helping students see the practical benefits of studying Physics to develop curiosity, stimulate thinking, exploration, improve self-study, self-thinking of students at the Vietnam - Korea University of Information Technology and Communications.
Keywords*: Practical, practical question system; Active teaching ; Interest.*

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I. Introduction

In the context of increasing demands for high-quality human resources in the era of Industry 4.0 and Vietnam's ongoing process of international integration, continuous learning and the ability to apply scientific knowledge to real-world situations have become essential. Learners must actively develop internal competencies, avoid relying on rigid patterns of thinking, and cultivate creative and independent reasoning.

Students' learning motivation is strongly influenced by the perceived relevance and meaningfulness of instructional content. As an experimental science closely linked to everyday life, General Physics naturally generates questions arising from observable physical phenomena. When learners are able to interpret these phenomena and connect theoretical knowledge with real-life contexts, they experience greater satisfaction and recognize the practical value of studying physics, thereby fostering deeper engagement and interest.

To enhance students' motivation, instructors must adopt effective strategies that stimulate curiosity and promote active learning. Integrating real-world contexts and practical question systems into instruction represents a highly effective approach. Drawing on teaching experience, this article examines practical problem contexts and the development of real-life question systems, and applies these insights to designing lectures using practical questions in teaching the Mechanics component of General Physics at the Vietnam–Korea University of Information and Communication Technology.

II. Teaching Through Real-World Contexts to Enhance Learners' Engagement

"Practice refers to human activities—primarily productive labor—that create the essential conditions for the existence of society" [1]. Learners generally "acquire knowledge most effectively when teachers require them to apply concepts and principles to practical situations once they have understood them" [2]. Therefore, instruction should be designed so that students can apply acquired knowledge to real-life contexts and use physics principles to interpret everyday phenomena. This not only helps them recognize the value and relevance of learning but also deepens their understanding of the subject matter.

To achieve this, several pedagogical principles must be followed: clearly defining learning objectives; selecting content and exercises that incorporate meaningful real-world contexts for each lesson; and identifying appropriate learning resources for students. During instruction, teachers should also ensure that real-world applications are feasible, contextually appropriate, and used in moderation. Examples introduced should be engaging, carefully selected, scientifically accurate, and aligned with students' cognitive levels. Moreover,

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applications should be relevant, up-to-date, and presented in a way that creates a comfortable learning atmosphere, with suitable tone, clarity, and professionalism to avoid monotony.

III. Applying a System of Real-World Questions in Teaching General Physics

The General Physics course, positioned within the Natural Sciences curriculum, forms a core component of undergraduate education. Based on an analysis of the curriculum, the author implemented the use of real-world questions at various stages of instruction across selected lessons. From this approach, a structured system of practical questions was developed and integrated into the design of instructional content in the "Dynamics of a Particle" chapter of Mechanics, with the aim of enhancing student engagement and creativity. This system was subsequently applied in teaching at the Vietnam–Korea University of Information and Communication Technology. The main results are summarized as follows:

- Steps for Developing a System of Real-World Questions:

+ First: Identify learning objectives for each lesson.

+ Second: Determine the logical structure of the content and select exercises that incorporate meaningful real-life contexts.

+ Third: Specify appropriate instructional methods aligned with the lesson objectives.

+ Fourth: Construct a system of practical questions that is consistent with the defined logic, methods, and pedagogical principles.

- Using these steps, the author developed a set of real-world questions for the "Dynamics of a Particle" chapter and designed one complete lecture based on this system. A comparative analysis with a traditional lesson plan demonstrates the advantages of using real-world questions.

*** Content Structure of the "Dynamics of a Particle" Chapter**

"Dynamics of a Particle" is a foundational chapter in Mechanics. Its content includes: composition and decomposition of forces, conditions for equilibrium, Newton's laws, gravitational force and the law of universal gravitation, spring force and Hooke's law, and friction. These concepts are essential both for solving classical mechanics problems and for explaining real-world physical phenomena.

The chapter provides numerous applications across daily life and scientific fields. Examples include the explanation of urgent societal topics such as traffic safety, interaction forces, and applications of physics in household technologies like washing machines. Studying this content not only enriches students' academic knowledge but also equips them with the ability to interpret familiar real-life phenomena.

*** Identification of Practical Contexts for the Chapter**

There are many practical problems to apply knowledge, but giving core content for students to solve is a very important thing when teaching. Based on the objectives, content and application of knowledge when determining practical problems suitable to the ability and level of application of students, the author proposes the following contents:

- Problem 1: Inertia: Human use of inertia in daily activities and transportation.
- Problem 2: Tug-of-war: Observation, analysis, and explanation of forces involved.
- Problem 3: Bridge structures: Historical development of simple bridges in river regions.
- Problem 4: Friction: Effects of friction in daily life, cycling, and problem-solving related to bicycle motion.
- Problem 5: Tides: Tidal phenomena, applications in clean-energy generation, and safety concerns during low tide.
- Problem 6: Athletics: Mechanics of shot put, javelin throwing, and related sports…

*** Developing Real-World Quantitative Exercises**

Quantitative exercises based on real-life data and scenarios help students perceive the applicability of physics concepts, enhance problem-solving skills, and promote the transfer of knowledge to authentic contexts. Accordingly, the author developed a set of quantitative exercises aligned with the objectives of the course and grounded in practical situations.

- System of Quantitative Real-World Exercises

1. A bird of mass 26 g perches at the midpoint of a taut horizontal wire. Show that the tension in the wire is given by: $F_t = \frac{mg}{2\sin\theta}$(where θthe angle between the wire and the horizontal). Determine the tension for $\theta = 10^0$and when $\theta = 10{,}5^0$

2. Shortly after jumping from an aircraft, a skydiver with weight 720 N reaches an approximately constant velocity. Identify the two dominant forces acting on the skydiver, describing their magnitudes and directions.

3. A motorcyclist and the motorcycle have a total mass of 150 kg. The motorcycle travels at 36 km/h and encounters an obstacle 30 m ahead; the rider applies the brakes. The frictional braking force is 300 N.

a. Will the rider be able to stop in time? Explain.
b. How does the result change if the motorcycle carries an additional 50 kg?
c. State the implication for motorcycle operation.
4. At the time of its launch, the RMS Titanic was the heaviest human-made ship, with a mass of 6.0 x 107 kg. Determine the net force required to give the ship an acceleration of 0.1 m/s2?
5. A student pushes a 10-kg bicycle over a distance of 5 m against a frictional force of 13 N. If the student exerts a 20-N force and the bicycle starts from rest, determine its final velocity.
6. A wooden crate with mass m=360kg is lying on the floor of a truck. The truck is moving at a speed of $v_0=120km/h$. The driver applies the brakes to slow the truck down to 62km/h in 17s. During this time, how much force is applied to the wooden crate? Assume the wooden crate does not slide on the floor of the truck.
7. A car with a mass of 2 tons starts off without any cargo and moves with an acceleration of 0.3m/s2. When the car is carrying an additional cargo, it moves with an acceleration of 0.2m/s2. Knowing that the resultant force acting on the car in both cases is equal. Find the mass of the cargo?
8. A baseball player hits a 0.15 kg ball so that the ball's velocity changes from 48 m/s horizontally and due east to 81 m/s horizontally but due west in a short time interval of 0.01 s. Estimate the force the player exerts on the ball, assuming this force is uniform and ignoring all other forces acting on the ball.
9. To lift a bag of food, a person applies an upward force of 35N to the bag. Describe the "reaction force" according to Newton's third law by indicating: the magnitude of the reaction force, the direction of the reaction force, which object the reaction force acts on? Which object causes this reaction force?
10. Two carts 1 and 2 have a mass of 1.0 kg, both with springs attached to them. An object of unknown mass m is tied to cart 1. Cart 2 is pushed in to compress the springs and then released. The magnitude of the acceleration of the two carts is $a_1=0,7m/s^2$, $a_2=1,52m/s^2$; these carts have small wheels and are lubricated. Determine m.
11. With what force does the Earth attract the Moon? Given the distance
between the Moon and the Earth is $r=38.10^7m$, the mass of the Moon is $m=7,37.10^{22}kg$, the mass of the Earth $M=6,0.10^{24}kg$is .
12. Two ships each weighing 50,000 tons are 1km apart. Compare the gravitational force between them with the weight of a 20g weight. Take $g=9,8m/s^2$.
13. A wooden box with mass m=2.5kg is lying at rest on a horizontal floor. The coefficient of sliding friction between the object and the floor is 0.2. Take $g=9,8m/s^2$.
a. If a horizontal force of 3.5N is applied to a wooden box, will the box move? What is the magnitude of the frictional force acting on the box and in what direction?
b. Same question as above but with a force of 5N.
14. Place a cup on a light piece of paper on the table and use your hand to pull the paper horizontally.
a. How much acceleration is needed to make the cup start sliding on the paper? Knowing that the coefficient of friction between the cup and the paper is 0.3 $g=9,8m/s^2$.
b. In the above condition, what will be the force acting on the paper? Knowing that the coefficient of sliding friction between the paper and the table is 0.2, the mass of the cup is 50g.
c. Would the result in question b above change if the glass had water?
15. A refrigerator weighing 890N moves evenly on the floor. The coefficient of sliding friction between the refrigerator and the floor is 0.51. What is the horizontal force pushing the refrigerator? With the force found, can the refrigerator move from rest?
16. A truck weighing tons $m_1=5$pulls a car weighing tons $m_2=1$with a stiff cable $k=2.10^6N/m$. From the start, the two cars accelerate evenly and after 20 seconds, they travel 200m. Determine the stretch of the cable and the force pulling the truck, ignoring road friction.
17. A girl pushes a sled on a horizontal road. When the sled has a speed of 2.5m/s, the girl lets go and the sled slides a distance s = 6.4m before stopping. Determine the coefficient of friction between the sled and the road surface.
18. Suppose the car is released when its speed is 5m/s along a horizontal road and the coefficient of friction $\mu_k$between the car and the road surface is 0.050. How far will the car slide before stopping?
19. A person pulls a 45kg wooden box at a constant speed on a horizontal floor thanks to a rope connected to the wooden box. The angle θbetween the rope and the horizontal is 55^0, the coefficient of friction between the wooden box and the floor is 0.5. Determine the tension in the rope.

- System of Qualitative Questions

Qualitative questions grounded in real-world contexts enable students to deepen and reinforce conceptual understanding, while also serving as tools for assessing knowledge and practical skills. Such context-based qualitative exercises encourage learners to analyze phenomena, develop logical reasoning, enhance judgment and creativity, and strengthen their ability to apply theoretical principles to explain natural, everyday, and technical situations.

1. Place a brick on top of a piece of paper and let it fall freely. Does the brick "press" on the paper as it falls? What will the answer be if it falls in the air?
2. To prevent water jets from the bicycle wheels from hitting the riders, mudguards are attached to the wheels. How should the mudguards be attached?
3. What must be the orbital period of a satellite for it to be a geostationary satellite of the Earth?
4. A passenger on the bus said that when there were few passengers, when the bus passed through a bad road, the bus shook a lot, making the passengers very uncomfortable. But when the bus was full of passengers, it felt smoother even when passing through bad roads. Is that feeling correct? Please explain.
5. Is it possible to make the reading of a force gauge smaller or larger than the weight of an object hanging from it?
6. In military engineering experiments on bullets, it was found that conical bullets always fly further than spherical bullets under the same conditions. Explain why?
7. A boy from inside a moving train throws a piece of chalk horizontally in the opposite direction of the train's motion with the same speed as the train. How will the piece of chalk move relative to the train and to the person standing on the ground?
8. When we bend our elbows we can lift a heavier object than when we extend our arms horizontally. Why?
9. When workers carry heavy bags, they often lean forward a little. Explain why?
10. People often say: "You can't lift yourself up by your hair." Is there a scientific basis for this statement? Please explain.
11. Why are spaceports often located near the equator and why are artificial satellites always launched in the same direction as the Earth's rotation?
12. After hitting the floor, a ball bounces higher than its original position. What should be done to make the ball bounce like that?
13. To be able to jump high, circus performers do the following: One performer stands at the end of a plank placed on a support, the other end of the plank is raised high; another performer jumps and stomps on the raised end. As a result, the performer can jump high. Please explain the basis of the above method?
14. To allow water to be projected farther from a hose, one end is often covered, leaving only a small opening for the water to exit. Explain the physical basis for this practice
15. Boaters on the river shared their experience: if the boat is going downstream, it should stay in the middle of the river, and if it is going upstream, it should stay close to the river bank. Why do they do that?
16. Observe a train running at high speed, see pieces of paper on both sides being sucked into the train. At stations, passengers are always asked to stand away from the railway when the train is entering the station. Explain?
17. Why do ships in ports often hang old car tires on both sides of the ship?
18. When a child was eating boiled peanuts, he wanted to choose the big ones. He cleverly shook the basket of peanuts many times, and the big peanuts rose to the top. Explain the basis for this method?
19. If a steel ball is dropped on a hard stone slab, it will bounce a number of times. Sometimes one of the bounces will be higher than the previous one (but not higher than the height from which the ball was dropped). Explain? Is there any contradiction with the law of conservation of energy?
20. Given a long stick, find the center of gravity of the stick without using any other tools?
21. Based on mechanical knowledge, how can you distinguish between a raw egg and a boiled egg without breaking the egg?
22. How can you determine the internal volume of a pot if you only have a scale?
23. A cylindrical glass cup is filled to the brim with liquid. Using a cup of a different shape and slightly smaller volume, how can you divide the liquid in the cup into two equal parts?
24. How do you measure the diameter of a soccer ball using only a straight, hard ruler?
25. A person wants to determine the mass of a boat he is in. What should he do if he has only a rope in his hand and he knows his own weight?
26. Using only a scale and a graduated cylinder, how can you determine whether an aluminum ball is solid or has a gas cavity inside? Is it possible to somehow determine whether the cavity is at the center of the ball or offset toward the surface?
27. In a train moving on a railway track, at any moment of motion, there are points that are not moving and points that are moving in the opposite direction to the motion of the train. What are these points?
28. How can the density of a stone of any shape be determined? Determine using the following tools and materials: Stone, dynamometer, water bottle.
29. How to determine the coefficient of sliding friction $\mu$of wood on wood if you only have the following tools: Wooden board, wooden stick, protractor?
30. Will the gravitational force between two objects change if we place a thick sheet of glass between the two objects?

3 1 When a collision occurs between a car and a motorbike, it is usually the motorbike that is damaged, but according to Newton's third law, the forces acting on the two vehicles must be equal, that is, those forces must cause the same damage. Explain that "contradiction"?
32. After measuring a person's body temperature with a thermometer, we often see the doctor shake the thermometer vigorously, causing the mercury in the tube to fall. What is the physical basis for this method?
33. When observing fighters, we see that they often stand with their knees slightly bent and their legs spread wider than normal. What is the effect of this position?
34. Why do people attach a tail to a kite?
35. There is a joke like this: A horse learned Newton's third law and then refused to pull a cart anymore. It said: "No matter how hard I try to pull the cart, it is useless because no matter how hard I pull the cart, the cart will pull me back with the same force. Two forces equal in magnitude and opposite in direction will be balanced so neither I nor the cart will move!". What do you think when you hear this story? Are the things in the story true?
48. When making cables, people do not use one large wire but many small wires braided together. Why is this necessary?
49. In the flying motorcycle circus, the performer has to ride a motorcycle on the vertical wall of a cylindrical "wooden barrel". Is it really that dangerous? The secret of success What is at stake in this circus: recklessness or the inevitable laws of physics?
50. A person holding one end of a rope of a bucket of water and rotating it rapidly in a vertical plane saw that the water in the bucket did not spill out even when the bucket was at its highest position. A student said that this contradicted the theory because when moving in a circle, water is affected by a centripetal force directed downward and thus the water would pour out faster. Is this a contradiction? Please explain.

*** Develop one instructional module that integrates practical applications and a system of real-world inquiry questions.**

The lesson "Gravitational Force – Newton's Law of Universal Gravitation" is delivered in a single class period. Its primary content includes the statement of the universal law of gravitation and its applications. The question set is designed to guide students in investigating and explaining phenomena such as tides, planetary motion, and the determination of an object's acceleration at height h compared with that near Earth's surface. The instructional process is implemented through a system of real-world questions and a corresponding lesson plan.

- Questionnaire

+ Gravity. Law of universal gravitation

Question 1: What is a tide? Who is usually interested in tides? What is the main cause of this phenomenon?
Question 2: Why does the Earth move around the Sun, giving us four seasons: spring, summer, autumn, and winter in a year?
Question 3: At the end of the 17th century, Issac Newton asked the question: "Why does an apple fall to the ground?"
Question 4: How does the force of the apple's attraction to the Earth compare to the force of the Earth's attraction to the apple? Is this force an interaction force due to objects in direct contact with each other?
Question 5: Two boats with masses m1 and m2 swim on a river, a distance r apart. How is the mass of the two boats related to the interaction force between them? What will the gravitational force be like if the two boats swim closer to each other and vice versa?
Question 6: Why is this interaction force called the universal gravitational force?
Question 7: Why does the Moon always revolve around the Earth? And why do planets (including the Earth) revolve around the Sun in specific orbits?

+ Gravity is a special case of gravitational force.

Question 8: If the objects are close to the ground or have $h<<R$, what is this acceleration expression? What do you think about the result you just found?
Question 9: Why do tides occur in the oceans? Analyze and explain this phenomenon?
Question 10: According to you, in places where the tide rises, what do we take advantage of this phenomenon for?
Question 11: Where can tidal phenomena also occur?
Question 12: What should we do when the tide goes out?

+ Quantitative practice exercises

1. On September 12, 1959, a Soviet space rocket placed its national emblem on the surface of the Moon. How many times is the gravitational force of the national emblem on the Moon smaller than on Earth? (Knowing that the Moon's radius is 3.8 times smaller than the Earth's radius and the Moon's mass is 81 times smaller than the Earth's mass?

2. With what force does the Earth attract the Moon? Given that the distance between the Moon and the Earth is r = 38.10 7 m, the mass of the Moon is m = 7.37.10 22 kg, and the mass of the Earth is M = 6.0.10 24 kg.
3. Two ships each weighing 50,000 tons are 1km apart. Compare the gravitational force between them with the weight of a 20g weight. Take g=9.8m/s 2 .

- Teaching Procedure
+ Activity 1: "Gravitational Force and the Law of Universal Gravitation"
The instructor organizes group-based learning in which students observe images and videos related to tidal phenomena and answer Questions 1–7. The key conceptual goals include:
. Explaining tidal variations observed at river mouths, which are governed by gravitational interactions (Q1).
. Understanding that seasonal changes arise from gravitational effects combined with Earth's axial tilt, which remains constant in direction as Earth orbits the Sun (Q2).
. Using the motion of the Moon around Earth and the planets around the Sun to illustrate Newton's conclusion that all objects attract each other via gravitational force, acting through a gravitational field rather than direct contact (Q3–4).
. Recognizing that gravitational force magnitude is proportional to the product of interacting masses and decreases with increasing distance (Q5).
. Explaining that gravitational attraction between Earth and the Moon sustains the Moon's orbit, just as gravity governs planetary motion around the Sun (Q6–7).
+ Activity 2: "Weight as a Special Case of Gravitational Force"
Students observe the motion of a falling object and respond to Questions 8–12. The weight of an object is interpreted as the combined effect of gravitational force and the centrifugal inertial force due to Earth's rotation. Because the centrifugal component is negligible compared to Earth's gravitational pull, weight is approximated as gravitational force (Q8).
For Q9–10, students examine tidal phenomena, which depend not only on gravitational attraction but also on coastal geometry, seabed depth, river inlets, islands, and ocean currents. Tides are exploited in navigation, aquaculture, and, in regions with large tidal amplitudes (up to ~11 m), tidal power generation. Earth's crust and atmosphere also experience minor tidal variations. Measuuctor sres such as planting vegetation and reinforcing embankments are used to mitigate riverbank erosion (Q10–11).
+ Activity 3: Summary and Problem-Solving Guidance
The instrynthesizes key concepts and provides guidance for solving practice problems.
. Do Exercise 1
The gravitational attraction between the badge and the Moon and the Earth: $F_{TD}=G\frac{m_1 m_{TD}}{R_{TD}^2}$; $F_{MT}=G\frac{m_1 m_{MT}}{R_{MT}^2}$
Make a ratio :$\frac{F_{TD}}{F_{MT}}=\frac{m_{TD}}{m_{MT}}.\frac{R_{MT}^2}{R_{TD}^2}=5,61$
The gravitational pull of the national emblem on the Moon is 5.61 times smaller than on Earth.
. Do Exercise 2
The Earth attracts the Moon with a force :$F_{hd}=G\frac{m_{MT}m_{TD}}{R_{TD}^2}=0,2.10^{21}(N)$
. Do Exercise 3
The gravitational force between two ships $F=G\frac{m_1 m_2}{r^2}=6,67.10^{-11}\frac{(5.10^7)^2}{(10^3)^2}=0,17$ (N)
Weight of a weight with mass 20g : P= mg = 0.02 . 9.8 = 0.196 (N)
So the gravitational force between the two ships is less than the weight of the 20g mass weight .
Students showed special interest in the lesson content because the knowledge in the lesson was closely related to real-life problems. Many questions were raised among students and between students and teachers. Most of the questions revolved around the problem of transmitting electricity over long distances, how to increase and decrease voltage.

IV. Evaluation of results and conclusions

4.1. Evaluation of Experimental Results and Scientific Contribution

After defining the objectives and developing a set of practice-oriented questions aligned with each instructional topic, the author designed corresponding teaching procedures and implemented them in an introductory physics course for Cohort 24 in the Information Technology program. Student learning outcomes were subsequently assessed through content-specific examinations. The test results were collected, analyzed, and interpreted to evaluate the effectiveness of the proposed approach.
Comparison between Cohort 24 and Previous Cohorts

A comparative analysis was conducted to examine differences in learning performance between Cohort 24 and earlier cohorts.

Class	Total	Excellent	Good	Average	Weak	Poor

	students	Student (%)	Student (%)	Student (%)	Student (%)	Student (%)
Physics 09	59	4(7)	24(41)	21(36)	6(10)	4(7)
Physics 10	70	3(4)	25(36)	31(44)	10(14)	1(1)
Physics 11	69	4(6)	36(52)	25(36)	3(4)	1(1)

Table 1. Student Examination Results After Instruction Using the Practice-Oriented Question System

Class	Total students	Excellent Student (%)	Good Student (%)	Average Student (%)	Weak Student (%)	Poor Student (%)
Physics 08	38	0(0)	5(13)	18(47)	10(26)	5(14)
Physics 07A	33	0(0)	8(24)	16(48)	6(18)	3(10)
Physics 07	30	0(0)	9(30)	15(50)	3(10)	3(10)

Table 2. Examination Results of Students from Previous Cohorts Without Instruction Using the Practice-Oriented Question System

Comment

Statistical analysis indicates that both examination scores and overall course performance improved notably. The proportions of students achieving good and excellent grades increased significantly, while the rates of average and below-average performance declined; notably, no students fell into the failing category compared with previous cohorts.

These findings reaffirm that integrating real-world problems and practice-oriented question systems into instruction yields substantial and encouraging outcomes. This approach enhances students' independent inquiry, logical reasoning, and creativity, thereby optimizing their self-directed learning. Simultaneously, it supports more effective and engaging teaching practices within the institution

4.2. Conclusion

The study introduces an instructional approach grounded in real-world problems and practice-oriented questioning, designed to promote students' self-discovery, inquiry, and intrinsic motivation. This method fosters logical reasoning and maximizes creative potential, thereby strengthening students' capacity for self-directed learning and independent research. Classroom observations indicate that lessons employing this approach are significantly more engaging and effective than traditional lectures or sessions relying solely on electronic slide presentations.

The author hopes that the demonstrated benefits of using a system of practice-oriented questions will encourage broader adoption of this method to stimulate student interest, enhance analytical and creative thinking, and ultimately develop strong self-learning habits. Beyond its instructional value, this approach can serve as a tool for lecturers to further cultivate students' logical reasoning, enabling them to acquire course content more effectively.

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