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Elasticity in Daily Life: A Potential Topics in Learning Physics

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Abstract

As a branch of natural science, physics explores the fundamental properties of matter and energy and their interactions. This study specifically examines the concept of elasticity—the ability of an object to return to its original shape after removing an external force—and equilibrium, which are crucial in understanding various physical phenomena. The research aims to highlight the practical applications of elasticity and equilibrium principles in daily life across multiple fields. Additionally, it seeks to underscore the importance of physics education in preventing misconceptions about these fundamental concepts. The findings suggest that effectively applying elasticity and equilibrium principles can enhance problem-solving in everyday scenarios. However, there is a critical need to improve physics education, particularly in literature and practical simulations, to mitigate common misconceptions and enhance understanding.

Keywords: Elasticity and physics learning

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INTRODUCTION

Physics is a branch of natural science that focuses on the fundamental properties of matter, energy, and their interactions. Physics is also defined as science derived from the systematic observation of nature, which studies mechanical physics, particularly elasticity and equilibrium (Sari, 2017). The "Physics and its Role in Life" section explores the broad scope of physics, its various branches, and its significance in everyday life. It aims to enhance understanding of the complexity of the universe and its components, which will ultimately deepen appreciation of the Creator of the universe (Desilva, 2020). Rapid technological advances are closely linked to physics principles, as fields such as information technology, electronics, medicine, and transportation require a solid understanding of the concepts (Soekarman, 2021). One branch of physics that explains the ability of an object to change shape after being applied a force but returning to its original shape when the force is removed is elasticity.

Elasticity refers to the ability of an object to return to its original shape after an external force is removed. When force is applied to an elastic material, its shape will change (Lusiana, 2017). Examples of everyday life are springs and rubber, which usually experience an increase in length. However, there is a limit to the force that can be applied in these examples. A rubber band can break if the stretching force exceeds its elasticity limit. However, a spring will not return to its original shape if stretched too far (Hasanah, 2016). Thus, elastic materials have elasticity limits. Elasticity plays an essential role in maintaining both static and dynamic balance. In static balance, elasticity ensures that objects can return to their original shape after being subjected to a force without permanent deformation. In dynamic balance, elasticity allows objects to respond to forces in a way that supports stability and control during movement (Rahayu, 2017). Understanding this relationship can be more easily applied in physics learning.

Learning physics using real examples and modern technology can increase students' interest in learning and understanding (Kanza, 2020). For example, clay and plasticine, when pressed, will change shape. But it cannot return to its original shape after the pressure is released (Harefa, 2021). When a force deforms a solid, its particles resist the change in shape, creating a reaction force that helps maintain its original shape. All the forces acting on the object must be balanced so the resultant force is equal to zero. Another example of application is in springs used in vehicle suspension systems. The spring absorbs shock and returns to its initial position, ensuring the vehicle remains stable on uneven road surfaces. If the applied force is below the elastic limit, the object will return to its original shape after removing the force to maintain balance. This opposing force is called elastic (Hidayati, 2016). However, this research is urgent about the critical role of physics in everyday life in the context of elasticity and balance. Thus, this research aims to improve the understanding of the principles of elasticity.

METHOD

The research methodology employed in this study involved a systematic approach to gather and analyze data on equilibrium and elasticity from reputable scientific sources (Baruqi, 2009).

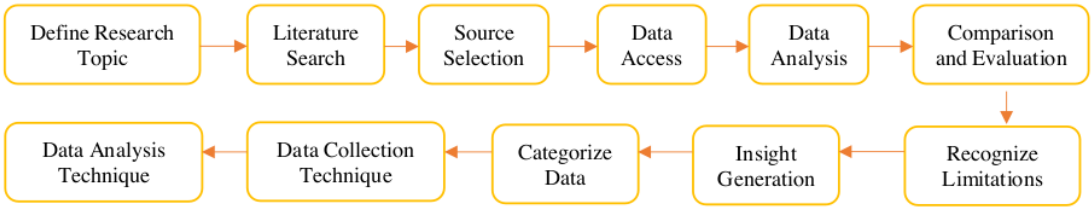

Figure 1. Interactive model qualitative analysis step chart

Based on Figure 1, the research steps started with determining the topic by identifying the research focus and emphasizing the principles of equilibrium and elasticity in physics. Next, a comprehensive literature search was conducted with relevant keywords (e.g., "equilibrium," "elasticity," and "mechanical analysis") to find suitable journal articles and studies. The selected articles had to be from reputable journals using experimental methodologies relevant to the research objectives. Then, data was accessed through institutional subscriptions to download the required articles and data. The data was analyzed by recording the experimental setup, measurement instruments, and results from the elastic test pieces and mechanical systems. The analyzed data were compared with the research objectives to assess relevance and suitability while considering variations in experimental methods.

Recognize potential research limitations by being identified, including measurement uncertainties and variations in experimental conditions that may affect data validity. Insights into equilibrium behavior and elasticity in physical systems resulted from the data analysis, which served as the analytical basis for further interpretation. Finally, the data is categorized as primary data by classifying the data.

RESULTS AND DISCUSSION

Table 1 provides a list of various national and international research journals focused on the applications of elasticity in everyday life.

Tabel 1. List of scientific research of elasticity in daily life.

No	Journal	Journal Review Results
1	Souisa (2011) **The Analysis of Modulus of Elasticity and Poisson Number using the Pull Test** (*Analisis Modulus Elastisitas dan Angka Poisson Bahan Dengan Uji Tarik*) Jurnal Barekeng, 5(2), 9-14	The journal findings indicate that tensile tests on iron, brass, and alloy steel materials reveal that when each material is stretched, it elongates and narrows in width, with the percentage of width reduction proportional to the percentage of elongation. This relationship is defined by the Poisson's ratio, which differs for each material: iron has a Poisson's ratio of 0.106 ± 0.002, brass 0.104 ± 0.002, and annealed alloy steel 0.103 ± 0.005. The higher

No	Journal	Journal Review Results
		Poisson's ratio in iron suggests greater elasticity compared to brass and alloy steel, with differences also attributed to each material's unique composition and response to tensile forces. Additionally, the study focuses on tensile testing only, applying force until the material fractures, which provides quantitative data on elasticity, elastic limits, and ultimate tensile strength, as well as determining the modulus as a measure of stress-strain proportionality (Souisa, 2011).
2	Hidayati F, Akhsan H, & Syuhendri (2016) **Students Grade X Misconceptions Identification on the Material of Elasticity and Hooke's Law at State Senior High School 1 Indralaya** (*Identifikasi Miskonsepsi Siswa Kelas X pada Materi Elastisitas dan Hukum Hooke di SMA Negeri 1 Indralaya*) Jurnal Inovasi dan Pembelajaran Fisika, 3(2), 3838 https://ejournal.unsri.ac.id/index.php/jipf/article/view/3838	The study identified several misconceptions among 35 tenth-grade science students at SMA Negeri 1 Indralaya regarding elasticity and Hooke's Law. Data collection involved a test of 15 multiple-choice questions on these concepts, accompanied by a Certainty of Response Index (CRI) on a six-point scale (0-5). Results showed a relatively low average score of 41.9, with 51.05% of students requiring clarification, 8.38% struggling with comprehension, and 40.57% understanding the concepts. The misconceptions included beliefs that energy can appear or disappear, compressed springs have less elastic energy, elastic objects lack an elastic limit, the elastic modulus measures a material's ability to return to its original shape, and objects with greater bending strength have a higher elastic modulus (Hidayati et al, 2016).
3	Akmam (2002) **Elasticity Parameters Determination of Igneous Rocks and Their Geophysical Aspects Using Sonic Viewer Instrument** (*Penentuan Parameter Elastisitas Batuan Beku Dan Aspek Geofisikanya Menggunakan Instrumen Sonic Viewer*) Project Report. Padang: FMIPA UNP, Padang.	The study found that the water absorption of igneous rocks in Andalas is generally higher than in Pasir Laweh, with the exception of phaneritic diorite rocks. The Poisson's ratio values obtained range from 0.30 ± 0.01 to 0.41 ± 0.02, while the Lame constant (rigidity modulus) values range from 2.98×10^0 Pa to 1.30×10 Pa. Instrumental methods were used to determine the elasticity parameters of various phaneritic rock types in Tanah Datar Regency (Akmam, 2002).
4	Baruqi M S, Sholihah S Z, Sugiharto A, Martonio B C, Sulthoni A, Supriyanto D, Kusuma K N, Aini A N, Tambun D & Suryaningrum W. (2009) **Measurement of Tensile Strength, Compressive Strength and Modulus of Elasticity of Solids** (*Pengukuran Tensile Strength, Compressive Strength dan Modulus Elastisitas Benda Padat*) Surabaya: Universitas Airlangga.	The results indicate that as stress increases, strain also increases, shown by the blue line on the graph. This line illustrates PVC remaining in the elastic region initially, where it can still stretch, before moving into the plastic region, where it can no longer return to its original shape. Using the regression graph depicting the stress-strain relationship, the elastic modulus of PVC was calculated, resulting in a regression equation of y = 0.082x. Consequently, the elastic modulus of the test material is determined to be 0.082 kN/m² by differentiating the regression equation. This experiment effectively measures mechanical properties such as tensile strength, compressive strength, and the modulus of elasticity. In particular, tensile strength defines the force needed to break or

No	Journal	Journal Review Results
		damage the material, allowing the relationship between stress, strain, and the modulus of elasticity of PVC to be clearly understood. This method proves to be both practical and efficient (Baruqi and Sholihah, 2019).
5	Soekarman (2021) **Implementation of Physics Learning on the Topic of Elasticity Through Inquiry Based Learning at SMA Negeri 2 Donggo** (*Impementasi Pembelajaran Fisika Pokok Bahasa Elastisitas Melalui Inquiry Based Learning di SMA Negeri 2 Donggo*) Jurnal Pedagogy: Jurnal Penelitian dan Pengembangan Pendidikan, 8(2), 197-209 https://doi.org/10.33394/jp.v8i2.3521	The study results indicate that learning in schools can effectively incorporate an inquiry-based approach or problem-solving method. The inquiry model, a cognitive learning approach commonly used in science education, encourages small group learning to enhance knowledge, critical thinking, attitudes, and communication skills (Joyce et al., 2000). Wenning (2011) outlines the stages of inquiry learning, including discovery learning, interactive demonstrations, inquiry lessons, inquiry labs, and hypothetical inquiry, collectively known as the inquiry spectrum. This approach helps students develop a range of intellectual and scientific skills and now includes real-world applications involving authentic problem-solving at the chapter's end. Specifically, the inquiry learning process on Elasticity and Hooke's Law, using the Hooke's Law Physics learning unit from P4TK IPA, was successfully implemented, with 100% of students achieving complete mastery (Soekarman, 2021).
6	Primavera I R C and Suwarna I P (2014) **The Effect of Audio-Visual Media (Video) on Student Learning Outcomes of Class XI on the Concept of Elasticity**) (*Pengaruh Media Audio-Visual (Video) terhadap Hasil Belajar Siswa Kelas XI pada Konsep Elastisitas*) Prosiding Seminar Nasional Pendidikan IPA, FITK UIN Syarif Hidayatullah Jakarta	The study's findings indicate that, based on pretest data, the experimental class had an average score of 22.96, while the control class averaged 23.55, showing no significant difference in initial learning outcomes on the concept of elasticity, as evidenced by the homogeneity test. After different instructional treatments, the experimental class, which used audio-visual media (videos), achieved a higher average score of 65.82 compared to the control class's 57.68. With a calculated t-value of 2.41 exceeding the t-table value of 1.99, this result suggests that audio-visual media significantly impacted student learning outcomes. This conclusion is further supported by an 8.73-point improvement in the experimental class's posttest scores over the control class, underscoring the effectiveness of audio-visual media in enhancing understanding (C2), application (C3), and analysis (C4). Conversely, conventional teaching in the control class primarily improved recall (C1), with students responding positively to audio-visual learning (Primavera and Suwarna, 2014).
7	Kristanti, Sulistiawati S D, & Saeri. (2023) **Application of Olive Oil on Skin Elasticity in Hemodialysis Patients with Impaired Tissue Integrity**	The study results indicate that, based on pre-test and post-test data from the Numerical Rating Scale (NRS) pruritus itch dimension questionnaire, the total pre-test score of 25 categorized the patient's pruritus as severe,

No	Journal	Journal Review Results
	Penerapan Pemberian Minyak Zaitun Terhadap Elastisitas Kulit pada Pasien Hemodialisa dengan Gangguan Integritas Jaringan Jurnal Ilmiah Mahasiswa Surabaya, 4(2), 1-13	with scores for itching duration (5), itching intensity (2), itching development (3), disruption of activities (5), and itching location (10). After applying olive oil twice daily for three days, the post-test scores showed a total of 23, re-categorizing pruritus as moderate, with slight improvements in itching development, disruption of activities, and itching location. This data suggests that olive oil may reduce pruritus levels in chronic kidney failure patients undergoing hemodialysis and also improve skin elasticity and tissue integrity (Kristanti et al, 2023).
8	Loko I M (2021) **Improving Learning Outcomes of Elasticity of Objects and Hooke's Law Through Experimental Methods Based on Cooperative Learning in Students of Class XI IPA 3 SMA Negeri 1 Tegallalang** (*Peningkatan Hasil Belajar Elastisitas Benda dan Hukum Hooke Melalui Metode Eksperimen Berbasis Pembelajaran Kooperatif pada Siswa Kelas XI IPA 3 SMA Negeri 1 Tegallalang*) https://doi.org/10.46444/suluh-pendidikan.v19i1.239	The research was conducted in two cycles, Cycle I and Cycle II, each consisting of three meetings. These cycles aimed to evaluate the success of students in learning physics through experimental methods based on cooperative learning. At the end of each cycle, evaluations and reflections were conducted to assess the improvement in students' physics learning outcomes. Prior to the cycles, regular learning sessions were conducted, followed by an evaluation test to gauge students' initial physics knowledge, serving as a benchmark for comparing their progress during the action cycles. The analysis of the data revealed that implementing the experimental method based on cooperative learning significantly enhanced students' understanding of object elasticity and Hooke's law, highlighting the importance of this approach in improving physics learning outcomes (Loko, 2021).
9	Soekarman (2021) **Implementation of Physics Learning on Elasticity through Inquiry-Based Learning at SMA Negeri 2 Donggo** (*Implementasi Pembelajaran Fisika Pokok Bahasan Elastisitas Melalui Inquiry Based Learning di SMA Negeri 2 Donggo*) Jurnal Paedagogy: Jurnal Penelitian dan Pengembangan Pendidikan, 8(2), 197-209 https://doi.org/10.33394/jp.v8i2.3521	The study investigated the learning process of elasticity material through a Hooke's Law unit, employing an inquiry-based model across six levels. Conducted over three meetings of four lesson hours each within one week, the research utilized a descriptive method that included observations, interviews, and tests, analyzed quantitatively. The findings indicated that the inquiry learning process for elasticity and Hooke's Law, utilizing physics learning units, was highly effective, achieving a 100% completion rate in student learning outcomes (Soekarman, 2021).
10	Kogout and Etsion (2002) Elastic-Plastic Contact Analysis of a Sphere and a Rigid Flat Journal of Applied Mechanics, 69(5), 657-662 https://doi.org/10.1115/1.1490373	The journal results indicate that the analysis of the elastic-plastic contact model between a deformable sphere and a rigid plane, conducted using the finite element method, identifies three distinct stages of contact evolution, transitioning from fully elastic to fully plastic. This study enhances our understanding of elastic-plastic contact and reveals significant differences when compared to previous models that relied on arbitrary assumptions, underscoring the superiority of the presented model in

No	Journal	Journal Review Results
		accurately describing elastic-plastic sliding contact (Kogout and Etsion, 2002).
11	Sari M I S and Budiningarti (2017) **Application of Beach Ball Type Class Discussion Learning Model as an Effort to Improve Learning Outcomes of Class X Students of SMA Negeri 2 Mejayan on the Subject of Elasticity** (*Penerapan Model Pembelajaran Diskusi Kelas Tipe Beach Ball sebagai Upaya Meningkatkan Hasil Belajar Peserta Didik Kelas X SMA Negeri 2 Mejayan pada Pokok Bahasan Elastisitas*) Jurnal Inovasi Pendidikan Fisika (JIPF), 6(3), 175-180	The study employed one experimental class and two replication classes that received the same treatment, leading to an improvement in student learning outcomes, implementation, and responses after applying the Beach Ball type classroom discussion model to elasticity material. Utilizing a pre-experimental design with a one-group pre-test and post-test framework, the research analyzed students' pre-test and post-test scores using the paired t-test and gain index. The results indicated a significant enhancement in students' learning outcomes, with a significance level of 5%, following the implementation of the Beach Ball discussion model, as all three classes consistently demonstrated improved learning outcomes (Sari and Budianingarti, 2017).
12	Zulfikar (2017) **Experimental Analysis of Elastic Modulus of Glass Fiber Reinforced Plastic (GFRP) Composite Material Based on Fiber Diameter Variation Due to High Strain Rate Impact Load** (*Analisa Eksperimental Modulus Elastisitas Bahan Komposit Glass Fiber Reinforced plastic (GFRP) Berdasarkan Variasi Diameter serat Akibat Beban Impak Laju Regangan Tinggi*) Journal of Mechanical Engineering, Manufactures, Materials and Energy (JMEMME), 1(2), 47-56	The journal results indicate that GFRP composites are among the most widely used alternative materials to metal due to their lightweight nature, ease of shaping, good strength, and relatively low production costs. This study examines how variations in fiber diameter affect the mechanical behavior of GFRP composites, particularly under high-impact strain rates, utilizing impulse-momentum theory in the elastic region as the foundational science. AGC equipment was employed for testing, as it generates high strain wave rates in unidirectional loading. The laminated composite structure, which consists of long chopped-strand glass fiber sheets, demonstrates elastic properties that are isotropic on a macrostructural level. The study findings reveal a relationship between stress propagation along the specimen and time (t), highlighting the material's resistance to deformation in response to applied impact loads (Zulfikar, 2017).
13	Lusiana Y I, Yushardi, and Sudarti (2017) **Learning Elasticity and Hooke's Law with Guided Discovery Learning Model at SMA Negeri 1 Jenggawah (Study on Critical Thinking Skills and Student Learning Motivation)** *Pembelajaran Materi Elastisitas dan Hukum Hooke dengan Model Pembelajaran Guided Discovery di SMA Negeri 1 Jenggawah (Studi pada Keterampilan Berpikir Kritis dan Motivaasi Belajar Siswa)* Jurnal Pembelajaran Fisika Univeritas Jember, 6(1), 65-71 https://jurnal.unej.ac.id/index.php/JPF/article/view/4659/3416	This research employed a posttest-only control group design at SMA Negeri 1 Jenggawah during the odd semester of 2016/2017. Samples were selected using cluster random sampling, designating XI IPA 3 as the control class and XI IPA 4 as the experimental class. Data were gathered through tests on critical thinking skills, observations of learning motivation, interviews with teachers and students, and learning documentation. An independent sample t-test was conducted using SPSS 22 for data analysis, where $p > 0.05$ indicated no significant difference, while $p \leq 0.05$ suggested that the experimental class performed better. The findings revealed that the guided discovery learning model had a significant positive impact on critical thinking

No	Journal	Journal Review Results
		skills and student learning motivation concerning elasticity and Hooke's law at SMA Negeri 1 Jenggawah (Lusiana et al, 2017).
14	Budi E, Budi A S, Fitri U R, Aprilia R, & Andriyani D (2021) **Study of Spring Constant Properties and Elastic Modulu** (*Kajian Sifat Tetapan Pegas dan Modulus Elastisitas*) Jurnal Pengabdian Masyarakat Sains dan Aplikasinya (JPMSA), 1(1), 6-11 https://journal.unj.ac.id/unj/index.php/jpm-sains/article/view/18248	The objective was to explore the spring constant's value and its correlation with the elastic properties of the spring material, represented by the modulus of elasticity. Two springs, made from the same material and measuring 6.8 cm in length but differing in diameter (spring 1 with a diameter of 0.8 cm and spring 2 with a diameter of 1.0 cm), were used. The results revealed that despite being made of the same material, the springs had different spring constants, with average values of 8.561 N/m for spring 1 and 4.432 N/m for spring 2. According to Hooke's law, the spring constant is directly proportional to the modulus of elasticity and inversely proportional to the length of the material. Both springs shared the same geometric length but varied in diameter, with the smaller diameter spring exhibiting a larger spring constant (Budi et al, 2021).

According to data and analysis, the application of physics in equilibrium and elasticity offers numerous advantages, facilitating the resolution of various problems and demonstrating significant effectiveness, as noted. In the sub-chapter titled "Physics and Its Role in Life," the extensive scope of physics, its branches, and its role in daily life are explored. This research illustrates that the principles of elasticity can assist individuals in determining the stress and strain values of materials and in identifying the parameters of elasticity. A literature review yielded 14 research articles focusing on the application of physics in elasticity and equilibrium in everyday life, categorized into areas such as health, beauty, and material usage. Research findings from Souisa M (2011), Akmam (2002), Baruai et al. (2019), and Kristanti et al. (2023) highlight how the principle of physical elasticity can be applied to assess the elasticity of materials for practical daily uses, such as testing moisture in health or beauty products. Low skin elasticity can lead to issues such as dryness and cracking. Similarly, in construction, if elasticity and equilibrium deviate from initial calculations, it may result in structural failures or accidents, including electrical shocks.

Hidayati et al. (2016), Soekarman (2021), Primavera and Suwarna (2014), and Loko (2021) have discussed the materials utilized in experiments, particularly focusing on their mechanical properties. These studies underscore the necessity of analyzing elastic modulus and Poisson's ratio through tensile testing, which provides comparative values of Poisson's ratio across different materials. This aligns with the research conducted by Kogut and Etsion (2002) and Budi et al. (2021), which emphasize the importance of understanding properties such as the spring constant and Young's modulus. A solid grasp of these concepts helps researchers avoid misunderstandings or misconceptions during experimental procedures. Consequently, thoroughly reviewing the theoretical foundation before undertaking research is crucial to ensure a smooth research process and produce accurate, relevant results aligned with established theories. This meticulous examination of material characteristics further ensures that researchers can interpret data correctly, thereby yielding more valid research outcomes.

Based on the findings from Sukarman (2021), Sari and Budiningarti (2017), and Lusiana et al. (2017), various learning models such as inquiry-based learning, beach ball-type class discussions, and guided discovery were employed. The implementation of these instructional methods has proven effective for teaching elasticity in physics, significantly enhancing student learning outcomes. The widespread applications of elasticity concepts in everyday life enable students to effectively assess their mastery and comprehension of the subject. Elastic materials hold considerable potential for everyday use.

CONCLUSION

This article emphasizes the importance of physics in everyday life, particularly in understanding the concepts of elasticity and equilibrium. As a branch of natural science, physics explains the interactions between matter and energy, which are highly relevant across various fields, such as information technology, medicine, and construction. Research indicates that the principles of elasticity can be utilized to determine the stress and strain values of materials and to identify elasticity parameters applicable in daily life, such as in the testing of health and beauty products. Furthermore, the various studies analyzed reinforce that understanding the mechanical properties of materials, such as elastic modulus and Poisson's ratio, is crucial for preventing errors in experimental procedures. The emphasis on effective teaching methods, such as inquiry-based learning and discussions, has also been found to enhance student learning outcomes in grasping the concept of elasticity. Overall, a solid understanding of elasticity and equilibrium can assist individuals in addressing practical everyday problems while reinforcing the theoretical foundations that underpin scientific research.

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