

Literature Review of the Concepts of Elasticity and Oscillation in Fundamental Physics 1: Various Research Variables, Educational Level, and Instructional Methods

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Abstract: The purpose of this study is to provide a comprehensive overview of the concepts of elasticity and vibration, based on research variables, educational levels, and teaching strategies. The article is organized based on queries conducted in reputable international databases, such as Scopus and Web of Science, using content analysis techniques, such as analyzing article identities, educational information, synthesis of used approaches, and measured variables. In the topics of elasticity and oscillation, qualitative, quantitative, and hybrid methods can be used to investigate a variety of variables, as indicated by the research findings. Among these variables are conceptual comprehension, academic achievement, and student interest. In addition, the educational level being investigated determines how elasticity and oscillation concepts are taught in the classroom. These findings highlight the significance of utilizing a variety of instructional strategies to effectively convey the concept of elasticity and oscillation to measure various variables with practical consideration on educational settings. In addition, our review provides a comprehensive list of common variables research that can serve as a valuable resource for educators and researchers seeking to enhance their elasticity and oscillation research. This systematic review highlights the need for additional research on effective teaching methods for oscillation and provides educators and researchers with useful insights.

Keywords: Educational level; Elasticity; Instructional method; Literature review; Oscillation

Introduction

In contrast to the field of physics itself, the field of physics education has seen a comparatively low amount of research conducted on the subject matter of physics (Adal et al., 2022; Chou et al., 2022; Gnesdilow, 2022). This is especially true regarding the education of physics teachers. Therefore, the purpose of this literature review is to present a comprehensive overview of how the content of elasticity and oscillation in physics has been distilled from a wide range of credible indexed sources. This overview will serve as an alternative portrayal of the study's developments in the content of physics, particularly in regard to elasticity and oscillation (Aygün et al., 2022; Robertson et al., 2022). A critical

appraisal of the previous research that has been done on a certain subject is called a "literature review." It involves synthesizing and assessing the knowledge collected and conclusions obtained from earlier study on the subject area (Bolinger, 2022; Leite et al., 2023; Voss, 2021). The purpose of the review of the current research on a certain subject is to provide an exhaustive and accurate account of the studies that have already been conducted on the subject, as well as promising areas for further investigation (Priemer et al., 2020; Sumardi et al., 2022).

Fundamental physics 1 focuses primarily on investigations pertaining to the fundamental laws that regulate the universe. The basics of elastic properties and an oscillation hold significant importance in the field of physics (Adal et al., 2022; Cahill et al., 2018;

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Starkey et al., 2018). A comprehensive comprehension of fundamental principles, particularly elasticity and oscillation, is imperative in attaining a sturdy comprehension of these kinds of concepts. The concepts of elasticity and oscillation possess wide-ranging implications across diverse fields, encompassing both commonplace and scholarly as well as technological spheres (Borrachero et al., 2019; Bouquet et al., 2019; Rinaldi et al., 2020). Problem-solving, the creation of cutting-edge technologies, and the enhancement of living conditions may all be improved by a greater knowledge of the concepts beneath elasticity and oscillation.

The extent of a person's comprehension will unquestionably affect their ability to adequately explain incidents in their surroundings, including concepts from the study of physical phenomena such as elasticity and oscillation. It is common practice to correlate higher levels of education with a more profound comprehension of the aforementioned ideas (Firdaus et al., 2019; Santyasa et al., 2018; Shubha et al., 2019). As a result, it is very important to investigate the connection between the level of education and the comprehension of ideas like elasticity and oscillation that are covered in Fundamental Physics 1.

This presumption is accurate for the following reason: when students reach higher levels of school, their cognitive growth is noticeably further compared to their thinking process when they were children (Chen et al., 2022). Consequently, educators have access to a vast array of methods of instruction that can aid them in illustrating various topics to students. Students' comprehension of elasticity and oscillation can be enhanced through the implementation of appropriate instructional techniques (Sun et al., 2019; Wibowo et al., 2020). Experiential demonstrations, simulations of computers, and problem-based instruction are examples of such methods.

This study's objective is to examine the various research variables, educational levels, and also teaching methodologies used to deliver an in-depth review of the concepts of elasticity and oscillation.

Method

In the course of the evaluation, a comprehensive study of the articles is carried out, with a broad variety of aspects like research variables, educational level, and instructional strategies all being taken into consideration. An investigation using strategies derived from content analysis was carried out so that appropriate responses could be provided to the questions that were raised by the research. In this analysis, we identified article specifics, performed a

synthesis of the methodologies that were applied, and measured a set of variables. This study will reveal the analysis of relevant aspects of variables, provide extra details about the educational backgrounds of the participants, and reveal the components of teaching strategies that correlate with the participants' overall educational achievement.

The Search Technique

The author used keywords or keyword combinations associated with oscillation and its derivatives to search for pertinent literature in the two most prominent databases, Scopus and Web of Science. The document search was restricted to journal articles published between 2018 and 2023 and only in journal article format.

The Selection Standards

The sources for this article were Scopus and Web of Science. The 50 documents among the results appeared to be duplicates (Figure 1 depicts the review procedure). Five inclusion criteria were used in this study to evaluate abstracts and collect relevant studies. The processed articles required journal publication. The focus of the research articles was elasticity, oscillation, and their derivatives. Quantitative, qualitative, and mixed research methodologies were utilized for this study. It required the study of elasticity and oscillation concepts in any subject. The investigation has taken place within the realms of science education and applied science programs. Methods of data analysis include things like examining the article's identification, gathering information on the educational level of respondents, synthesizing the many methodologies used, and measuring factors.

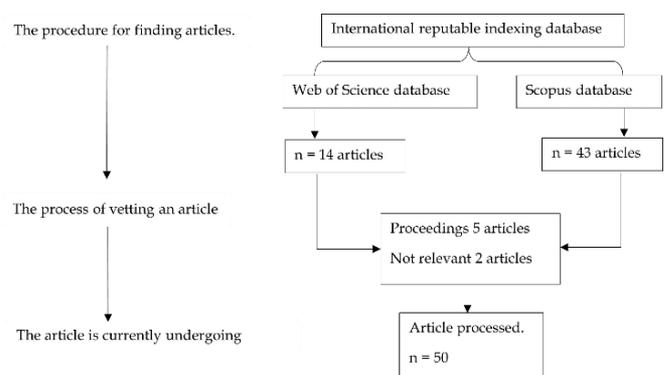


Figure 1. Process of documents review

Result and Discussion

This scholarly article offers a comprehensive and enlightening exposition of the investigation that was featured in the antecedent edition of Fundamental

Physics 1 concerning the domains of elasticity and oscillation. The discourse encompasses an inquiry into ascertaining the presence of quantifiable elements in interrelated research, the academic qualifications of the subjects involved, and the correlation between pedagogical approaches and academic accomplishment.

The investigation of the correlation between different modes of instruction and the educational attainment level of participants can lead to the achievement of this objective. Moreover, this synopsis can function as a point of citation for subsequent scholars in the field of physics education who aim to augment the existing knowledge in that specific domain.

This literature review presents a sequential discussion of each study subject. Upon completion of this task, it serves to guarantee that the results will be communicated in a comprehensive and exhaustive fashion.

The Measurement of the Research Variables

The present response incorporates all the facets that have been scrutinized in prior research endeavors. The aforementioned aspects encompass variables that are amenable to quantification, variables that are subject to interpretation and understanding, and factors that can be examined through the utilization of both of these methodologies. The research factors that were looked at for this study are laid out in table 1, which shows their distribution.

Table 1. Distribution of the Research Variables

Research Variables	Frequency
Conceptual understanding	10
Learning achievement	6
Students interest	3
Inquiry performance	3
Creative thinking	2
Students' perception	2
Mental model	2
Students' curiosity	2
Self-efficacy	2
Students' epistemological	2
Students' attitude	1
Students' participation	1
Students' justification	1
Self-Regulation	1
Conceptual change	1

The conceptual knowledge variable is the one that receives the greatest attention from researchers, as is seen from Table 1. This is the case for both elasticity and oscillation, respectively. The learning outcomes come next, followed by the interest of the students, and then the performance of the inquiry rounds off the process. The average number of years of schooling held by those who took part in the research.

The Educational Level of the Respondents Involved in the Research

The participants of this survey were sourced from a heterogeneous array of educational environments, a factor that was mirrored in their respective answers. The data exhibits a wide spectrum of educational attainment, spanning from primary education to doctoral qualifications. According to the findings of this inquiry, the teaching profession was represented in the respondents of three studies: two studies had actual teachers, and the third study had lecturers as its respondents. Table 2 provide any further information the fact that may require.

Table 2. Educational Level of Respondents

Educational Level	Frequency
Elementary School Student	1
Junior High School Student	2
Secondary School Student	7
High School Student	12
Undergraduate Student	9
Postgraduate Student	1
Preservice Teacher	1
Non Participants research	17

According to the information presented in Table 2, the vast majority of responders are students currently enrolled in high schools (12 articles), followed by students currently enrolled in universities (9 articles).

The Characteristics of the Instructional Methods Associated with the Educational Level of the Research Respondents

The characteristics of the process of learning shift depending on the amount of education that one is receiving. Several different theories of how children grow and learn have an impact on this phenomenon. In conclusion, Table 3 illustrates the wide variety of educational pursuits that are pursued by the various types of educational institutions.

The progression from tangible to abstract learning may be seen in Table 3, which depicts a trend in learning patterns from elementary school to higher education. When it comes to helping youngsters in elementary school visualize concepts and get a better grasp on what they're learning, the usage of simulations is extremely helpful (Cervetti et al., 2012; Widiana et al., 2021). When compared to pupils in primary school, however, college students are more capable of abstracting concepts and have had a greater variety of learning experiences. This results in a large reduction in the utilization of simulations in higher education (Alvarez, 2021; De Oliveira Almeida et al., 2018). Self-directed learning is often emphasized throughout the learning process in higher education; this type of learning frequently

includes direct experimentation or the performance of field and laboratory research.

Table 3. Relationship between Educational Level and Instructional Methods

Educational Level	Instructional Method
Elementary School	Phet Simulations
Junior High School	Inquiry Learning, Simulations Smartphone-based learning, Tablet based-learning, simulations,
Secondary School	Inquiry Learning, Physical Laboratory, Virtual Laboratory Problem based learning,
High School	Investigation, Laboratory, Board-games, Game Physics Playground, U-Physics App Project-Based Learning,
Undergraduate	Neurodidactic, smartphone experimental-based learning, computer -based MATLAB, concept-context map, Online Laboratory, Physical Laboratory
Postgraduate	Experimental activity

There are connections between Piaget's theory of cognitive development and the age category of elementary school children. During the concrete operations stage, which typically occurs between the ages of 7 and 11, children begin to develop logical reasoning skills and are able to comprehend cause-and-effect relationships, according to Piaget (Sibgatullin et al., 2022). An approach that integrates Piaget's theory with cognitive learning theory can be used to encourage active and constructive learning among students. Students can engage in building their understanding of concepts as well as their critical thinking skills throughout exercises that involve inquiry, discussion in groups, and problem-solving, for example (Zandvakili et al., 2018).

In addition, Piaget's theory implies that intellectual ability constructs alongside grow older, indicating the fact that an instructional method that fuses Piaget's philosophy and cognitive learning theory might help children in developing ability to reason logically and a comprehension of connections between causes and effects (Sibgatullin et al., 2022). Children will gradually develop a wider range of different educational preferences, enabling for the inclusion of technological instruments and tutoring of students in junior high school on how to use such instruments within the framework of learning (Lui et al., 2020).

Albert Bandura's social learning theory is a relevant learning theory for middle school students. According to this theory, infants learn by observing and imitating the behaviors of others in their social environment (A. Widodo, 2021). Teachers can use positive models or

examples to teach new concepts in the context of learning. Learning through collaboration, throughout where learners collaborate with other groups to address problems and provide assistance to other learners in achieving their educational goals, is additionally a successful technique.

High school and college have distinguishing traits that set them apart from one another. Lev Vygotsky's social constructivism is a relevant learning theory that comes into play when one reaches the levels of education that are seen in high schools and universities (Darling-Hammond et al., 2020). This strategy places a significant emphasis on the crucial role of relating to others and working together in work throughout learning (Han et al., 2021; Sáiz-Manzanares, 2021). Within the framework of conventional schooling, practices such as learning through projects, discussions in groups, and collaborative effort towards the finishing of group assignments may encourage the gaining of understanding as well as the formation of social abilities (Hamengkubuwono et al., 2022; Han et al., 2021; Sáiz-Manzanares, 2021; Widodo et al., 2020). Additionally, the use of educational equipment that facilitates interpersonal interaction and collaboration-based learning, such as virtual classrooms or discussion boards, can support the implementation of theory of social constructivism inside the context of higher education (Schmid et al., 2022).

Conclusion

Based on the examined review, it can be concluded that conceptual understanding and academic achievement are the most researched variables. In terms of level of education, secondary school students are the respondents most commonly targeted in research sampling. In addition, the complexity of instructional media utilized demonstrates the relationship between educational levels and teaching methods. Elementary school teaching methods tend to be straightforward and teacher-led, whereas university students are more independent and capable of experimenting on their own. This research is limited by the small number of articles involved and the fact that the new research topics cover only a tiny percentage of the subject of Fundamental Physics 1, allowing other aspects unexplored in the systematic review of articles completely.

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Author Contributions

Yudi Kurniawan; conceptualization, writing original draft preparation, Andi Suhandi; supervision and Achmad Samsudin.; methodology.

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Conflicts of Interest

The authors declare no conflict of interest.

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