Web of Technology: Multidimensional Research Journal
webofjournals.com/index.php/4

Volume 3, Issue 12 December 2025 **ISSN (E):** 2938-3757

METHODOLOGY OF TEACHING THE SECTION ON TENSILE AND COMPRESSIVE DEFORMATION USING DIGITAL SOFTWARE

B. K. Mukhamedsaidov
Professor-Teacher of the Faculty of Professional Education and Arts of the
National Pedagogical University of Uzbekistan named after Nizami

Muhitdinova Nodira Zayniddin qizi
National Pedagogical University of Uzbekistan named after Nizami Faculty of
Professional Education and Arts 2nd year Technological Education Direction

Abstract

The contemporary landscape of education in technical and engineering disciplines is marked by an increasing reliance on digital programs to facilitate a deeper and more comprehensive understanding of theoretical and practical aspects of the subject matter. In structural mechanics and material sciences, the concepts of tensile and compressive deformation are foundational topics that require not only conceptual clarity but also a heightened ability to analyze and visualize stress-strain behavior under different loading conditions. The use of digital programs in teaching these concepts enhances pedagogical effectiveness and student engagement by offering dynamic, interactive, and precise methods for illustration and analysis.

Keywords: Digital program, tensile deformation, compressive deformation, teaching methodology, educational software, structural mechanics, material science, simulation, interactive learning, stress-strain analysis.

Introduction

The process of teaching the section on tensile and compressive deformation benefits markedly from a blended methodology that integrates theoretical instruction with practical application through digital tools. The digital programs utilized in this context are selected based on several criteria: their appropriateness for visualizing material behavior, their capacity for simulating multiple loading scenarios, and their user-friendliness for both instructors and students. The teaching methodology commences with a clear exposition of the fundamental theoretical principles governing tensile and compressive stresses, strains, Young's modulus, yield points, and ultimate strengths. Once these foundations have been established, the instructional focus shifts to the deployment of digital programs for more interactive and practical exploration. An integral part of this methodology involves the gradual introduction of students to the relevant software environment. Instructors begin by demonstrating the core features of the chosen program, ensuring that students become competent in navigating the interface, inputting material properties, defining geometry, and applying boundary and load conditions. The didactic advantage lies in the ability of the software to instantly display the consequences of various inputs, making abstract concepts concrete and observable.

MATERIALS AND METHODS

During the course of the instructional sequence, students are encouraged to construct digital models of specimens subjected to both tensile and compressive loading. The manipulation of digital models allows learners to observe, in real-time, the deformations and stress distributions that take place within materials. The iterative process of altering variables such as force magnitude, cross-sectional area, and material type, coupled with immediate visual feedback, facilitates a much clearer grasp of how theoretical principles manifest in actual mechanical behavior. The use of digital programs also enables the comprehensive introduction of concepts such as stress-strain curves, elastic and plastic deformation regions, and the impact of various factors on material performance. Through graphical displays and real-time plotting functions, students can precisely track and analyze the intervals of elastic and plastic deformation, the proportional limit, and the point of failure. This clarity, achieved through visual aids and numerical data, is seldom replicated in purely textbook-based instruction. As students manipulate variables and parameters within digital simulations, they develop an intuitive sense for the interplay between theory and real-world behavior [1].

Assessment within this digital-enhanced teaching methodology is structured to reinforce both theoretical and practical competencies. Students are not only required to demonstrate their understanding of the basic equations and laws governing tensile and compressive deformation but are also tasked with performing simulations, interpreting results, and communicating their findings in a scientifically rigorous manner. This comprehensive approach ensures that learning moves beyond rote memorization and fosters genuine problem-solving skills [2].

RESULTS AND DISCUSSION

The methodology promotes collaborative learning as well, as students often work in pairs or small groups when carrying out digital simulations. This collaborative environment fosters communication, critical thinking, and peer learning, as students explain their reasoning and share insights about the variations in simulation outcomes. The instructor's role in such a setting is that of a facilitator and guide, providing targeted feedback and ensuring that each student achieves mastery of not only the software but also the underlying material behavior. Furthermore, frequent integration of formative feedback is a notable dimension of this approach. Instructors monitor students' progress during simulations, offering suggestions and clarifications to solidify understanding. Digital platforms often allow for the collection and analysis of student inputs and results, which can serve as a valuable diagnostic tool for identifying difficulties and knowledge gaps. By tailoring additional instruction to address these gaps, the methodology ensures that no student is left behind in mastering the critical concepts of tensile and compressive deformation [3].

A key pedagogical strength of using digital programs in teaching tensile and compressive deformation is the opportunity it provides for self-paced learning. Students can revisit simulations multiple times, alter conditions, and observe results at their own pace, enabling differentiated instruction that caters to individual learning styles and speeds. This flexibility encourages student agency and responsibility for their own learning, factors known to enhance long-term retention and understanding. It is also worth noting that the digital approach paves the way for the incorporation of advanced topics and further exploration. Once students become adept at standard simulations, instructors can introduce more complex scenarios such as non-linear material responses, temperature effects, and multi-axial loading conditions. The digital platform thus becomes a springboard for advanced study and deeper inquiry, encouraging students to push beyond the basics and engage with the more intricate facets of material behavior [4].

In evaluating the efficacy of this methodology, it is observable that students exhibit greater confidence in applying theoretical knowledge to practice. The regular use of digital simulations demystifies the often-intimidating mathematical formulations and connects abstract concepts to tangible outcomes. Students consistently report increased engagement and motivation to learn; many express appreciation for the opportunity to “see” and “test” material responses in a manner that is immediate and impactful. Another critical benefit concerns the development of technical competence with software tools that are standard in the engineering industry. The experience of working with these programs in an academic setting not only reinforces understanding of tensile and compressive deformation but also prepares students for professional environments where digital analysis is the norm. Familiarity with such platforms enhances their employability and equips them with valuable analytical skills.

The instructional methodology also emphasizes the importance of critical interpretation of digital outputs. Students are guided to understand not only how to operate the programs but also how to critically evaluate the validity and limitations of simulation results. Instructors encourage skepticism and inquiry, prompting learners to question unusual outcomes, check for convergence errors, and reflect on the appropriateness of the modeling assumptions made. This attention to critical thinking ensures that students do not become passive users of technology but are empowered as thoughtful, discerning engineers. The role of consistency and structured practice in this teaching methodology should also be highlighted. Regular assignments and lab sessions utilizing digital programs ensure continuous engagement with both theory and practice. Over time, as students repeatedly encounter variations of tensile and compressive deformation scenarios, their fluency and confidence in managing new problems increase substantially. A further dimension of the methodology addresses interdisciplinary integration. While the focus remains on tensile and compressive deformation, students are periodically encouraged to contextualize their learning within broader domains such as structural design, materials engineering, and applied mechanics. The digital programs used are often capable of simulating additional phenomena such as buckling, fracture, and time-dependent deformation, thereby fostering an understanding of how the principles learned are instrumental in a wider engineering context [5].

Ensuring the accessibility and inclusiveness of digital instruction forms yet another pillar of this methodology. Efforts are made to provide adequate access to computers and software to all students, and to accommodate varying levels of prior experience with digital tools. Supplemental materials and support are made available to help every student reach proficiency, fostering a learning environment characterized by equity and support. From the perspective of curriculum development, the integrative approach outlined here requires thoughtful planning and ongoing evaluation. Instructors continuously review and update digital exercises to align with the latest advancements in software capabilities and material science. Constructive feedback from students is solicited and incorporated, ensuring the teaching methodology remains dynamic and responsive. The success of this methodology relies ultimately on the commitment of instructors to facilitate a supportive, interactive, and technologically enriched learning environment. By combining rigorous theoretical instruction with the immersive, experimental power of digital programs, the approach cultivates not only a mastery of tensile and compressive deformation, but an enthusiasm for lifelong learning and professional growth.

CONCLUSION

In conclusion, the methodology of teaching the section on tensile and compressive deformation using digital programs represents a significant evolution in engineering education. Through a careful integration of theory, practical simulation, collaborative learning, and critical evaluation, students are empowered to understand and apply fundamental concepts in a meaningful and lasting way. The interactivity and immediacy of digital tools bridge the gap between abstract principles and real-world application, preparing students for success both academically and professionally. Looking forward, the continued refinement and expansion of such methodologies will ensure that engineering education remains responsive to the needs of both students and the ever-changing technological landscape. This teaching approach not only imparts essential knowledge and skills but also instills an appreciation for innovation, critical inquiry, and the practical relevance of academic study.

REFERENCES

1. Abdullayev, M.A., & Ergashev, B.S. (2020). "Innovative Approaches to Teaching Mechanics Lessons Based on Digital Technologies." Uzbekistan Journal of Engineering Pedagogy, 3(2), 85-92.
2. Azamova, K.A. (2018). "The Effectiveness of Using Electronic Resources in Teaching Materials Science." Higher Education Issues, 2(14), 17-21.
3. Ganieva, D.M. (2019). "Teaching Tensile and Compressive Strength of Materials through Interactive Programs." Problem-based Lesson, 4(24), 30-35.
4. Hashimov, S.K., & Qosimov, A.Kh. (2021). "Modern Teaching Methods for Engineering Subjects." Uzbekistan Pedagogical Bulletin, 1(19), 67-73.
5. Jabborov, S.K. (2022). "Studying Mechanical Stress and Deformation via Digital Educational Tools." Innovative Pedagogy, 6(31), 56-61.
6. Murodov, Sh.M. (2019). "Simulation of Tensile–Compression Experiments in Digital Programs." Young Scholars' Research, 2(9), 40-45.
7. Nazarova, N.O. (2018). "Teaching Engineering Subjects Using Information Technologies." Journal of Educational Innovations, 1(6), 12-18.