International Journal of Information and Communication Technology Education
Volume 17 • Issue 4

Application of Pedagogical Information Technologies in the Educational Process of Universities in Uzbekistan

Bazar Dzhumaevich Ulugov, Tashkent State Technical University Named After Islam Karimov, Termez Branch, Uzbekistan
Shavkat Urolovich Kasimov, Tashkent State Pedagogical University Named After Nizami, Termez Branch, Uzbekistan

ABSTRACT

The article is devoted to the formation of students' information competence in the study of technical mechanics. This document provides a systematic review of models and methodologies that combine modern teaching technologies, innovations, and applied programs in technical education. The article shows the relevance of the development of students of applied programs that contribute to improving the readiness of students for engineering activities. This paper gives an example of using the application module of the AutoFEM Analysis add-on application integrated into the AutoCAD software package to calculate one of the problems of technical mechanics.

KEYWORDS

Application Program, AutoCAD, Educational Process, ICT, Information Competence, Material Resistance, PIT, Technical Mechanics

1.0 INTRODUCTION

Currently, a very important factor in human life is higher education. An important component in the formation of information competence is the ability to use ready-made software products in their professional activities. The primary goal of modern engineering education is that it is necessary to prepare a competitive personality. In most parts of the world, innovative engineering education is now on the path of development. Unfortunately, not every university graduate is a competitive person because it is not enough to have a high level of education and professional skills. It is also important at the same time to have psychological training and the ability to realize the tasks. Maintaining a high level of education is the main factor in social and economic progress and the most important condition for the sustainable development of any state, and this requires the improvement of the entire system of higher education (Bolotin and Bakayev, 2017a,b; Moreira, Gonçalves, et al., 2017; Aristizábal et al., 2017). Technical mechanics is a science that allows the widest and most diverse application of various elements of information provision in the learning process. One such tool is application software such as AutoCAD (2016; Ulugov Bozor, 2018). There are many programs equipped with application modules designed to solve the problems of solid mechanics. As an example, we consider the solution of problems of discipline technical mechanics using the software package AutoCAD. The proposed program includes several application modules, of which AutoCAD is of most interest to us (Megri, Hamoush, and Stallings, 2018; Almerich et al., 2020; Megri et al., 2018). Auto FEM makes it possible to perform design iterations quickly and inexpensively on computer

DOI: 10.4018/IJICTE.20211001.oa15

models instead of costly physical prototypes. Regardless of industry application, from aerospace to machine-tool, Auto FEM Analysis provides significant product quality benefits, enabling engineers to go beyond hand calculations and verify proof of concept for their designs. Auto FEM Analysis enables designers to meet functional design specifications, but not waste materials, helping to reduce the cost of production, shipping, and packaging (Görz et al., 2017; Raji, 2017; Han et al., 2017). The introduction of new technologies, such as finite element modeling, already at the initial stage of training, not only provides a powerful tool for visualizing mechanical processes but also increases students' interest in working in the technical field. As a computational experiment, it was proposed to carry out finite element modeling to calculate the stress-strain state of structural elements based on the AutoCAD program (Gros, Kinshuk, and Maina, 2016; Poitras et al., 2017; Hew and Kadir, 2016). Currently, this program is widely used in the educational process of higher educational institutions in the Republic of Uzbekistan. In particular, depending on the direction of preparation, this program can be studied in various disciplines: computer science, engineering graphics, and computer design. To study technical mechanics, students already have the skills to build three-dimensional models. Even if such skills are absent, this is not a significant obstacle to laboratory work using the program, since the AutoCAD program has a standard graphical user interface combined with many Windows applications, which significantly reduces the time to master the program. Technical mechanics is the course that develops creativity and analysis ability (Revilla-Cuesta et al., 2020). However, if students do not realize the physical meaning of the task and the nature of the given conditions, then they will not be able to evaluate the results of computer calculations. Therefore, before proceeding with the implementation of laboratory work, it is necessary to study the theory and perform computational and graphic tasks for each section of the discipline passed. The implementation of laboratory work is a logical continuation of the development and consolidation of the studied sections of the discipline technical mechanics. In this regard, we list the main tasks of a computational experiment using an application program:

- formation of a visual representation of the stress-strain state under various types of loads;
- demonstration of the benefits of using application programs in solving problems of optimizing structural elements.
- verification of the reliability of the results obtained using the analytical calculation method.

To increase the effectiveness of the educational process, teachers are constantly looking for new ways and means (Moreira, Maria Joao Ferreira, et al., 2017; Bolotin and Bakayev, 2018). Currently, the trend of a personality-oriented approach to learning is aimed at transferring training to a subjective basis with a focus on personal self-development (Osipov etc., 2016; Suleman 2018). These goals can be achieved through a specially organized educational process, which, while preserving its basic structure (content, means, methods, training criteria) should be structured in such a way that innovative educational technologies are used in the educational process:

- a set of methods and tools to achieve the desired result;
- a method for converting this into necessary;
- method of production.

Today, pedagogical technology is understood as a consistent system of actions of a teacher associated with the solution of pedagogical tasks, or as a systematic and consistent implementation in practice of a pre-designed pedagogical process (Mouza et al., 2017; Canbazoglu Bilici, Guzey, and Yamak, 2016)). Thus, pedagogical technology is a strictly scientific design and accurate reproduction of pedagogical actions that guarantee success. Teaching technologies, in contrast to teaching methods, involve the development of content and methods for organizing the activities of students themselves

(Heitink et al., 2017; Bakaev, Bolotin, and Aganov, 2016). They require diagnostic targeting and objective quality control of the learning process, aimed at developing the personality of students in general. There are many types of pedagogical technologies that can be distinguished for various reasons. In didactics, three main groups of technologies:

1. The technology of explanatory and illustrated training, the essence of which is to inform, educate students and organize their reproductive activities to develop both general educational and special (subject) skills.
2. The technology of personality-oriented learning aimed at translating learning on a subjective basis with a focus on personal self-development.
3. The technology of developing education, which is based on a learning method aimed at incorporating the internal mechanisms of a student's personal development.

The group of a personality-oriented approach to teaching includes the technology of multilevel (differentiated) training, collective mutual learning, the technology of complete assimilation of knowledge, the technology of modular training, etc. (Ramirez, Collazos, and Moreira, 2018; Pondee, Premthaisong, and Srisawasdi, 2017). These technologies allow you to take into account the individual characteristics of students, and improve the methods of interaction between teacher and student. In our opinion, the technology of collective mutual learning is the most adapted to the specifics of the technical education process (Asset et al., 2015).

More than a dozen fundamental studies, both in the general theory of pedagogy and in private teaching methods of individual subjects, are devoted to teaching methods, which, to a large extent, determine the effectiveness of academic work in a technical university (Ulugov Bazar Dzhumaevich, 2020; Chai, Hwee Ling Koh, and Teo, 2019). However, despite the variety of pedagogical research, the problem of teaching methods remains relevant. Until now, attempts have been made by theoreticians and educators to create a scientific system of teaching methods and develop technological approaches to their use in higher education. The word method translated from Greek means - research, way to achieve the goal (Drossel, Eickelmann, and Gerick, 2017; Cuhadar, 2018). The etymology of this word also affects its interpretation as a scientific category. Therefore, for example, in a philosophical encyclopedic dictionary, a method in the most general sense is understood as a way to achieve a specific goal, a set of techniques or operations for the practical or theoretical development of reality. In modern pedagogy, there are three main groups of methods:

1. Teaching methods
2. Methods of education
3. Methods of pedagogical research

The most ambiguous in the definitions and, at the same time, the practical relevance teaching methods that act as a complex, multidimensional and many-quality education, interconnected with other categories of didactics (goals, content, means used, forms of organization and results) (Dong et al., 2020; Eickelmann, Gerick, and Koop, 2017).

Analysis of the scientific, popular scientific and methodological literature - on the problem of the informatization of higher professional education, published over the past decade, it can be argued that the second approach, which can conditionally be called technocratic, is prevailing today. All manuals, programs, concepts, guidelines and educational standards related to the provision of educational information, prepared and published by the Ministry of Education of Uzbekistan, have been reliably approved in this regard. This has an explanation. The rapid development of computer hardware and software in the 80 - the 90s of the 20th century led to the need for their active implementation in the educational process of universities. However, the development, and even more so their applied use in pedagogical practice, was not possible at this time to all representatives of the university intelligentsia. Leadership was seized by representatives of technical sciences with appropriate training and qualifications. Representatives of the humanities, whose subject area turned out to be poorly structured, poorly programmable, and hence informatization in the broad sense of its meaning, are behind. Unfortunately, we have to admit that these trends continue to persist to the present. In this case, it is advisable to talk only about the automation of certain aspects of the learning process, the transfer of information from paper to computer, expanding visualization capabilities of educational information presented to students, etc (Munyengabe etc., 2017; Blackwell, Lauricella, Wartella, 2016).

From didactics, we can talk about information technology training only if it:

- satisfies the main features of the technological development of training (preliminary design, diagnostic targeting, system integrity, reproducibility, etc.);
- solves problems that were not previously theoretically or practically solved in the educational process;
- as a means of collecting, processing, storing and presenting educational information to the student, an integrated set of computer and other information tools is used, the choice or development of which is determined by the goals and didactic tasks solved by the military teacher.

To implement these features, methods and technologies of artificial intelligence are applied. For educational purposes, information technology is proposed to be divided into the following two types:

- training in the use of specific methods in practice, obtaining and systematizing various evidence;
- training in the analysis of information, its systematization, creativity, research methodology.

The group of educational information technologies (PIT) using engineering graphics programs includes:

- educational audio and video materials;
- Internet resources on the subject and direction of the educational process;
- Electronic textbooks, teaching aids and teaching materials;
- Interactive tests, etc.
- Computer engineering programs such as «AutoFEM Analysis add-on application is integrated with AutoCAD»

By the nature of the management of cognitive activity of students when working with pedagogical software products, they are divided into linear, branched, branching, as well as programs containing all of these characteristics – combined.

2.0 STATEMENT OF PROBLEM:

The scientific novelty is determined by the practice-oriented empirical basis of research. The relevance lies in the growing social and economic importance of education as a strategic resource for the development of the individual, society and the state. To improve the quality of training of specialists, the level of development of the educational-material base of education is essential (Moreira, Maria João Ferreira, et al., 2017). It makes it possible to organize educational and cognitive activities of students at a higher level, to increase the intensity of teachers' work and students' interest in the process of obtaining the necessary education (Ríordáin, Johnston, and Walshe 2016; Bakayev et al., 2018). The subject of the study is the impact of project activities on the motivation of students to study technical mechanics. The problem posed in this article is the development of the motivational sphere of learning through the design and research activities of students at technical universities.

3.0 PURPOSE OF STUDY

The purpose of this study includes the following to:

1. Prove that design and research activities contribute to the development of students' motivation to learn.
2. Solving the problem on the subject technical mechanics in the AutoCAD program, developing strategic directions for improving the graphic education of students of a technical university.
3. Research of the effectiveness of the use of modern technologies and innovations using engineering graphics software in the process of teaching students of a technical university.
4. Analysis of the solution of problems in the subject technical mechanics using computer programs AutoCAD, assessment of the effectiveness of design and research work.
5. The solution of the problem technical mechanics plot in engineering graphics.

4.0 QUESTIONS/HYPOTHESIS

We, the researchers, identified the following as research questions:

1. What is the level of effectiveness of materials resistance education in the development of engineering skills in university students?
2. What is the opinion of teachers about the role of materials resistance education in the development of society?
3. What are the challenges facing effective teaching of resistance learning in universities?

5.0 RESEARCH METHODOLOGY

5.1 Research Designs

The research design was based on a descriptive survey design since the opinions of respondents were sought.

5.2 Population & Sample

By the ethics of organizing and conducting the research, the procedure of participation of 90 first-year students and 8 teachers of professional departments in the experiment has been considered and discussed at the meetings of the professional chairs. The discussion procedure was recorded in the minutes at the meetings of the Department of General Professional Sciences of Tashkent State Technical University named after Islam Karimov (Minutes Nº 3 of September 3, 2018). With this approach, respondents agreed to work in control and experimental groups, and the teachers of these educational institutions to work as experiments.

5.3 Instrumentation Procedure for data Collection

The instrument used to collect the data was a questionnaire developed by the researcher based on a 4-point modified Likert scale: SA = strongly agree (4), A = agree (3), D = disagree (2) and SD = strongly disagree ... (1). The questionnaire consisted of four sections from A to D. Section A asked for information about AutoCAD modeling and whether to help understand the basic hands-on exercises; Section B asked for information on whether computer modeling provides an additional tool for learning new knowledge; Section C asks participants for views on whether computational modeling can help improve understanding of experimental work, and section D asks participants for views on whether computational modeling can replace a practical experiment. The instrument was approved by three (3) testing and measurement experts from the Termez branch of the Islam Karimov Tashkent State

Technical University, Termez, Uzbekistan. A pilot study was conducted with twenty (8) teachers not involved in the study and a reliability factor of 0.82 was obtained using the Cronbach alpha method.

5.4 The Procedure of Data Analysis

For the administration of the questionnaire, the researchers and two research assistants visited the respondents. A total of 90 copies of questionnaires were administered to the teachers in the selected schools. Out of which 88 were properly filled and retrieved, representing ninety-eight Percent (98.2%) of the total respondents. We studied the level of mastering the subject of Technical Mechanics by 90 students in groups 8-18, 9-18, and 10-18 studying at the Termez branch of the Tashkent State Technical University named after Islam Karimov. Levels of mastering the lessons with the help of traditional and pedagogical information technologies were compared and evaluated. We used the following survey to collect data:

- The AutoCAD simulation helped you to understand basic practical training?
- The computer simulation provides you with an additional tool to explore new knowledge?
- The computer simulation helped to enhance the understanding of experimental work?
- Computational simulation can replace the hands-on experiment?

As an example, we consider the implementation of laboratory work on the topic "Investigation of the stress-strain state of a stepped beam during bending and tension (compression)." Before embarking on a computational experiment, the student must perform an analytical calculation of the stepped beam, determine the internal forces, stresses, strains, plot and determine the dimensions of the cross-sections. The admission to the laboratory work is the completed computational and graphic task, the results of which are used as source data for the computational experiment. The result of the analytical solution of the problem will be the diagrams of internal efforts, stresses and deformations. Successful completion of this work indicates that the student is familiar with the methodology for determining internal force factors, has familiarized himself with the basic terminology on the topic being studied and can begin to calculate the task on the computer. Static structural analysis using the program consists of several stages (Sugimoto et al. 2016; Shahnavaz et al. 2020). Consider the main stages of calculating the strength of the beam.

5.4.1 Static Analysis

Static Analysis allows calculating the state of stresses and strains in a structure
under the impact of constant in time forces applied to the model. It is also possible to account for stresses building up due to thermal material expansion/contraction, or for structural deformations introduced by known displacements. By using the "Static analysis" module, the user can evaluate the strength of a structure developed by him, with respect to admissible stresses, identify the most vulnerable parts of the structure and introduce the necessary changes, optimize the design (Table-1).

AutoFEM Analysis enables designers to meet functional design specifications but not waste materials helping to reduce the cost of production, shipping, and packaging. All calculations rely on the finite element method (FEM). At the same time, an associative relationship is maintained between the three-dimensional model of a part and the finite element model used in calculations. Parametric notifications of the original solid model are automatically propagated into the meshed finite element model. The following table shows the properties (elastic modulus, poisson's ratio, sher modulus, thermal conductivity, thermal expansion coefficient, and mass density)of the material selected for the model (Table-2).

AutoFEM Analysis provides easy-to-use yet powerful design analysis tools for designers and engineers that help them improve design quality, avoid field failures, reduce material costs, and shorten time-to-market. AutoFEM Analysis add-on application is integrated with AutoCAD and

Table 1. Settings of Study and Model.

Settigs of Study	
Name of study	Study 1
Commentary	Test 1
Author	Ulugov Bazar Dzhumaevich
Company	Termez Branch of TSTU
Date	04.04.2020 12:57:54
File name	c:/users/Documents/draw3.dwg
Settings of the calculation	
Stabilize the unfixed model	Not used
Model	
Solid 1	1.4000 (X6Cr13)

Table 2. Materials.

Materials	
1.4000 (X6Cr13)	
Elastic modulus (E)	2.2E+11A
Poisson's ratio (NU)	0.28
Shear moduls (G)	7.9E+10Pa
Thermal conductivity (K)	14W (m*K)
Thermal expansion coefficient (ALPHA)	1.1E-0.5m/K
Mass density (RHO)	7700 kg/m^3
Yield limit (SIGMAYIELD)	2.3E-0.8Pa
Tensile strength (SIGMAXT)	4E+0.8Pa
Compressive (SIGMAXC)	
Specific heat (C)	440J(kg*K)

performs static, frequency, buckling and thermal analysis. AutoFEM makes it possible to perform design iterations quickly and inexpensively on computer models instead of costly physical prototypes. The following table shows (type of finite element, number of elements, and number of nodes) FEA Mesh Properties (Table-3).

AutoFEM Analysis offers a wide spectrum of powerful tools to help engineers to perform virtual testing and analysis for predicting the physical behaviour under various loading conditions. Fully integrated with AutoCAD modelling software AutoFEM Analysis allows you to test a design and run multiple iterations without ever leaving AutoCAD. The following table shows (type of loading, geometry, direction, load) Boundary Conditions (Table-4).

AutoFEM utilizes the AutoCAD Model Tree, Properties dialogue boxes, command and menu structure, and many of the same mouse and keyboard commands, so anyone who can design a part in AutoCAD can analyse it without having to learn a new interface. Plus, since AutoFEM uses

Table 3. FEA Mesh Properties

FEA Mesh Properties	
Mesh 1	
Type of finite element	Quadratic tetrahedron
Number of elements	2587
Number of nodes	5314

Table 4. Boundary Conditions

Boundary Conditions	
Fixture 1	
Type of loading	Total Fixture
Geometry	Face 1;
Pressure 1	
Type of loading	Pressure by area
Geometry	Face 2; Face 3; Face 4; Face 5; Face 6; Face7;
Direction	Normal to surface
Load	150000 Pa
Force 1	
Type of loading	Force per square
Geometry	Face 8;
Direction	Normal to surface
Load	100000 N

native AutoCAD geometry, design changes made in a model are automatically updated for analysis calculations.The following table shows (type of setting, coordinates) Sensors (Table-5).

Regardless of industry application, from aerospace to machine-tool, AutoFEM Analysis provides significant product quality benefits, enabling engineers to go beyond hand calculations and verify proof of concept for their designs. In the following figure, we get the result obtained (Displacement, magnitude) by the program (Figure 1).

Quick and inexpensive analysis often reveals non-intuitive solutions and benefits engineers by providing them with a better understanding of product characteristics. In the following figure, we get the result obtained (Equivalent Stress) by the program (Figure 2).

Field failures can lead to costly recalls and liability issues. AutoFEM Analysis shows how a model will perform under real-world conditions before it is built. The ability to perform quick and inexpensive design iterations prior to releasing the design has become a critical competitive advantage. In the following figure, we get the result obtained (The factor of safety by equivalent stress) by the program (Figure 3).

5.5 Method(s) of Data Analysis

Data collected was analyzed using descriptive statistics for the research questions while the hypothesis was tested using independent sample t-test statistics. Mean scores were used in answering the research

Table 5. Sensors

Sensors	
Group of sensors 1-1	
Type of setting	3D Point
Coordinates	X: 270.062, Y: 440.904, Z: 13
Group of sensors 1-2	
Type of setting	3D Point
Coordinates	X: 287.562, Y: 433.404, Z: 17.25
Group of sensors 1-3	
Type of setting	3D Point
Coordinates	X: 305.062, Y: 425.904, Z: 21.5
Group of sensors 1-4	
Type of setting	3D Point
Coordinates	X: 322.562, Y: 418.404, Z: 25.75
Group of sensors 1-2	
Type of setting	3D Point
Coordinates	X: 340.062, Y: 410.904, Z: 30

Figure 1. Displacement, the magnitude

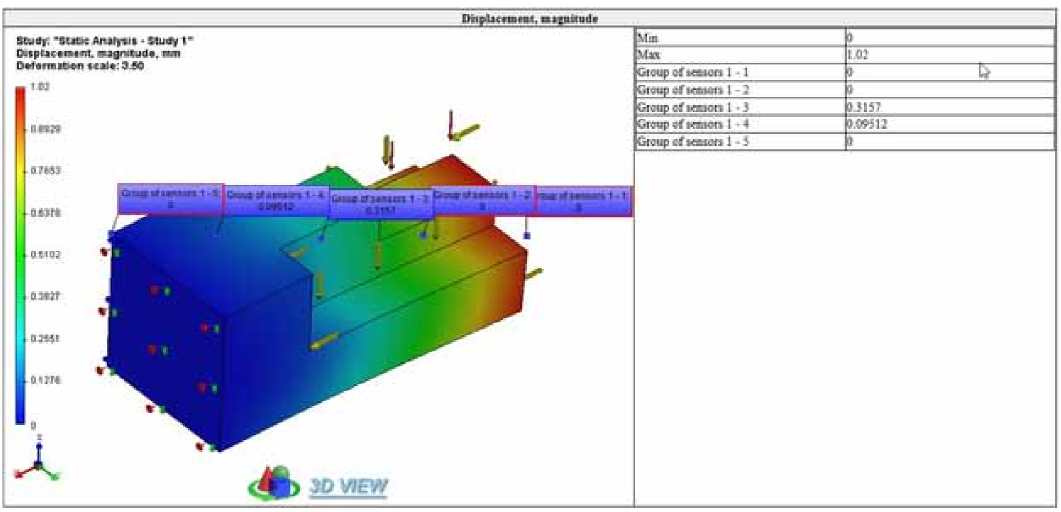


Figure 2. Equivalent Stress.

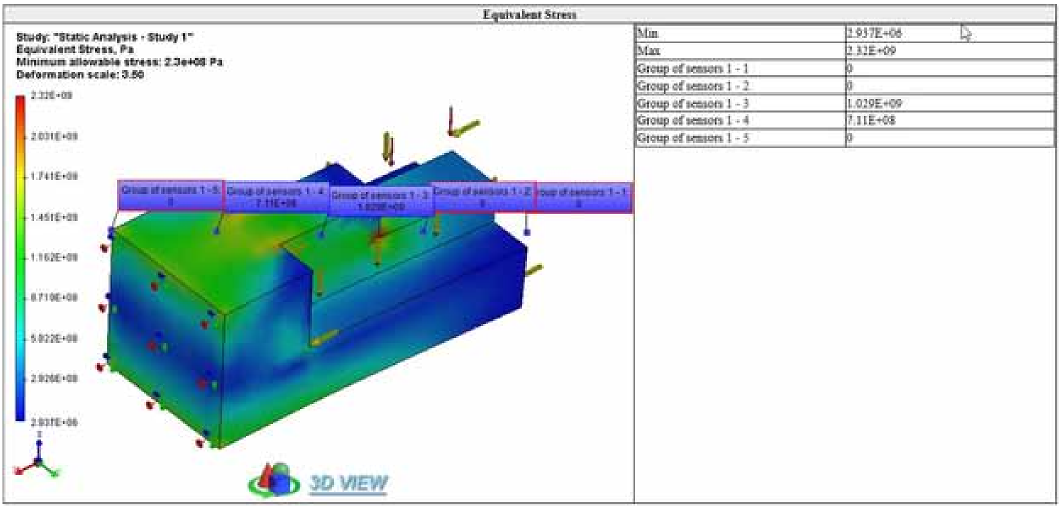
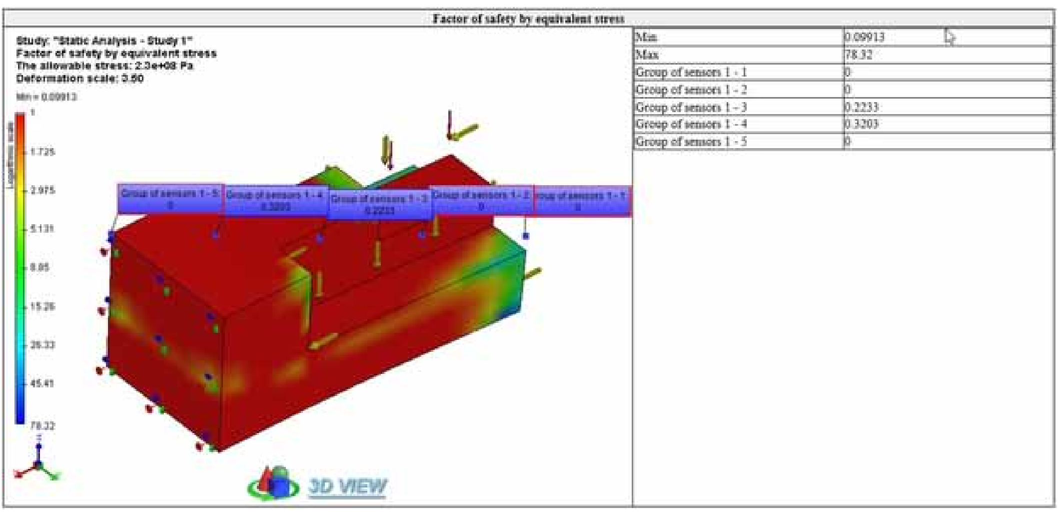


Figure 3. The factor of safety by equivalent stress.



questions. Since the 4-point rating scale was used for the instruments, the decision rule was based on the midpoint for the scales, which is 2.5. Therefore, only mean scores of 2.50 and above were accepted as indications of agree while mean scores below 2.50 was regarded as disagree.

6.0 RESULTS

Research Question 1: What is the level of effectiveness of materials resistance education in the development of engineering skills in university students?

The results of Table-6 showed that respondents answered yes to questions 1-6 with an average score above 2.50, indicating that engineering education is a technical tool for developing the university student community. effective in developing skills. Hence, this means that students agree that an

Table 6. Mean and Standard Deviation of Respondents' Opinion about Technical Education.

S/N	Items/Statements	SA	A	DA	SD	Mean	STD	Remarks
1	The use of AutoCAD applications in the teaching of engineering at universities provides the special skills needed to expand the opportunities of young people in Uzbekistan.	68	16	3	1	3.55	.672	Accep-ted
2	The use of AutoCAD applications in the teaching of general subjects allows university students to be creative and innovative.	65	15	6	2	3.40	.808	Accep-ted
3	The AutoCAD application program offers students functional skills that allow them to work independently and become self-reliant.	70	13	3	2	3.57	.751	Accep-ted
4	The formation of engineering skills in university students leads to the formation of an understanding of the socio-economic and environmental situation for the sustainable development of society.	32	26	20	10	2.99	.929	Accep-ted
5	Through the use of AutoCAD applications in the teaching of general subjects at universities, students develop verbal and nonverbal expression skills, problem-solving skills, team/group work skills, as well as listening and empathy skills. are expected to have.	55	13	8	12	3.18	.856	Accep-ted
6	The knowledge gained by university students through ICT can be used to solve the problem of unemployment in the society.	32	40	10	6	2.70	1.118	Accep-ted

engineering degree at universities provides students with certain skills that they need to improve after graduating from university.

Research Question 2: What is the opinion of teachers about the role of materials resistance education in the development of society?

As can be seen from Table-7, respondents accept all items 7-10 as the role of engineering education in the development of society in Uzbekistan. Each of the five points should have been in the range from 2.72 to 3.21. The table shows that the curriculum for engineering education in universities by faculty will lead to economic growth that will reduce poverty, empower youth, create wealth and lead to sustainable societies.

Research Question 3: What are the challenges facing effective teaching of resistance learning in universities?

Table-8 shows that engineering education in Uzbek universities faces some challenges. Items 16, 17, 18, 19, and 20 have an average score of 3.11, 3.40, 3.06, 3.21, and 2.83, respectively. This means that there are not enough qualified teachers, not enough funds, lack of motivation for teachers, some of the problems facing effective teaching of engineering education at the university.

Table 7. The mean and standard deviation of respondents' opinions on the role of engineering education in community development.

S/N	Items/Statements	SA	A	DA	SD	Mean	STD	Remarks
7	The integration of the curriculum and the organization of training for engineers at universities can contribute to the development of the community in Uzbekistan.	50	27	8	3	2.94	1.074	Accepted
8	The engineering curriculum at universities leads to poverty reduction, youth empowerment, wealth creation and economic growth.	50	29	7	2	2.96	1.022	Accepted
9	Engineering education provides life and professional skills that enhance a person's potential for sustainable development in society.	46	25	9	8	2.80	1.112	Accepted
10	Training engineering education that promotes human development.	45	26	10	7	2.72	1.060	Accepted

Table 8. Mean and Standard Deviation scores of Respondents' Opinion on Challenges facing Effective Teaching of Engineering Education.

S/N	Items/Statements	SA	A	DA	SD	Mean	STD	Remarks
11	Inadequate engineering skilled teachers.	60	20	5	3	3.11	.909	Accepted
12	Non-availability of funds, facilities and equipment for teaching and learning to engineer.	65	15	6	2	3.40	.630	Accepted
13	Lack of motivation and specific training for teachers.	55	15	15	3	3.06	.982	Accepted
14	Lack of laboratory, workshops and conducive classroom for practical work.	59	22	5	2	3.21	.923	Accepted

7.0 DISCUSSION

The results of the study showed that teachers agree that teaching engineering at a university provides certain skills needed to empower students after graduation. In particular, teachers were of the highest opinion that entrepreneurship education is an effective tool in developing students' engineering skills for community development. This finding is supported by the findings of Ulugbek Ulugov (2018), who found that introducing engineering skills into the education system in Uzbekistan would enable young people to become entrepreneurial, innovative and creative. Eickelmann (2017) stated that entrepreneurship education will offer functional education for the youth to enable them to be self-employed and self-reliant which in turn lead to sustainable national and community development. The role of Engineering Education in community development was another area where the majority of the respondents agreed upon. The results showed that the curriculum for engineering education at universities leads to poverty reduction, youth empowerment, wealth creation, and economic growth. It provides life and professional skills that enhance a person's potential for sustainable development of society in Uzbekistan. Thus, the importance of engineering training for sustainable development is that life and professional skills enhance human potential; strengthens self-sufficiency and improves the quality of education and life. It provides training to all sectors of the private and civil society and has refocused the existing educational program towards sustainable development in Uzbekistan. Teaching technical education in universities not only drastically reduces social ills among young people, but also satisfies their needs and desires for useful work and self-development. People who are engineers often claim that they have more opportunities for freedom, a higher level of dignity, and greater opportunities to manage their lives. At present, the rapid introduction of information and communication technologies in education, computerization of the educational process, has become a leading pedagogical methodological idea. In addition to technical means for the successful use of pedagogical information technologies, it is necessary to address the following organizational issues: - preparation of information and learning environment to support the educational process of the higher education institution using practical software; - Development of teaching methods in the electronic environment, accelerating the system of training qualified personnel in the field of computer technology; - Adequate provision of e-learning with teaching materials; - training of teachers for teaching using practical software; - The need for perspective and system used by teachers. The availability of a skilled workforce is critical to the adoption of innovative production strategies. How can governments develop educational reforms - broadly understood to include adult training and retraining - that will help their country to meet this challenge. The results of this study showed that the respondents considered five points in the context of the problems of effective teaching of engineering education in higher education institutions in Uzbekistan. These problems include a shortage of teachers with engineering skills, a lack of funding, an inadequate teaching and learning environment, a low level of engineering culture, and the public's attitude towards the development of higher education. Finally, the study found that there was no significant difference in the average perception of university students about the role of engineering education in the development of society by men and women. According to teachers, the selected skills will allow students to create jobs after graduating from university.

8.0 CONCLUSION

The results of this study showed that the use of AutoCAD applications in teaching the science of strength of materials is effective in shaping the engineering skills of university students for the development of society. In addition, the majority of respondents believe that engineering training promotes self-employment, employment opportunities and investment, which improves community development and reduces urban migration syndrome in rural areas. The effectiveness of the quality of forming the readiness of university students to the introduction of pedagogical information technology (PIT) depends to a large extent on a purposefully designed model of involving students in active activities that covered such components and their elements: methodological-targeted (purpose, tasks, approaches, principles); content-technological (stages, content, forms, methods, technologies, means, pedagogical conditions); productive-evaluative (components, levels, criteria and indicators). Visual-spatial skills are essential for performing a variety of everyday tasks, as well as being successful in multiple areas. This work provides empirical evidence to support the claim that the study of the "Material Resistance" course, common in computer science or engineering programs, helps to develop stronger visual-spatial skills. In particular, PITs have impacted on educational practice in education to date in quite small ways but that the impact will grow considerably in years to come and that PIT will become a strong agent for change among many educational practices. Extrapolating current activities and practices, the continued use and development of PITs within education will have a strong impact on the PIT and teaching-learning process; quality and accessibility of education; learning motivation, learning environment, and PIT usage and academic performance. According to the research results, there are various problems associated with the effective teaching of engineering education in the universities of Uzbekistan. Thus, according to the results of the study, the development of engineering skills among university students leads to the formation of awareness and understanding of the socio-economic and environmental situation for the sustainable development of society in Uzbekistan.

9.0 RECOMMENDATION

The adoption and use of PITs in education have a positive impact on teaching, learning, and research. PIT can affect the delivery of education and enable wider access to the same. Also, it will increase flexibility so that learners can access education regardless of time and geographical barriers. It can influence the way students are taught and how they learn. It would provide the rich environment and motivation for the teaching-learning process which seems to have a profound impact on the process of learning in education by offering new possibilities for learners and teachers. These possibilities can have an impact on student performance and achievement. Similarly wider availability of best practices and best course material in education, which can be shared using PIT, can foster better teaching and improved academic achievement of students.

Conflicts of Interest

The authors declare no conflict of interest.

ACKNOWLEDGMENT

The authors gratefully acknowledge the great help and cooperation provided by all the respondents of this study. The authors would also like to thank PhD. Associate Professor Turaev Bahodir Ergashevich, and PhD. Shavkat Kasimov, PhD. Fakhriddin Nosirov for his assistance and insights on an earlier draft of this article.

REFERENCES

Almerich, G., Suárez-Rodríguez, J., Díaz-García, I., & Cebrián-Cifuentes, S. (2020). 21st-Century Competences: The Relation of ICT Competences with Higher-Order Thinking Capacities and Teamwork Competences in University Students. *Journal of Computer Assisted Learning*, *36*(4), 468–479. doi:10.1111/jcal.12413

Aristizábal, L. F., Cano, S., Collazos, C. A., Moreira, F., Alghazzawi, D. M., & Fardoun, H. (2017). Tools and Methods Applied in Interactive Systems to Evaluate the User Experience with Deaf/Hard of Hearing Children. *ACM International Conference Proceeding Series*.

Asset, A., Gabdyl-Samatovich, T. D., & Balkiya, M. (2015). ScienceDirect Modern Pedagogical Technologies in Communicative Competence Formation. *World Conference on Educational Technology Researches*, *182*, 2014.

AutoCAD 2016 Instructor. (2016). Retrieved August 14, 2020 https://books.google.co.uz/books?hl=ru&lr=&id=sXbqBwAAQBAJ&oi=

Bakaev, Bolotin, & Aganov. (2016). Physical Training Complex Application Technology to Prepare Rescuers for Highland Operations. *Teoriya I Praktika Fizicheskoy Kultury, 2016*(6).

Bakayev, V., Vasilyeva, V., Kalmykova, S., & Razinkina, E. (2018). Theory of Physical Culture- a Massive Open Online Course in Educational Process. *Journal of Physical Education and Sport*, *18*(1).

Bilici, , Guzey, & Yamak. (2016). Assessing Pre-Service Science Teachers' Technological Pedagogical Content Knowledge (TPACK) through Observations and Lesson Plans. *Research in Science & Technological Education*, *34*(2).

Blackwell, C. K., Lauricella, A. R., & Wartella, E. (2016). The Influence of TPACK Contextual Factors on Early Childhood Educators' Tablet Computer Use. *Computers & Education*, *98*, 57–69.

Bolotin, A., & Bakayev, V. (2017a). Structure of the Parameters That Define the Preparedness of Archers for Competitive Struggle. *Journal of Physical Education and Sport*, *17*(3).

Bolotin, A., & Bakayev, V. (2017b). The Differences in Response of the Respiratory System of Long and Middle-Distance Runners and Their Influence on Recovery Rate. *Journal of Physical Education and Sport*, *17*(4).

Bolotin, A., & Bakayev, V. (2018). Pedagogical Practice for Development of Coordination Potential of MMA Fighters and Estimation of Its Efficiency. *Journal of Human Sport and Exercise*, *13*(1).

Bozor & Ulugbek. (2018). The prospects of development of science in the XXI century and the place of innovation in them. *Materials of the Republican Scientific-Online Conference on the Subject*.

Chai, C. S., Joyce, H. L. K., & Teo, Y. H. (2019). Enhancing and Modeling Teachers' Design Beliefs and Efficacy of Technological Pedagogical Content Knowledge for 21st Century Quality Learning. *Journal of Educational Computing Research*, *57*(2), 360–384.

Cuhadar, C. (2018). Investigation of Pre-Service Teachers' Levels of Readiness to Technology Integration in Education. *Contemporary Educational Technology*, *9*(1), 61–75.

Dong, Y., Xu, C., Chai, C. S., & Zhai, X. (2020). Exploring the Structural Relationship Among Teachers' Technostress, Technological Pedagogical Content Knowledge (TPACK), Computer Self-Efficacy and School Support. *The Asia-Pacific Education Researcher*, *29*(2), 147–157.

Drossel, K., Eickelmann, B., & Gerick, J. (2017). Predictors of Teachers' Use of ICT in School – the Relevance of School Characteristics, Teachers' Attitudes and Teacher Collaboration. *Education and Information Technologies*, *22*(2), 551–573.

Dzhumaevich, U. B. (2020). Efficiency of use of autodesk inventor engineering programs and pedagogical information technologies in the field of 'resistance of materials' in the process of teaching students of technical universities. *ACADEMICIA: An International Multidisciplinary Research Journal*, *10*(5), 130–43.

Eickelmann, B., Gerick, J., & Koop, C. (2017). ICT Use in Mathematics Lessons and the Mathematics Achievement of Secondary School Students by International Comparison: Which Role Do School Level Factors Play? *Education and Information Technologies*, *22*(4), 1527–1551.

Ghavifekr, S., & Rosdy, W. A. W. (2015). Teaching and Learning with Technology: Effectiveness of ICT Integration in Schools. *International Journal of Research in Education and Science*, *1*(2), 175–191.

Görz, I., Herbst, M., Börner, J. H., & Zehner, B. (2017). Workflow for the Integration of a Realistic 3D Geomodel in Process Simulations Using Different Cell Types and Advanced Scientific Visualization: Variations on a Synthetic Salt Diapir. *Tectonophysics*, *699*, 42–60.

Gros, Begoña, Kinshuk, & Maina. (2016). The Future of Ubiquitous Learning: Learning Desings for Emerging Pedagogies. *Lecture Notes in Educational Technology*.

Han, Bouferguene, Al-Hussein, & Hermann. (2017). 3D-Based Crane Evaluation System for Mobile Crane Operation Selection on Modular-Based Heavy Construction Sites. *Journal of Construction Engineering and Management, 143*(9).

Heitink, M., Voogt, J., Fisser, P., Verplanken, L., & van Braak, J. (2017). Eliciting Teachers' Technological Pedagogical Knowledge. *Australasian Journal of Educational Technology*, *33*(3).

Hew, T. S., & Kadir, S. L. S. A. (2016). Predicting the Acceptance of Cloud-Based Virtual Learning Environment: The Roles of Self Determination and Channel Expansion Theory. *Telematics and Informatics*, *33*(4), 990–1013.

Megri, A. C., Hamoush, S., & Stallings, D. L. (2018). An Outreach Program Focusing on Design Process and 3-D-Printing. *ASEE Annual Conference and Exposition, Conference Proceedings*.

Mesquita, A., Moreira, F., & Peres, P. (2017). The Future of Higher Education – Students' Views about Challenges Promoted by Technologies. Advances in Intelligent Systems and Computing, 571.

Moreira, F., Ferreira, M. J., Collazos, C. A., & Cano, S. (2017). Profile-Oriented Programming Teaching to Non-Technical Students: A Case Study. *Iberian Conference on Information Systems and Technologies, CISTI*.

Moreira, F., Ferreira, M. J., Santos, C. P., & Durão, N. (2017). Evolution and Use of Mobile Devices in Higher Education: A Case Study in Portuguese Higher Education Institutions between 2009/2010 and 2014/2015. *Telematics and Informatics*, *34*(6), 838–852.

Moreira, F., Gonçalves, R., Martins, J., Branco, F., & Au-Yong-Oliveira, M. (2017). Learning Analytics as a Core Component for Higher Education Disruption: Governance Stakeholder. *ACM International Conference Proceeding Series*.

Mouza, C., Yang, H., Yi, C. P., Ozden, S. Y., & Pollock, L. (2017). Resetting Educational Technology Coursework for Pre-Service Teachers: A Computational Thinking Approach to the Development of Technological Pedagogical Content Knowledge (TPACK). *Australasian Journal of Educational Technology*, *33*(3).

Munyengabe, S., Zhao, Y., He, H., & Hitimana, S. (2017). Primary Teachers' Perceptions on ICT Integration for Enhancing Teaching and Learning through the Implementation of One Laptop Per Child Program in Primary Schools of Rwanda. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(11), 7193–7204.

Osipov, A., Starova, O., Malakhova, A., Vonog, V., Zhavner, T., Salyamova, P., Struchkov, V., & Kudryavtsev, M. (2016). Modernization Process of Physical Education of Students in the Framework of Implementation of the State Strategy for the Development of Physical Culture, Sport and Tourism in the Russian Federation. *Journal of Physical Education and Sport*, *16*(4), 1236–1241.

Peres, P., Moreira, F., & Mesquita, A. (2017). Higher Education Teachers in Portugal Use Technology in Their Educational Activities: Myth or Reality? *Iberian Conference on Information Systems and Technologies, CISTI*.

Poitras, E., Doleck, T., Huang, L., Li, S., & Lajoie, S. (2017). Advancing Teacher Technology Education Using Open-Ended Learning Environments as Research and Training Platforms. *Australasian Journal of Educational Technology*, *33*(3).

Pondee, P., Premthaisong, S., & Srisawasdi, N. (2017). Fostering Pre-Service Science Teachers' Technological Pedagogical Content Knowledge of Mobile Laboratory Learning in Science. *ICCE 2017 - 25th International Conference on Computers in Education: Technology and Innovation: Computer-Based Educational Systems for the 21st Century, Workshop Proceedings*.

Raji, S. A., Zava, A., Jirgba, K., & Osunkunle, A. B. (2017). Geometric Design of a Highway Using Autocad Civil 3D (vol. 4). Academic Press.

Ramirez, G. M., Collazos, C. A., & Moreira, F. (2018). All-Learning: The State of the Art of the Models and the Methodologies Educational with ICT. *Telematics and Informatics*, *35*(4), 944–953.

Revilla-Cuesta, V., Skaf, M., Manso, J. M., & Ortega-López, V. (2020). *Student Perceptions of Formative Assessment and Cooperative Work on a Technical Engineering Course.* Sustainability, 12(11).

Ríordáin, M. N., Johnston, J., & Walshe, G. (2016). Making Mathematics and Science Integration Happen: Key Aspects of Practice. *International Journal of Mathematical Education in Science and Technology*, *47*(2).

Shahnavaz, F., Taghaddos, H., Najafabadi, R. S., & Hermann, U. (2020). Multi Crane Lift Simulation Using Building Information Modeling. *Automation in Construction*, 118.

Sugimoto, Y., Seki, H., Samo, T., & Nakamitsu, N. (2016). 4D CAD-Based Evaluation System for Crane Deployment Plans in Construction of Nuclear Power Plants. *Automation in Construction*, *71*, 87–98.

Suleman, F. (2018). The Employability Skills of Higher Education Graduates: Insights into Conceptual Frameworks and Methodological Options. *Higher Education*, *76*(2), 263–278.

Ulugov Bazar Dzhumaevich worka as a senior teacher at the Termez Branch of the Tashkent State Technical University. Research interests are Pedagogical Information Technology (PIT), Information and Communication Technology (ICT), and Pedagogical Technology. 1992 Bachelor's degree from Termez State University (Uzbekistan). 1996 Master's degree from Yildiz Technical University (Turkey).