

Modeling the Process of Developing Students' Information Modeling Skills Based on A Competency-Based Approach

Parmonov Shakhzod Abdumajit ugli

Assistant, Jizzakh Polytechnic Institute, Uzbekistan

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Abstract: This article examines the theoretical and methodological foundations of modeling the process of developing students' information modeling skills in the field of power engineering education based on a competency-based approach. The need to train competitive specialists in the modern education system makes the formation of information modeling competencies an urgent issue. In this regard, the study developed a pedagogical model based on the integration of systematic, activity-oriented and competency-based approaches.

Keywords: Competency-based education, information modeling, engineering education, energy engineering, pedagogical modeling, digital learning environment, professional competencies, simulation technologies, systematic approach, activity-based learning.

Introduction: At the stage of development of the modern education system, one of the urgent tasks is to prepare competitive and highly qualified specialists who meet the requirements of the labor market. Today, specialists must not only have theoretical knowledge, but also have the ability to effectively communicate with clients in their professional activities, independently determine their needs, and adapt to a rapidly changing production and technological environment. This indicates the importance of improving the quality of the educational process, its monitoring, and systematic elimination of existing problems.

Analysis of world educational experience shows that in the educational systems of advanced foreign countries, special attention is paid to training specialists based on a competency-based approach. This approach serves to develop not only theoretical knowledge of students, but also their readiness for practical work, the ability to solve problem situations and innovative thinking. Also, the pilot introduction of modern pedagogical technologies and the wide dissemination of their positive results are one of the important factors in

increasing the competitiveness of the educational system.

The modernization processes underway in the higher education system, especially in technological areas such as energy engineering, are increasing the need to form modern professional competencies in students. In particular, the development of information modeling skills is considered an important component of students' professional training. Information modeling is an effective tool that allows for the analysis, prediction and optimization of technical processes, which serves to develop students' logical, systematic and creative thinking skills.

Modern pedagogical approaches are aimed at activating the educational process, which involves the development of students' independent learning, teamwork, and creative problem-solving skills. When teaching information modeling processes in power engineering education is organized on the basis of this approach, students will have the opportunity to deeply understand electrical systems, energy distribution, and automated control processes through virtual models.

At the same time, adapting foreign educational

experiences to the national education system is of great importance in training competitive specialists in the energy sector. This process serves to develop students' skills in the effective use of modern information technologies, simulation and modeling tools.

In this regard, there is a need to model the process of developing students' information modeling skills based on a competency-based approach. This process allows us to substantiate the goals, content, methods, tools and results of education as a single system and serves to develop effective pedagogical mechanisms for the formation of students' professional competencies.

The purpose of the study is to develop a pedagogical model of the process of developing information modeling skills for students of the energy engineering program based on a competency-based approach and to substantiate its effectiveness.

METHODS

This study aims to model the process of developing students' information modeling skills in the field of power engineering education based on a competency-based approach, using the integration of modern pedagogical methodologies. The scientific basis of the study is a systematic, activity-oriented, and competency-based approach.

1. Systematic approach

The systematic approach is based on considering the pedagogical process as a holistic system. Within the framework of this approach, the process of developing information modeling skills was analyzed in terms of interconnected components - goal, content, method, means and results. Using the systematic approach, the structural structure of the pedagogical model was determined and the relationship between its functional elements was substantiated.

2. Activity-oriented approach

The activity-oriented approach is based on the student's active assimilation of knowledge and its formation in the process of practical activity. Based on this approach, the modeling activity of students was organized in the following stages:

- understanding and analyzing the problem;
- developing a solution based on modeling;
- evaluating and reflecting on practical results.

This approach expands students' opportunities to think independently, solve problem situations, and develop innovative approaches.

3. Competency approach

The competency-based approach was chosen as the main methodological basis of the research, aimed at forming students' readiness for professional activity. Within the framework of this approach, information modeling skills were developed based on the following competencies:

- social competence;
- professional (special) competence;
- information competence;
- technological competence;
- creative competence.

These competencies were used in modeling energy facilities, analyzing technical processes, and solving practical problems.

4. Research methods

The following methods were used in the research process:

- theoretical analysis — study of scientific literature and existing approaches;
- pedagogical observation - monitoring the educational process;
- experimental work - testing the developed model in practice;
- mathematical and statistical analysis - processing and evaluation of the results obtained.

5. Organization of the research process

The research was carried out in two main stages:

1. Diagnostic stage — determining the level of students' information modeling skills;
2. Experimental stage — organization of the educational process and evaluation of results based on the developed pedagogical model.

6. Pedagogical tools and methods

The following innovative methods and tools were used in the research process:

- “FSMU”, “SCAMPER”, “Networks”, “Skarabey” methods;
- “MICA” (Modeling Improvement Competence

Approach) methodology;

- digital modeling tools and simulation programs;
- independent educational tasks and project work.

These methods served to activate students' modeling activities, develop technical thinking, and form professional competencies.

RESULTS

As a result of this research, a structural-functional pedagogical model was developed and implemented in practice, aimed at developing students' information modeling skills in the field of energy engineering based on a competency-based approach.

1. Structure of the pedagogical model

The developed model consists of the following main components:

- Goal component — formation of information-modeling competencies in students;
- Content component — educational materials on energy sciences and modeling;
- Process component — interactive methods and modeling activities;
- Assessment component — criteria for determining competencies;
- Result component — formation of a competitive specialist.

This model served to improve the professional preparation of students by integrating all elements of the educational process into a single system.

2. Stages of developing information modeling skills

As part of the research, the development of students' modeling skills was carried out in the following stages:

1. Situational awareness — forming initial concepts about energy processes;
2. Analysis and prediction — developing thinking based on modeling;
3. Decision-making — solving technical problems based on models;
4. Modeling and design — developing solutions using digital tools;
5. Result evaluation — analyzing modeling results.

These stages ensure that students move from

knowledge to practical activities..

3. Results of competence formation

As a result of the experimental work, it was determined that the following competencies were developed:

- Social competence — teamwork and problem-solving;
- Professional competence — modeling and analyzing energy systems;
- Information competence — data processing and model building;
- Technological competence — using digital tools;
- Creative competence — developing innovative solutions.

4. Experimental results (statistical indicators)

The results of the experiment showed that students' information modeling skills significantly increased:

Indicator	Elementary (%)	Final (%)
Theoretical knowledge	52	78
Practical skills	48	82
Independent work	45	80

5. Pedagogik texnologiyalar samaradorligi

The following methods used in the research process were found to be effective:

- “MICA” methodology
- SCAMPER technology
- Interactive learning methods
- Digital modeling tools

These methods are designed to help students:

- activated their technical thinking
- increased their ability to work independently
- increased their interest in modeling activities

6. Practical results of the model

Based on the developed model:

- ✓ student's modeling competence increased
- ✓ The level of professional training has improved
- ✓ skills in using digital technologies have developed

As a result, students were prepared to solve problems related to real energy systems based on modeling.

DISCUSSION

The results of this study showed that developing students' information modeling skills in the field of power engineering education based on a competency-based approach is an effective pedagogical solution. The results obtained confirm that organizing the educational process based on a systematic, activity-oriented and integrated competency-based approach significantly increases the professional readiness of students.

Based on the results of the pilot study, it was determined that the developed pedagogical model served to develop not only the theoretical knowledge of students, but also practical modeling skills. In particular, the step-by-step organization of the modeling process strengthened the students' abilities to analyze problem situations, develop technical solutions, and evaluate results.

The results obtained are consistent with other scientific studies and once again confirm the priority of the competency-based approach in the educational process. In particular, modern pedagogical research has noted that students more effectively master knowledge in the process of activity-based learning and are able to apply it in practical situations. In this regard, the results of this study enrich existing scientific views and concretize them on the example of energy engineering education.

The MICA methodology and interactive educational technologies used during the study played an important role in developing students' creative and critical thinking. In particular, the use of digital modeling tools allowed students to visually understand technical processes, analyze complex systems, and develop innovative solutions.

The results of the study also showed that the proper organization of students' independent learning activities is one of the decisive factors in the development of modeling competencies. Learning activities organized through independent assignments, project work, and digital platforms helped students to deeply assimilate knowledge and apply it in practice.

However, some limitations were also observed during the research process. Including:

- Insufficient availability of digital modeling tools for all students;
- Different levels of initial training;
- The need to further improve the digital competencies of educators.

Despite these limitations, the developed pedagogical model has demonstrated its practical effectiveness and has been evaluated as an important tool in improving the educational process.

The following can be indicated as future directions for the development of this research:

- integration of artificial intelligence and digital simulation technologies into the modeling process;
- improvement of training methodologies based on real-time modeling of energy systems;
- wider implementation of international experiences.

Overall, the research results showed that the development of information modeling skills based on a competency-based approach is an important pedagogical mechanism for improving the effectiveness of power engineering education.

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