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IMPROVING THE EXPERIMENT PROCESS BY USING VIRTUAL LABORATORY IN THE EDUCATIONAL PROCESS

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Abstract: *Information and communication technologies provide powerful tools to support the shift to student-centered learning and the roles of teachers and students. Information technology can make teaching and learning more effective and efficient. In a constructivism learning environment, students construct their own knowledge by testing ideas and approaches based on their prior knowledge and experience, applying these to new tasks, contexts and situations, and integrating the new knowledge gained with pre-existing intellectual constructs.*

Keywords: *knowledge, laboratory activities, educational process, educational information technologies, laboratory experiments, educational process improvement.*

1. INTRODUCTION

Knowledge it can define as the power of capturing and understanding the essence of facts, the valorizing of information and certitude obtained in the form of experiences and lessons.

Miriam Webster dictionary defines knowledge, learning, erudition, and scholarship as synonyms: "mean what is or can be known by an individual or by humankind". Knowledge, "applies to facts or ideas acquired by study, investigation, observation, or experience".

Knowledge Society has been recognized as a new stage of the information age, the Information Society. In the "Report of the United Nations Commission for the Development of Science and Technology" published in 1998, the concept of Knowledge Society is presented as follows: "Knowledge Society recently the term has been used to focus on the role that information and communications technology (ICT) has evolved from a tool for technological change in an

instrument that offers new potential result of combining the information embedded in ICT systems the creative potential of people to develop their knowledge."

The role of computers in educational activities as a storage of well-structured information and relatively easy access to that information have shifted the emphasis in education objectives from the need to memorize large amounts of study material to an ability to retrieve and understand information and to determine what kind of information is necessary for resolving educational and applied professional tasks.

Redistributing knowledge between the computer and the human being, represent an important problem of developing student's knowledge, skills and abilities. Using information technologies in the military higher educational system, must be oriented towards the achievement of a strategic goal: to train not only specialists prepared to carry out orders, but also creatively thinking and creatively acting individuals capable of constant self-improvement and self-development.

When we develop theories (add explanations to facts, concepts, and principles) and laws (empirically validate principles and theories) we accomplish the highest goal of science-to control the variables we are studying.

Constructivist learning theory asserts that knowledge is not simply transmitted from teacher to student, but is actively constructed by the mind of the learner through experiences.

Founded in developmental psychology, constructivism suggests: (a) the learner should be an active organism within the environment, not just responding to stimuli, but engaging and seeking to make sense of things; (b) knowledge is best generated internally, not absorbed from an external source; and (c) the motivation for learning should be intrinsic.

To facilitate such learning by discovery, the teacher and instructional environment must allow repeated, prolonged experiences with the materials and events associated with the topic to be learned.

Computer – assisted training practice represents the basic for individual training programs, with a conversation type unfolding as a mean feature; it allowed a gradual and sequential introduction of information with the more complex programs, advance into the matter being governed by the results obtained at the intermediate, program – imposed tests. The graphic layout, the correlation between

the mathematics with the physical phenomena and their simulation on the computer ensured a favorable welcome of this modern method, along with the disappearance of repulsion towards the “simulator”, a feeling which had occurred due to the excessive emphasis laid on the simulators’ importance compared to the actual sortie hours.

2. BACKGROUND

A new approach of the mechanical behavior laboratory it should be implemented at the Department of Fundamentals Sciences that will contribute to develop the student's abilities to analyze mechanical behavior of structures, to design experiments, and to develop student’s professional skills.

The selected system must provide opportunities for the students to apply the spectrum of the mechanical behavior knowledge, including the fundamental principles of mechanics structures.

An integral part of the curricula is sequence of three hours mechanical behavior courses each week. The course, Mechanics and Materials Strength includes two hours of lecture and one hours of lab each week. Laboratories are offered to sections of about fifteen students.

The actual activity of laboratory experiment process is shown in fig. 1.

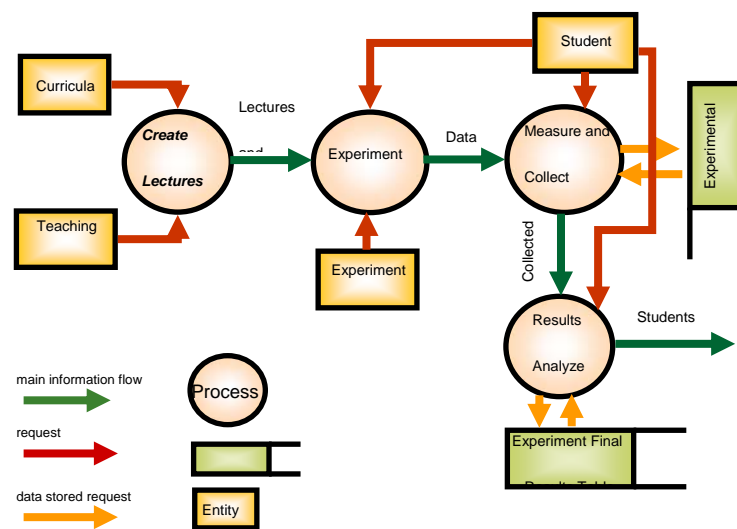


Fig.1 Laboratory Experiment Process “As Is”



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The laboratory has only one set of instrumentation, at the level of complexity required in the course.

Experiments use fixed apparatus for investigation. This educational equipment gives students an appreciation of measure of stress and strains, second moment of area, the neutral axis, torsion and bending equation. Strain gauges measure the strain. The experiment is supplied with a student guide and instructions for use.

The students complete the experiment using suggested conditions, run an experiment, measure and collect experimental data, evaluate the results and write a report. Because students went from one unrelated experiment to another throughout the semester, they did not have the opportunity to develop the "system level" perspective necessary to analyze and understand complex mechanical behavior.

The Mechanical lab activity requires to be upgraded so as to take advantage of using information and communication technologies in teaching. Computers have to be used for creating virtual laboratory experiments, data acquisition, calculation, graphing, report preparation, and teaching via built-in tutorials.

3. MOTIVATION AND CONTEXT FOR PROCESS IMPROVEMENT FOR LABORATORY ACTIVITY

The improvement of the educational process in the mechanical laboratory is shown in fig.2. As part of that process, it was determined that the new approach of Mechanics and Materials Strength should support several of the program's outcomes, including:

- students shall have the ability to analyze, design and realize mechanical behavior of structures.
- students shall have the ability to use contemporary computation techniques and tools.
- students shall have competence in design of experiments, experimental practices and data interpretation.
- students shall have the ability to apply statistical methods to analyze and interpret data.
- students shall have effective oral and written communication skills.
- students shall have the ability to plan, schedule and execute experiments.

It is clear that a new approach for the laboratory activity was required to accomplish the goal of supporting these student outcomes. The students have to perform an integrated sequence of laboratory experiments with a new system. As the students progress through the series of experiments, they are increasingly involved in experimental design. In this way, the students will develop a systems approach to engineering problems, the ability to design and conduct experiments, and professional skills. It was determined that the important skills to develop should be related to the design of experiments. In the context used here, physical design of experiments deals with identifying a problem and solving it. It includes the determination test variables and data requirements, the selection and the design of the instrumentation system.

An important and relatively unique aspect laboratory design is the use a Structures Virtual Experimentation Pack that includes the software simulations of all Structures teaching experiments that enables a range of computer simulated experiments for mechanical and structural engineering, students studying the

principles of mechanical behaviors of structures. It uses a variety of delivery methods including computer software, textbooks and user guides.

The software includes simulations of each experiment module. The laboratory experiments and lecture material presented

throughout the semester are designed specifically to develop student's ability to design experiments. The experiment modules enable students to explore subjects such as bending moments, torsion, shear, deflection of frames, beams and cantilevers, stresses and strains and investigate various structures.

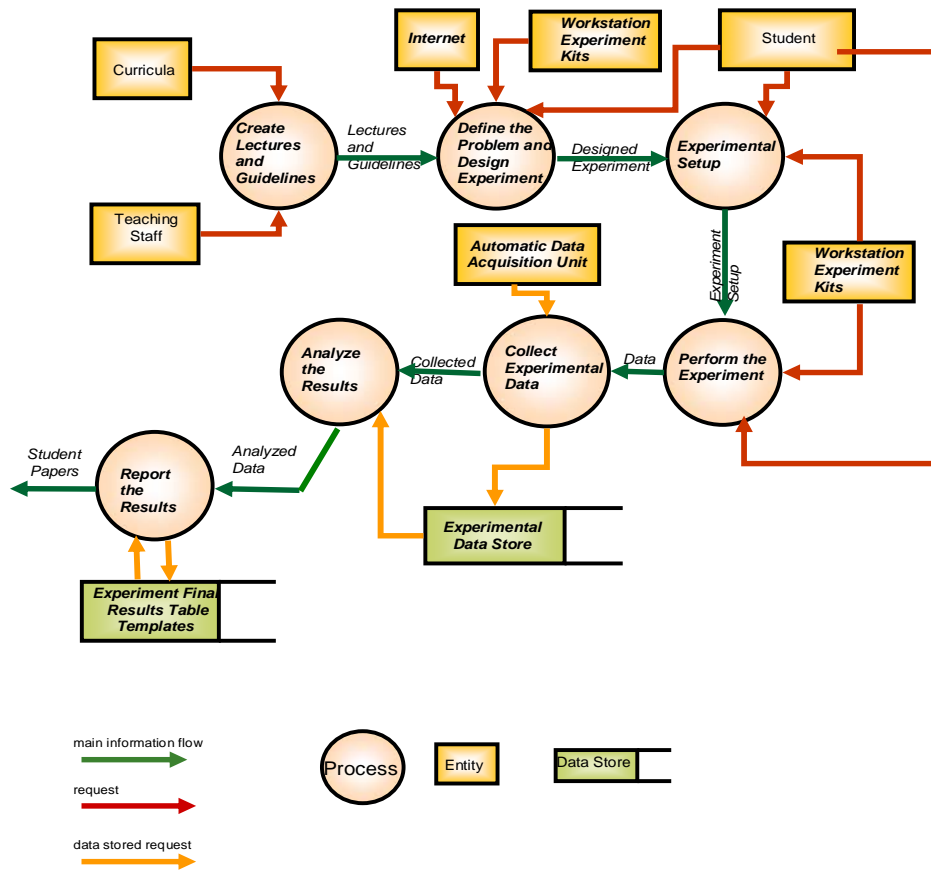


Fig. 2 Improved Mechanical Laboratory Experiment Process “To Be”

Laboratory content:

- structures laboratory including virtual (simulated) experimentation;
- 9 workstations;
- 15 students.

Laboratory has to include 9 workstations each consisting of 1 set of virtual experimentation, 1 computer (networked), 1 projector, projector and whiteboard controls, 2 networked printers (including server), 1 interactive board.

By concentrating on student understanding and learning efficiency, the laboratory kit range allows students to test structure models for themselves and get first-hand experience of how different structures behave:

- automatic data acquisition;

- the use of computer software means students learn efficiently and make the best use of laboratory time;
- simulation software;
- flexibility and modularity.

Powerful simulation software allows virtual experiments to be conducted for the complete range of structures experiments, with or without the hardware. A key feature of this range is flexibility.

The experiment modules and instrumentation simply fix to an ergonomic frame. They are easily removed and swapped for another experiment, making sensible use of laboratory space and time. One experiment can show several principles because the range is modular. Structures range meets the needs of



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academic courses and the demands of modern education.

The new approach for the laboratory activity and the process improvement laboratory experiment are important for student's learning process because provides:

- affordable, effective method for students to quickly learn the principles of structures mechanical behavior;
- authentic virtual experiment options;
- easy understand for students;
- safety for students use;
- comprehensive, versatile and powerful combinations, interchangeable experiment modules;
- quick and accurate data collection using automatic data acquisition;
- realistic and verifiable experimental results;
- best use of laboratory time – makes result taking more efficient;
- convenient tabulation and graphing of experimental results.

4. CONCLUDING REMARKS

Used at academic levels, this educational equipment will give students an appreciation of converting principles to results. By using various media in support of the experiments, student interest is maintained and learning becomes more effective.

Using IT for studying, it should be that students being educated in IT to be able to make full use of:

- word processing; presentations; communication tools; collaborative work;
- internet information access; electronic mail and file transfer;
- numerical processing spreadsheets, statistics;

- programming;
- graphic design;
- database analysis & management;
- control of equipment & instruments, data capture;
- desktop publishing;
- integrated work environment;
- conferencing;
- gateway to information & data banks.

In parallel with the development of computer-assisted training, the need occurred for a development of self-training, an activity meant not to only acquire intellectual and practical skills, but also to consolidate previously acquired abilities.

The use of virtual laboratory in the learning process is a natural consequence of what might be called the 4th revelation in the didactic science, and it corresponds to the natural trends of refining both the methodologies and the conceptual system, used in comprehending the internal mechanism of learning.

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