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Doctor of Pedagogical Sciences, Associate Professor, **NATALIA PAZYURA**
National Aviation University, Ukraine
Address: 1 Kosmonavta Komarova Ave, Kyiv, 03680, Ukraine
E-mail: npazyura@ukr.net

PEDAGOGICAL STRATEGIES FOR TRAINING FUTURE TECHNICIANS IN AMERICAN AVIATION SCHOOLS

The article is devoted to the question of improvement of quality and efficiency of professional training of future technicians in aviation industry in the American educational establishments. Main attention is paid to the studies of pedagogical technologies, which are used for the sake of qualitative and efficient training of specialists of aviation industry. The main purpose of vocational education and training is to help students to develop a way of thinking that would enable them in understanding the technical systems and master learning at the conceptual level. It is a well known fact that researches of pedagogical technologies are aimed at the development of mental models. They are important because: first – they make possible a reduction of time for training. That is rather essential taking into account the fact how much time the “transformation” of a student’s level of knowledge from a novice to an experienced worker takes. The researches of pedagogical technologies help to find a optimum ways for acquisition of expert type of thinking. Secondly, pedagogical technologies help to cut down expenses on training. This is especially topical during professional training of technicians, who are to better understand structural, functional, behavioral aspects of technical systems. In addition, they must effectively operate in troubleshooting in the system which also shortens financial expenses on the maintenance of equipment.

Key words: aviation schools, technicians, pedagogical strategies, diagrams, instructions, simulators.

INTRODUCTION

Technological progress creates more requirements to the technical personnel which is responsible for operating support of the technical systems. That is why it is especially important to keep abreast of innovative technological introductions for the specialists of aviation industry, because lives of people depend on the quality of their training.

Taking into consideration modern rate of the development of science in the XXI century, technicians for maintenance of equipment must have good understanding of the technological systems and have skills which would give them possibility to seize new information about technological innovations to master new technologies successfully.

THE AIM OF THE STUDY

The aim of the paper is to study pedagogical technologies which are used in educational establishments of the USA for professional training of technicians for airplane maintenance. Main attention is paid to the use of diagrams, simulators for development of critical thinking skills, acquisition of mental models characteristic of an experienced specialist, and also understanding the structure, functions, conduct of the complex technical systems. The author reveals the efficiency of computer programs and simulators for troubleshooting in electrical systems of aircrafts.



THEORETICAL FRAMEWORK AND RESEARCH METHODS

Our research enabled us to draw conclusion about actuality of the question of technicians' professional training for maintenance of airplanes, and numerous researches of scientists confirm it. It is necessary to emphasize that the use of graphic material as complimentary training material has been a widespread trend in educational technology at all levels of education for a long time.

Schematic diagrams use abstract symbols for presentation of component parts of the technical systems. Abstract symbols on such diagrams are united by lines which specify their interrelation. They are used in order to illustrate electronic chains and hydrolysis streams, systems in service manuals etc, and also for providing visual information during teaching of students. Many attempts were carried out to study the difference of perception of information by novices and experienced workers in different fields: physics and mechanics (M. Chi, P. Feltovich, R. Glaser, J. Larkin, J. McDermott, D. Simon, H. Simon), troubleshooting in electronic equipment (D. Gitomer, S. Johnson, J. Rasmussen, A. Jensen). At the same time, in the literature the importance of concepts and principles of learning in educational establishments are underlined (M. Alvarez, D. Ausubel, D. Gowin, H. Hanesian, J. de Klerk, J. Novak, C. Stice).

Though schematic diagrams are widely used as a visual help for technical training programs and approved by the American association of aero-navigation as the most useful type of diagrams of all pedagogical technologies, the issue of pedagogical strategies for training in American aviation establishments is not revealed at the satisfactory level and it stipulated the choice of this topic.

For our research we used the method of critical thinking of methodical literature, curricula, which helped us to study main approaches to training of future avia-personnel in American schools. The method of analysis allows us to distinguish characteristic features of training in these establishments.

RESULTS

The researches of pedagogical technologies which are directed at the development of mental models indisputably have a very important value for training of technical personnel and for professional and technical education in general due to many reasons, and foremost, it is the reduction of time and finances on training. Besides, technicians, who understand and use in their work the causal model of the technical system better understand structural, functional and behavioral aspects of this system. Understanding these aspects, they are able to determine the problem in the system and settle it. In its turn, it leads to shortening time and expenses for maintenance of equipment that is especially valuable for aviation.

The help in acquisition by students necessary base of knowledge, which is usually owned by an experienced worker, requires teaching special mental models which describe the way a system works. Acquisition of these "expert models" helps the novices to understand instructions, find out ambiguities in the system, comprehend the component parts of the system and to their interrelation.

In the analyzed literature the importance of conceptual training and development of mental models in training of air-personnel is underlined. However, it appears that in many programs of technicians' training in aviation establishments other forms of training are preferable, such as a quantitative solution of problems and theoretical learning. For example, widespread approach to the study of electronics is the study of electronics bases, base theories, Ohm's law, Kirchhoff's law etc, and only then teaching ways to apply them for practical purposes.



Many scientists insist on the necessity to pay more attention to teaching conceptual understanding and it needs improvement of educational materials. As practice testifies, educational materials for students of technical specialties often use complicated and abstract diagrams, charts for explanation of work and functions of the technical systems and equipment. Without sufficient base knowledge in the certain industry, conceptual understanding of the system or equipment appears to be a difficult task.

Researches show, though, while using simple conceptual diagrams of technical systems as an initial stage of training, students understand the systems more quickly. Besides, students develop more perfect mental models, which allow them to comprehend a system as a whole mechanism, and determine connections among conceptual component parts, that is impossible to attain by using schematic diagrams (Johnson & Satchwell, 1992).

D. Egan and B. Schwartz in their work show how experienced specialists use organized knowledge at their work. The group of experienced specialists and novices was asked to recall symbolic diagrams and drawings and then reproduce them by memory. As a result, experienced specialists remembered far more than novices did. The researchers came to the conclusion that memory of experienced technicians is organized round the “conceptual clusters” of information. For specialists it is easier to remember drawings as whole pieces of information than separate parts of them (Johnson & Satchwell, 1992).

In the analyzed literature it is stressed that all individuals often form internal mental images of themselves and those who they contact with. For example, most people can imagine how a thermostat can work to control the temperature in a house. They can present mental image how the thermostat connects to the heating and how these devices interact with each other. At that time though this image, or mental model of this system can be absolutely incorrect, it is possible to use the presentation to explain operational peculiarities of the system or in the process of repair.

For deeper level of knowledge of the technical system, it is necessary to get the base understanding of physical structure of the system, its functions, component parts, interaction and interrelations between components. Since understanding of these important principles and conceptions can be not quite correct, technicians must have knowledge of these conceptions for understanding the technical systems as a whole (Johnson & Satchwell, 1992).

A modern cognitive theory considers the organization of specialist’s knowledge to be essential in his work. A specialist owns a considerable amount of knowledge organized in a complex, integrated structure, while a novice owns less of knowledge often not organized well. Therefore, specialist uses less short-term memory in work that allows him to concentrate only on information related to the problem. In comparison, a novice must focus on the specific, separate components of problem. Consequently, it limits work results. American scientists assert that for the quick training of novice to the level of specialist, the best technical instructions must be used to provide “organization of knowledge”. The best technical instructions encourage the development of mental models.

Mental models are our internal presentations or presentations of situation (problems) which we run into. These models help to predict or explain our interaction with surroundings, other people, technical equipment. One type of a mental model that is related to the workers of technical type is a causal mental model. It can be useful during initial study how a difficult system works and can result in the improvement of work process because of mental simulations. It is important that causal mental models are used for activation of the process of memorizing (Johnson & Satchwell, 1992).



In our research we considered the use of diagrams during the training of future technicians for aviation industry because the best presentation of different types of information is possible with the help of diagrams. Functional diagrams are used for presentation of fundamental conceptions or base components of the systems, and also for organization of meaningful interaction between conceptions and component parts. According to D. Ausubel concepts play a significant role in the acquisition and use of knowledge. His researches confirm that conceptual diagrams are effective in acquisition by students the base understanding, as well as for evaluation students' conceptual knowledge.

The use of functional diagrams leads to the creation of similar to the specialists' models much quicker, than it is possible to attain by usual instructions which use only schematic diagrams. The use of functional diagrams during the training of air-personnel in American schools provides possibility to develop knowledge of the structures of the complex technical systems. Scientists insist on that functional diagrams are an effective instructional means for providing the students' conceptual understanding of causal conduct of the system. Besides, the use of functional diagram considerably improves ability of students to reconstruct conceptual models similar to the specialists' models.

Another important aspect of technicians' professional training for maintenance of airplanes is students' preparation to understanding technical instructions and ability to find reason of breakages. Understanding technology, acquisition of troubleshooting skills, practical use of knowledge and skills are impossible without providing the students with a possibility to diagnose defective equipment. Technological progress creates problems for those, who are involved in operational maintenance of technical systems. Technicians and mechanics which maintain and repair complex equipment need various skills which considerably differ from the skills of the past century. Mechanics who got used to working "with hands" and who must have a look at the equipment in order to understand how it works have problems in maintenance of modern equipment. They presently can not rely on perceptual and physical capabilities for the troubleshooting of technical problems. Changes in technologies shorten that limit to which information critically important for troubleshooting can be perceived. As a result, growing use of electronics, complex character of modern equipment leads to the growth of importance of abstract thinking. These new technologies need mental and scientific skills more than physical ones. Successful technicians of the future for maintenance of equipment will be those, who have skills of troubleshooting, combine general and specialized understanding of the technological systems. An ability to acquire new information about technological changes plays a crucial part (Johnson & Satchwell, 1992).

We can come to a conclusion that troubleshooting turns into important skills for work of future air-personnel. It requires from technicians the use of their skill, knowledge, experience for the effective interrelation with the complex technical systems, which function in the unusual mode. Numerous researches show that skills of troubleshooting can be developed with the help of well organized instructions.

Theory-oriented instructions are more easily to and conduct than an effective activity-directed training. Instructors which aspire to the increase of an instructional component in experimental training often face the lack of educational equipment. However computer technologies can support technical instructions. The modern computer programs allow instructors to conduct practical training flexibly and more effectively because instructors are no longer limited by the lack of equipment and time. Students get experience in realistic troubleshooting during laboratory works and in their free time (Johnson, 1992).

The effective program for technicians' for troubleshooting training providing knowledge needed for understanding technologies is the tutor program Technical Troubleshooting



Tutor (TTT) that reproduces scenarios of problems related to aviation equipment. In such a way students can study airplane electronic systems. In this program several pedagogical technologies are incorporated. These principles combine the incorporated components of apprenticeship such as coaching, mentoring, encouraging microclimate of surroundings, the use of the real problems, situations, context, maximization of time spent on cognitive activity, reduction of cognitive overload during practice. The TTT provides the structured practical surroundings for students, as it is based on real problems. A problem scenario is offered for students trying to solve it by information collection and interpretation. Thus, students get instructions for thinking and activities development similar to those of an experienced specialist (Johnson, 1992).

So, The TTT allows instructors to make flexible practical training more effective. Well developed software allows students to get realistic training. The result of the use of this program is a possibility to train more technicians for shorter time (Berentsen, 2006).

While studying future technicians' for equipment maintenance training in aviation in US establishments an interesting pedagogical strategy has been found. According to it teachers of technical subjects combine efforts with teachers of academic subjects. Thus, it allows students to acquire empiric knowledge and skills usually difficult to obtain during traditional studies. While working on projects, usually offered during studies, students acquire skills of critical thinking and empiric knowledge (Cotton, 2002). Due to the use of activity-oriented technologies students become more independent and motivated to participate in an educational process (Brewer, Burgess, 2005).

CONCLUSIONS

Thus, our research allows us to conclude, that in American aviation schools the use of innovative pedagogical technologies in the training of future technicians for equipment maintenance in aviation shortens training time and financial charges. Students trained with the use of these technologies show better skills of critical thinking, equipment troubleshooting during practice. The use of such technologies saves time on novices' mental model transformation to the type of thinking inherent for experienced specialists. To our further researches we refer the comparative analysis of peculiarities of training avia-personnel in American and Ukrainian educational establishments.

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