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Research Article

ORGANIZATION OF A PEDAGOGICAL TESTING EXPERIMENT IN TEACHING NUCLEAR TECHNOLOGIES IN HIGHER EDUCATION INSTITUTIONS: ANALYSIS AND RESULTS

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ABSTRACT

In this article, the application of pedagogical research results to the educational process is important and shows the effectiveness of the performed research work. The main goal of experimental work aimed at improving the content and effectiveness of teaching nuclear technology to students of higher educational institutions is that high indicators have been achieved in the formation of knowledge of nuclear technology among students of higher educational institutions. Experimental work was carried out during 2019-2022, and experimental and control groups were selected from among students of Tashkent Medical Academy at Samarkand State Medical University and Bukhara State Medical University.

KEYWORDS

Nuclear technology, Pearson's Chi-square, Pearson's formula.

INTRODUCTION

During the organization of classes on the subject of nuclear technology, the content of the subject and the initial state of students' knowledge, imagination and skills were determined.

The results of the analysis showed that the students of higher education have insufficient knowledge of nuclear technology, that training manuals and textbooks are not published, and that they do not have an idea about the application of medical technical and nuclear energy laws to the body. In the experimental

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and control groups, all kinds of classes related to nuclear technology were conducted by 8 professors and teachers. In higher education institutions, the study of nuclear technology was carried out traditionally in the control groups, and based on the experimental method in the experimental groups.

Materials and methods

The science of nuclear technology was organized using modern educational technologies. The organization of classes with the help of pedagogical and information technologies, videos, demonstration experiments and electronic slides led to the formation of theoretical knowledge, practical skills and qualifications in students.

One of the main tasks is to confirm the content of the research work and the effectiveness of the ideas put forward in them based on the analysis of the final results of the experimental work conducted at the Samarkand State Medical University, the Bukhara State Medical Institute, and the Tashkent Medical Academy using mathematical and statistical methods.

Experimental work consists of three stages, i.e. highlighting (2019-2020), formative (2020-2021) and final (2021-2022) stages.

It was organized among students in the 1st stage of higher education institutions.

275 students from higher education institutions were involved in the pedagogical experimental work, 137 were divided into the experimental group and 138 were divided into the control group.

Table 1. Students of higher education institutions involved in pedagogical experimental work

Academic year	Experienced higher education institutions	Number of students		
		Experience	Control	Total
2019-2020	Samara State Medical University	20	19	39
	Bukhara State Medical Institute	17	18	35
	Tashkent Medical Academy	18	19	37
2020-2021	Samara State Medical University	14	15	29
	Bukhara State Medical Institute	14	13	27
	Tashkent Medical Academy	15	14	29
2021-2022	Samara State Medical University	16	15	31
	Bukhara State Medical Institute	12	13	25
	Tashkent Medical Academy	11	12	23

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	Total	137	138	275

As the main goal of the first stage of experimental work (2019-2020), research literature, dissertations, abstracts, and articles on the research problem in scientific journals were studied. Materials of foreign literature, international conferences, and conferences were studied and compared with the state of the field in our republic. As a result of the research, the content of the subject, methodological recommendations for its effective mastering, and the teaching methodology were formed. Higher education institutions studied the state of the science of nuclear technology and developed criteria for determining the level of students' knowledge and ideas about science. For this purpose, the activities of students in theoretical, practical and laboratory classes in the field of nuclear technology were studied. Science and working programs of nuclear technology were analysed. Organized training sessions were observed in higher education institutions.

Initial data collection questions were developed and offered to students.

1. What concepts do you know about ionizing radiation?
2. What do you know about reactivity?
3. What do you know about radioactive pharmaceutical preparations (RFP)?
4. What concepts do you know about radiation dose and safety?
5. What do you know about the use of X-ray diagnostics?
6. What is X-ray computed tomography?
7. What is the purpose of light therapy?
8. Corpuscular radiotherapy for what purpose is it used in medicine?
9. What is the purpose of electronic therapy?
10. What purpose is proton therapy used for?
11. What is the purpose of meson therapy?
12. What is ion therapy used for?
13. What do you know about neutron therapy?
14. What do you know about scintigraphy?
15. Radioimmunoassay
16. What is the purpose of positron emission tomography?
17. What purpose is nuclear energy used for?
18. What are the types of nuclear power reactors?
19. Impact of NPP on the Environment what do you know about
20. What do you know about the effects of nuclear power plants on people?
21. What do you know about accidents at nuclear power plants?

Observing classes, interviewing students and answering questions showed the following situations:

1) Lecture materials in higher education institutions are not related to the fields of specialization and the application of modern medical technical devices to patients is not covered;

2) Students do not actively participate in the test and problem-solving process in practical training;

3) They cannot practically explain the nuclear technological definitions and concepts they know by heart during the experimental work;

4) Students cannot demonstrate acquired knowledge, skills and abilities in practical training;

5) Classes are organized based on traditional methods;

6) It was found that most of the students have insufficient knowledge and ideas about the role of nuclear technology science in the medical field.

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In the second stage of experimental work (2020-2021)

An assessment criterion was developed for determining students' knowledge, skills, and abilities, and their mastery levels were determined in a 5-point (excellent, good, satisfactory, unsatisfactory) system.

Table 2. Assessment levels of students' knowledge, skills and abilities

Grade	Theoretical knowledge and practical skills
5	the student has complete knowledge of nuclear technology, thinks creatively, makes independent conclusions, works on issues and performs experiments.
4	the student knows the subject of nuclear technology, can draw conclusions, work on issues and perform experimental work, and cannot think independently.
3	the student does not have complete knowledge of the subject of nuclear technology, can conclude, does not independently carry out issues and experimental work does not think independently.
2	the student does not know the subject of nuclear technology, cannot draw conclusions, does not carry out issues and experimental work does not think independently.

Table 3. Students' mastery indicators at the beginning and end of the experiment

Experiment stage	Groups	Number of students	Grades				Average grade
			5	4	3	2	
At the beginning of the experiment	Experience	137	21	59	42	15	3.6
	Control	138	18	59	45	16	3.57
At the end of the experiment	Experience	137	36	82	15	4	4.09
	Control	138	19	71	41	8	3.7

Table 4. Students' mastery indicators at the end of the experimental test

In the second stage of experimental work (2020-2021)	In the second stage of experimental work (2020-2021)	In the second stage of experimental work (2020-2021)	In the second stage of experimental work (2020-2021)				In the second stage of experimental work (2020-2021)	In the second stage of experimental work (2020-2021)
			In the second stage of experimental work (2020-2021)	In the second stage of experimental work (2020-2021)	In the second stage of experimental work (2020-2021)	2		
In the second stage of experimental	In the second stage of experimental	In the second stage of experimental	In the second stage of experime	In the second stage of experim	In the second stage of	4	4.09	1.1

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work (2020-2021)	work (2020-2021)	work (2020-2021)	ntal work (2020-2021)	ental work (2020-2021)	experi mental work (2020-2021)			
	In the second stage of experimental work (2020-2021)	In the second stage of experimental work (2020-2021)	In the second stage of experime ntal work (2020-2021)	In the second stage of experim ental work (2020-2021)	In the second stage of experi mental work (2020-2021)	8	3.7	

RESULTS AND DISCUSSION

Pearson's "Chi-square" criterion was used to determine the reliability of the results obtained from the pedagogical experience and to demonstrate the effectiveness of the proposed work. Pearson's formula is expressed in the following form:

$$\mathbf{T}_{\text{куз}} = \frac{1}{n_1 n_2} \sum_{i=1}^{c} \frac{(n_1 Q_{2i} - n_2 Q_{1i})^2}{Q1i + Q2i}$$

Table 5. Students' mastery levels at the beginning and end of the experiment

Groups	Number of students	Grades			
		5	4	3	2
Experience	137	$\frac{36}{\frac{(137\cdot 54)}{275}} = 26,9$	$\frac{\mathbf{82}}{\frac{\mathbf{(137\cdot 153)}}{\mathbf{275}}} = \mathbf{76,2}$	$\frac{15}{\frac{(137\cdot 56)}{275}} = 27,8$	$\frac{4}{\frac{\mathbf{(137\cdot 12)}}{\mathbf{275}}} = \mathbf{5,9}$
Control	138	$\frac{19}{\frac{(138\cdot 54)}{275}} = 27$	$\frac{\mathbf{71}}{\frac{\mathbf{(138\cdot 153)}}{\mathbf{275}}} = \mathbf{76,8}$	$\frac{41}{\frac{(138\cdot 56)}{275}} = 28,1$	$\frac{\mathbf{8}}{\frac{\mathbf{(138\cdot 12)}}{\mathbf{275}}} = \mathbf{6}$
Total	275	54	153	56	12

Based on the obtained values, we calculate the x2- Pearson criterion:

$$x^2 = \frac{(36-26,9)^2}{26,9} + \frac{(82-76,2)^2}{76,2} + \frac{(15-27,8)^2}{27,8} + \frac{(4-5,9)^2}{5,9} + \frac{(19-27)^2}{27} + \frac{(71-76,8)^2}{76,8} + \frac{(41-28,1)^2}{28,1} + \frac{(8-6)^2}{6} = 19,1$$

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We define degrees of freedom:

$\mu = (\kappa - 1)(c - 1)$

Here κ - the number of columns of the analyzed data,

c - number of rows. $\mu = (4-1)(2-1) = 3$

Degree of freedom from the table $\mu = 3$ has been χ^2 we write the corresponding values of: $\chi^2_\kappa = \begin{cases} 7{,}815 \ p = 0{,}05 \\ 11{,}345 \ p = 0{,}01 \end{cases}$

It was determined that the statistical criterion value for the experimental and control groups was x2=19.1> x2crit =11.345. The analysis of the obtained results showed the confirmation of the ideas we put forward. The method of teaching based on modern pedagogical and information technologies offered by us has shown its advantages.

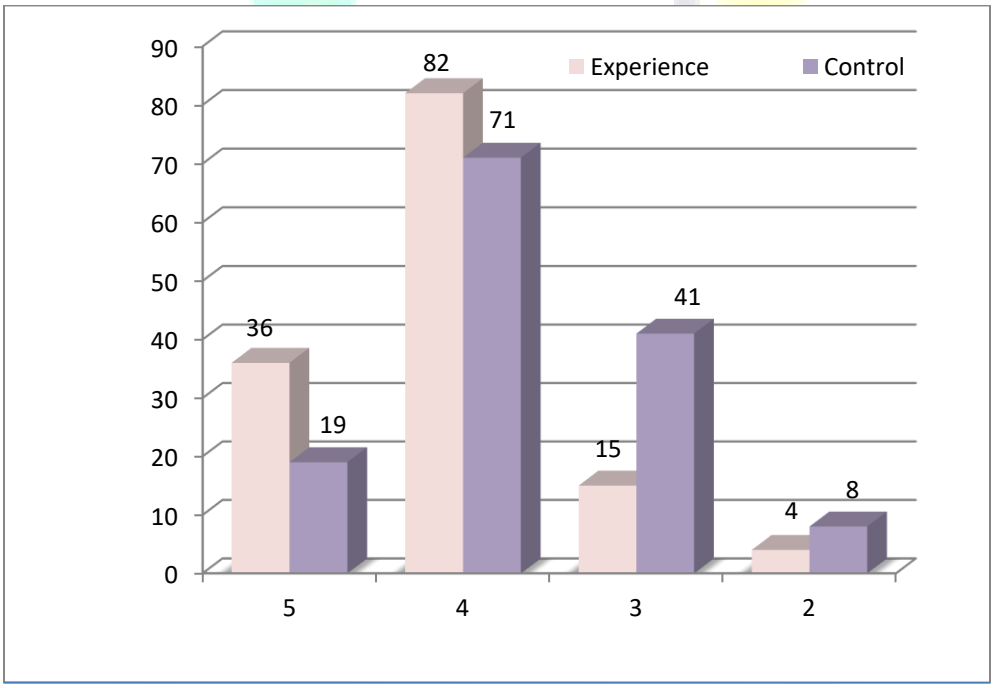

Fig. 1. Student learning rates at the beginning of the experiment

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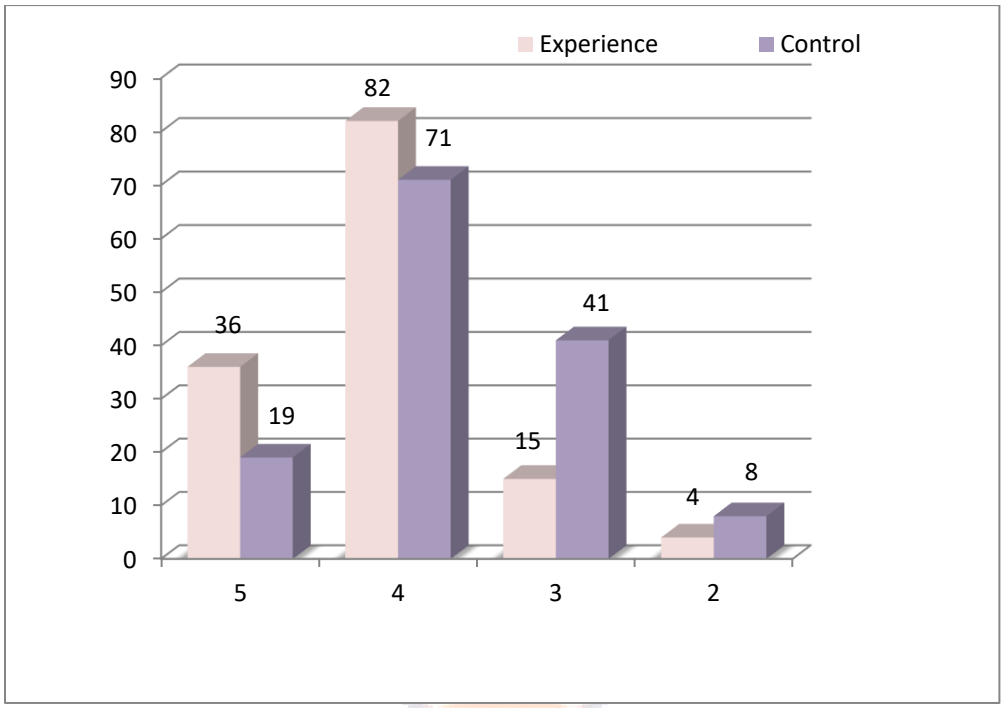

Fig. 2. Attainment indicators of students at the end of the experiment

CONCLUSION

As a result of the conducted experimental work, the improved content and teaching methodology of higher education nuclear technology science created the basis for making the following conclusions:

1. The content of the main stages of the pedagogical experiment-test work is explained. It is scientifically proven that the formation of training of medical specialists in higher education based on the science of nuclear technology has a positive effect on the educational process.
2. It was found that the improved content of the science of nuclear technology and nuclear technology in higher education serves to increase the efficiency of its assimilation.
3. Strengthening the practical application of the science of nuclear technology in the field of medicine in the training of highly qualified medical specialists in higher medical educational institutions was analyzed in a mathematical and statistical method.
4. Pedagogical experiment-test results are higher in experimental groups compared to control groups (xi square Pearson (□2) was proved based on the criterion.

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