Impact Factor:					
	ISRA (India) = 6.317	SIS (USA) = 0.912	ICV (Poland) = 6.630
	ISI (Dubai, UAE) = 1.582	РИНЦ (Russia) = 3.939	PIF (India) = 1.940
	GIF (Australia) = 0.564	ESJI (KZ) = 9.035	IBI (India) = 4.260
	JIF = 1.500	SJIF (Morocco) = 7.184	OAJI (USA) = 0.350

SOI: 1.1/TAS DOI: 10.15863/TAS
International Scientific Journal
Theoretical & Applied Science
p-ISSN: 2308-4944 (print) **e-ISSN:** 2409-0085 (online)
Year: 2022 **Issue:** 02 **Volume:** 106
Published: 22.02.2022 **http://T-Science.org**

QR – Issue QR – Article

L.K. Samandarov
Navoiy State Pedagogical Institute
Applicant, Republic of Uzbekistan
latifbeksamandarov@mail.ru

PEDAGOGICAL AND PSYCHOLOGICAL ASPECTS OF TEACHING PHYSICS OF THE ATOM, NUCLEUS AND ELEMENTARY PARTICLES IN PEDAGOGICAL HIGHER EDUCATIONAL INSTITUTIONS

Abstract: *This article highlights the pedagogical and psychological aspects of teaching atomic and nuclear physics in the preparation of future physics teachers. The specific features of teaching atomic and nuclear physics in theoretical, laboratory and practical classes are analyzed.*

Key words: *atomic and nuclear physics, teaching methods, pedagogy, psychology, pedotechnology, information technology.*
Language: *English*
Citation: Samandarov, L. K. (2022). Pedagogical and psychological aspects of teaching physics of the atom, nucleus and elementary particles in pedagogical higher educational institutions. *ISJ Theoretical & Applied Science, 02 (106),* 542-544.
Soi: http://s-o-i.org/1.1/TAS-02-106-53 ***Doi***: crossref https://dx.doi.org/10.15863/TAS.2022.02.106.53
Scopus ASCC: *3304.*

Introduction

In modern conditions, when scientific and technical knowledge is increasing in a continuous stream, the level of mastering the course of general physics for many areas of higher education institutions is one of the determining factors of the effectiveness of education. The physics course within the framework of state educational standards should form an integral system of knowledge and skills on the laws of modern physics and their practical application for future specialists preparing for all higher professional education. The fulfillment of this requirement, ultimately, comes down to the knowledge gained by students entering higher education institutions in physics in secondary schools. Because the topics in the higher education program are formed as an addition and development to general education knowledge. Knowledge of physics as a superstructure on a solid basis serves to form the worldview and scientific thinking of future specialists. Therefore, we can say that the quality and effectiveness of physical education in higher pedagogical educational institutions that train specialists for secondary schools determines the quality of the entire process of training engineers and technicians. This circumstance indicates that in pedagogical higher educational institutions it is necessary to pay serious attention to the issue of training future physics teachers[1].

In modern physics education, the subject “Physics of the atom, nucleus and elementary particles” occupies a leading place in the process of training future physics teachers. This is due, firstly, to the fact that this course is the final stage of the general physics course, and secondly, to the fact that nuclear technologies are now penetrating deeper into industry and our daily lives.

Modern physical education involves the use of advanced pedagogical technologies in the integration of traditional methods, as well as information and communication technologies.

The correct choice of pedagogical technologies and methods corresponding to each subject in teaching nuclear physics is one of the conditions for improving the effectiveness of teaching. The choice of methods used in the educational process means the choice of a pedagogical approach taking into account the age-related psychological characteristics of students. The worldview and thinking of students of higher educational institutions, in contrast to the worldview of students of schools and academic lyceums, should

be formed taking into account the psychology of higher education, the psychological climate among students and teaching staff[2].

The pedagogical process in a higher educational institution is a complex of opportunities, both for the listener and for the teacher, as a subject of creative self-realization of the pedagogical process, through the implementation of which there is an incomparable activation of self-development of students. Accordingly, the introduction of integrative educational technologies will remain relevant. In addition, in higher education, pedagogical and psychological aspects should be taken into account in the teaching of each subject[3].

Another important difference between a student and a schoolboy is that he is not just a student-listener, but an independent scientific researcher. And self-education is learning to self-organize your activities, self-control, developing new ideas, and so on. The main factor in the implementation of these tasks is the transition from a monologue lecture to a dialogical lecture–dialogue. Considering these aspects, when teaching students the physics of the atom, nucleus and elementary particles, it is advisable to use such advanced pedagogical technologies as “brainstorming”, “problem situation”, “cluster”, "intellectual map", etc., leading to deep thinking through a simplified scheme, taking into account logical dialectical connections, interdisciplinary integration, etc. Of course, the implementation of this task will depend on the student's level of knowledge in mathematics, chemistry and other natural sciences, as well as on the previous sections of the general physics course. It is on the basis of the knowledge formed by the student at the previous stages that a step is taken to the initial stage of studying processes, patterns in the microcosm. Although in fact quantum physics, which studies the laws of the microcosm, is fundamentally different from classical physics, it is impossible not to use classical concepts when studying quantum mechanical concepts. Take, for example, the concept of energy levels in an atom-electronic orbitals. At the same time, in Bohr's semi-classical theory, electrons are considered as moving particles in stationary orbits around the atomic nucleus[4]. Further research in this direction shows that in the microcosm, the concepts of trajectory, exact coordinates, exact energy at the exact time are not appropriate, i.e. instead of these values in the microcosm, we can only talk about the probabilities of finding particles at some point, the probable values of energy and momentum. But such states as the structure of the atom, the filling of energy levels in the atom, are gradually explained by the transition from simple to complex. The introduction of particle-wave dualism of microparticles into the consciousness of students, the formation of quantum mechanical representations requires excellent knowledge, qualifications and hard work from the subject teacher[5].

Conducting practical and laboratory classes in the physics of the atom, nucleus and elementary particles also requires the teacher to have specific knowledge. In all questions on this subject, considered in practical classes, elements of higher mathematics are used, such as integral and differential calculus, complex numbers, probability theory, the theory of numerical and functional series. This situation requires that the teacher and students work taking into account interdisciplinary integration in the educational process. The process of interdisciplinary communication is complex and has a feedback principle. Because the repetition of mathematical knowledge for studying the physics of the microcosm serves to form mathematical competence in future physics teachers in combination with their competence in physics[6].

Laboratory classes in atomic and nuclear physics also have their own characteristics. Such aspects include the complexity of laboratory facilities for atomic and nuclear physics, as well as the presence of problems with obtaining and storing radioactive samples. Taking into account these aspects, the curricula in atomic and nuclear physics, along with real laboratory work, also provide for virtual laboratory work performed on the basis of special computer programs. The correct organization of virtual laboratory work and their implementation, taking into account all experimental requirements, serve to form students' experimental skills and competencies. The methods of conducting classes in the physics of the atom, nucleus and elementary particles are different, and the effectiveness of any of these methods depends on many factors, such as the qualifications of the teacher and the readiness of the audience, that is, the level of knowledge of the listeners, as well as the amount of study hours allocated by the curriculum.

The role of information technologies in improving the quality of education in atomic and nuclear physics is invaluable and we can say that this is a requirement of the time. It is difficult to imagine without modern computers calculating the probabilities of nuclear processes in which identical particles obey the laws of statistical probability. In addition, these calculations allow not only to calculate a given state, but also to perform calculations for various values of system parameters. On the other hand, it must be remembered that computer technology is a means of solving a production problem, and is not the main means of theoretical and experimental knowledge[7].

One of the important points in teaching atomic and nuclear physics is the formation of skills to work with new information. It is known that new information is basically a collection of raw facts that are formed as knowledge by systematization,

generalization and identification of patterns in them[8]. Such generalization and systematization should be carried out not only for the educational material, but also for the student's private knowledge, and only in this case can the goal pursued in the learning process be achieved.

Difficulties arising in the general activities of students of higher educational institutions, by nature and form, can be divided into the following three groups:

- *Difficulties in cognition:* sharp differentiation of educational materials by content and volume, variety of forms and methods of teaching (lecture, seminar, colloquium, approbation, special course, etc.), complexity of seminar and lecture materials, variety of sources of obtaining material for them, insufficient qualifications for independent acquisition of knowledge, etc.
- *Socio-psychological difficulties:* changing the environment and living conditions; the transition to independence in all spheres of life and activity, the manifestation of cruelty towards volitional efforts, abilities, mental capabilities.
- *Professional difficulties:* Misconception about the process of adaptation to the conditions of higher education, the inability to effectively use the practice of specialty- specialization, the gap between practice and theoretical knowledge, the lack of professional qualities that meet the requirements of the chosen field of activity of students. [9].

The above general difficulties are also observed in the process of studying the discipline of physics of the atom, nucleus and elementary particles. There is no method that takes into account all pedagogical and psychological aspects and instructions for eliminating these difficulties[10]. Nevertheless, it can be said that in solving these tasks, the prevention of mental stress through the correct distribution of forces and capabilities in mental work, their systematization during the assimilation of educational material, the ability to properly allocate time is of paramount importance.

References:

1. Xudayberdiyev, E.N., & Samandarov, L.Q. (2020). Mesto i znacheniye kompleksnogo podxoda k povыsheniyu effektivnosti v prepodavanii fiziki. *FMI*, №6.
2. G‘oziyev, E. (1999). *Umumiy psixologiya kursining “Shaxs” bo‘limi.* (ma‘ruzalar matni). (pp.28-37). Tashkent.
3. G‘oziyev, E. (1997). *Oliy maktab psixologiyasi*. Tashkent.
4. Khudayberdiyev, E.N. (2021) Formation of environmental competence of physics students in teaching nuclear physics. *International Multidisciplinary Research Journal*, Vol. 11, Issue 11.
5. Xudayberdiyev, E.N, & Samandarov, L.Q. (2021). Problemi prepodavaniya teorii korpuskulyarno-Volnovogo dualizma dlya studentov – fizikov. *International Scientific Journal Theoretical & Applied Science*. Filadelfiya.
6. Xudayberdiyev, E.N., Samandarov, L.Q., & Nasriddinov, K.R. (2021). *Umumiy fizika (Atom, yadro va elementar zarralar fizikasi)dan laboratoriya ishlari o‘quv qo‘llanmasi.* Ch.: p.198.
7. Rogov, E.I. (1999). *Nastolnaya kniga prakticheskogo psixologa*. -M.: I-Tom. pp. 274-315, 369-374. I-Tom. pp. 277-320.
8. Semenov, Yu.V. (1993). Formirovaniye obobщennыx informatsionix umeniy v protsesse obucheniya fizike. *Prepodavaniye fiziki v visshey shkole*. (pp.57-61). Moscow: №3.
9. G‘oziyev, E. (1994). *Psixologiya*. Tashkent.
10. Xudayberdiyev, E.N. (2021). Bo‘lajak fizika o‘qituvchilarini tayyorlashda olamning fizik manzarasi bo‘yicha tasavvurlarni shakllantirish. *Academic Research In Educational Sciences*, Vol 2/Issue 9.