Implementation of Case Study Technology in Laboratory Lessons on Physics

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Abstract: The aim of investigations is revealing efficiency of using case study technology in laboratory lessons on physics relatively on other pedagogical technologies and traditional method of teaching a lesson. As the methods we used the case study technology, developing education technology and game technologies. Novelty of investigations is implementation of case study technologies in laboratory lesson on physics when pupils the laboratory work with inclined plane are doing. We showed that using new pedagogical and computer technologies allows us to teach lessons on physics more interesting, contently, in comparison of traditional ones. As the laboratory work, we choose the definition of efficiency coefficient of inclined plane. The analysis of results carried out experiments on revealing advantages of used technologies in mastery by pupils showed that the share pupils obtained the excellent knowledge when we used educational development technology then is approximately 1,5 times, and when the case study and games technologies are used then approximately 2 times more than the traditional method lesson.

1 INTRODUCTION

The last years the great attention to the quality of education on physics is paid. The quality of education growth depends, on the one side, on teacher, and the second side on pupils. If previously for growing quality of physics lesson the main attention to the theoretical style was been paid, and now is found that we must paid the great attention to laboratory lessons.

In paper (Potapova, 2021) the methodology for conducting the laboratory work on physics using smartphones as the measuring device had been developed. There authors showed that using smartphones allows pupils ensure transformation of student's attitudes to electronic devices. That is from the gadget's consideration as the communications device and equipment for game, musical content and communication on social networks using to the criterion of online education and future awareness to having in hand powerful equipment for investigations, measurements and data fixations.

In paper (Milinskii & Dneprovskaya, 2021)) the main difficulties emerging on students when they are calculating the direct and indirect errors of physical quantities, measured in the framework of laboratory works on physics had been considered. Authors proposed handout graphical material consisting the simplified instructions for calculating errors of these physical quantities. As the results of carried out investigations showed increasing the efficiency of performing by students the laboratory works and reduction of duration their performing.

In context of modern development society when the student graduate the university then he must possess planning skills and abilities, staging and conducting experiment and also critical and multilateral assessment estimation of obtained results, mastery of technique for errors calculation, ability to analyze and conclude on the obtained results, teamwork skills and ability for prognosis of experiment results. In paper (Levkin, Rasskazov & Xusainov, 2018) the methodology for conducting laboratory works on physics for bachelor students of engineering and technical specialties using interactive educational technologies had been proposed.

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In order to result of lesson was effective is requiring involve pupils for different activities: free and rapid thinking, flexible understanding of problems, fast solution methods of the problem and coming to a clear conclusion (Maxkamova, 2020). By conducting experiment on laboratory lesson on physics, using a creative, investigating and productive character of ability had been proposed (Tolmachyova & Kuzovova, 2019).

In paper (Gerasimova, 2021) the conspectus structure allowing to beginning teacher present all ability types requiring learn to perform in period of lesson, helping make self-analysis of lesson and modify in future the professional competitions had been proposed. Such training students promotes to that the game technology (didactic game method) in period of lessons can be used. Then one of students will being a "teacher" for 10-15 minutes, and all other students act as "pupils" in the class. "Teacher" presents the educational material, asks questions, asks "pupils" and "pupils" answer to questions, show experiences and demonstrate the physical phenomena and et al. After finishing answers, the analysis stage the just now conducted lesson is beginning. In another paper (Xusnutdinova, Gladkovskii & Protasovich, 2017) the involvement process to a creative work and internal motivation formation, appearance of philological and practical ability students for reaching the more qualitative results in education had been shown.

As it is known (Bazarova, 2021), when performing laboratory works on physics, then the difficulties dealing with the organization of independent works are arising. The skills obtaining independent knowledge, reading the scientific literature, analysis of obtained results in period of independent works are developed. In paper (Politsinskii, 2017) perform the laboratory work which, in opinion authors, promotes the formation on student's skills using the main laws of natural subjects in the professional activity, apply standard testing methods on definition of physical-mechanical properties had been proposed. In other paper (Solovyova, 2022) the methodology for activation of educational activity of students in physics laboratory based on the task approach had been described and justified. The expediency using special selected system and developed tasks on the separated stages, interactive models had been shown which promotes to growing education's result.

In paper (Dyujaya, 2016) had been noted that the important pedagogical condition in the process of developing interest among pupils to subject and educational activity totally is impact to the motivation sphere of pupils. Realization of this task promotes, in particularly, to following the principles of personal-oriented approach and individual study, compliance with subject-subject educational relations between teacher and pupil, using problem teach method, interactive working methods with class, project technologies, the broad implementation of information-communication devices to the training to laboratory lessons process. The pedagogical technology is functioning and as science too, which investigates the most rational educational ways and as system of methods, principles and regulators used in education and as real educational process.

Based on the results of the survey of teachers authors of paper (Gerlach & Tvelova & Belous & Varetsa, 2024) had obtained that educational organizations are equipped with sets of tabletop career guidance games; to expand and deepen teachers' ideas about the possibilities of using board games in career guidance work and increase their level of professional training in this area; to use board games more actively when organizing career guidance work in educational organizations; to create an up-to-date, constantly updated database these board career guidance games and provide access to it to all teachers of educational organizations.

Authors of paper (Khazhuev & Saidov, 2024) had constated that the pedagogical games are an effective tool in the educational process for the development of students' meta-subject skills. Using them not only helps us to increase motivation and interest in the educational process, but also develops in students important competencies necessary for successful adaptation to modern challenges. Based on systemic, subjective, activity-based, and axiological approaches, the authors of paper (Kariyev & Orazbayeva & Iskakova & Dyussekenova & Bakracheva, 2024) had developed a system for forming students' subjectivity during the educational process by actively utilizing interactive technologies.

2 MATERIALS AND METHODS

In the present paper, analysis of experimental results carried out on revealing the advantages using new information technologies when conducting lessons on physics is presented. As the lesson type, the laboratory work is chosen. Selected lesson title was "Definition of efficiency coefficient of inclined plane".

Experiments in 55th school of Tashkent city have been carried out. Then the same teacher have taught lessons on four parallel classes 9^{A}, 9^{B}, 9^{C} and 9^{D}. When he taught lesson on 9^{A} class then one used case study technology, on 9^{B} – developing teach technology, on 9^{C} – game technology and on 9^{D} –

traditional method. Before ending the previous lesson on physics teacher have warned pupils that they on the following lesson will perform the laboratory work.

For revealing results of carried out lesson on efficiency of used technologies at the beginning of the next lesson in each class teacher have distributed papers with tests consisting 10 questions on theme of previous lesson (see, Table 1). For solving these tests 10 minutes time have been allocated.

Table 1: Questions on testing mastery of pupils in duration of laboratory work "Definition of efficiency coefficient of inclined plane" (compiled by the authors).

№	question	correct answer	incorrect answer 1	incorrect answer 2	incorrect answer 3
1	What is the efficiency?	Share of intended use in the all spent energy	Share of intended use in the all spent force	Ratio of kinetic energy to potential one	Ratio of lifting force to gravity
2	What is the efficiency when we lift of load on inclined plane?	Then friction force and reaction force will work in our favor	Then gravity of load will work in our favor	Then friction force will work in our favor	Then we deal with the gold rule of mechanics
3	What is the unit of efficiency?	*%*	*Joules*	*Newtons*	*kilogram*
4	The range of values of efficiency?	$0 \div 100$	$1 \div 100$	$0 \div 50$	$-100 \div 0$
5	The mechanical work is defined by representation …	$A = Fs\cos\alpha$	$A = Fs\sin\alpha$	$A = Fs\,\mathrm{tg}\alpha$	$A = F/s$
6	The potential energy of the lifting load is defined by representation …	$E_p = mgh$	$E_p = mgs$	$E_p = mgh\sin\alpha$	$E_p = mgh\cos\alpha$
7	What forces are acting when we lift load by inclined plane?	gravity, prop's reaction force, friction force	gravity, elastic force, air resistance force	gravity, the device traction force	gravity, Archimedes force, friction force
8	What branches widely use of the inclined plane in?	in construction, manufacture, mineral deposits	In medicine	In science	In education
9	The angle of inclined plane is …	Angle between horizon and inclined plane	Angle between horizon and height of inclined plane	Angle between height and inclined plane	Angle between traction force and gravity
10	Power of device is measuring in …	*Watt*	*Joule*	*Pascal*	*Newton*

As we can see from Table that the proposed questions absent in the control questions list of the laboratory work's manuals, but pupils must know after conducting the laboratory work. That is, in order to answer to them questions pupils must use own quick-wittedness.

After this time duration, the papers with answers from all pupils have been collected. Then pupils with $8 \div 10$ correct answers we rated as "5" (excellent), $6 \div 7$ – "4" (good), 5 – 3 (satisfactorily) and $0 \div 4$ – 2 (unsatisfactorily).

When we analyze the share of pupils with "excellent" rate (excellent share) and mastery degree of the lesson theme by pupils one defines by following representations, correspondingly:

$$\text{excellent share} = \frac{\text{excellent}}{\text{total pupils quantity}} \cdot 100\%; \quad (1)$$

$$\text{mastery degree} = \frac{\text{excellent} + \text{good} + \text{satisfactorily}}{\text{total pupils quantity}} \cdot 100\%.$$

The efficiency of mastery degree of the lesson theme by pupils using a concrete educational technology in comparison of the traditional method of the lesson we define by representation:

$$\text{efficiency} = \frac{\text{technology} - \text{traditional method}}{\text{traditional method}} \cdot 100\% . \quad (2)$$

Here "technology" is the mastery degree when the concrete pedagogical technology is used, and "traditional method" is the same degree obtained during lesson in traditional method.

3 RESULTS

Results of experiments with corresponding quantities of pupils with all used pedagogical technologies have been presented on Table 2.

Table 2: Experimental results of defining pupil's knowledge obtained after completing the laboratory work using new educational technologies (compiled by the authors).

№	Used educational method	Total quantity of pupils, person	excellent, *person*	good, *person*	satisfactorily, *person*	unsatisfactorily, *person*	Excellent share, %	Mastery degree, %	efficiency, %
1	Case study technology	30	8	12	8	2	26,7	93,3	45
2	Developed educational technology	29	6	11	8	3	20,7	86,2	34
3	Game technologies	30	7	10	10	3	23,3	90,0	40
4	Traditional	28	4	10	4	10	14,3	64,2	-

4 DISCUSSION

It is seen from Table that in all cases where pedagogical technology is used the essential efficiency ($34 \div 45\%$) in comparison of the traditional method of lesson is observing. There the most mastery degree, 93,3%, we reached using case study technology, and the least, 86,2%, one obtained when development educational technology is used.

It should be also noted that the share pupils obtained the excellent knowledge when we used educational development technology then is approximately 1,5 times, and when the case study and games technologies are used then approximately 2 times more than the traditional method lesson.

This circumstance confirms once more the fact that now it is time for practically give up from the traditional lesson methods or at least we must teach the modern lesson in combination of traditional methods with the new educational technologies.

5 CONCLUSION

Thus, based on analysis of experimental results carried out on revealing the advantages of using new pedagogical technologies in the laboratory works on physics we can conclude that:

The first, in all cases where pedagogical technology is used the essential efficiency ($34 \div 45\%$) in comparison of the traditional method of lesson is observing. There the most mastery degree, 93,3%, we reached using case study technology, and the least, 86,2%, one obtained when development educational technology is used.

The second, the share pupils obtained the excellent knowledge when we used educational development technology then is approximately 1,5 times, and when the case study and games technologies are used then approximately 2 times more than the traditional method lesson.

The third, this circumstance confirms once more the fact that now it is time for practically give up from the traditional lesson methods or at least we must teach the modern lesson in combination of traditional methods with the new educational technologies.

The most important result of this paper in that the case study method is more effective than game technologies and developed educational technology ones when we carry out the laboratory work on physics.

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