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TEACHING OF ELECTROMAGNETISM WITH NDT (novel data technologies)

The importance to the affective domain in learning is underscored in many research pursuits at the expense of the cognitive development of students studying science, in particular, physics. The thesis has proposed a structure, the pedagogical technological combined medium (PTCM) founded on the electronic model, that builds on the existing premises of pedagogy, content, and technology to make space for the affective domain where these three premises intersect with each other. Establishment of the PTCM framework through a multi-loop model that explores the affective dimension as an overarching space for interaction among learners, teachers, and parents through a series of stages included home tasks, as well as seminar and out-of-university activities. The paper is wanted to show the effectiveness of the methods and techniques of teaching «Electromagnetism». The context provides the results of new technological education teaching, samples the needed literature, and also to bond strengthen the scientific research.

Key words: education, teaching, modern education technology, electromagnetism.

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Электромагнетизмді ЖАТ-пен оқыту (жаңа ақпараттық технологиялар)

Оқытуда аффективті доменнің маңыздылығы көптеген ғылыми зерттеулерде жаратылыстану ғылымдарын, атап айтқанда физиканы зерттейтін студенттердің когнитивті дамуы есебінен байқалады. Мақалада педагогика, мазмұны мен технология қолданысындағы алғышарттарына негізделген және осы үш алғышарттар бір-бірімен қиылысатын тиімді аймақ кеңістігін құру үшін педагогикалық технологиялық біріктірілген ортаның (ПТБО) электронды үлгісінің құрылымы ұсынылған. Технологиялық ортаны қолдану оқыту үдерісінің (эмоционалды саласының) аффективті домені үшін кеңістікті босатуға мүмкіндік береді. Көпқұрылымды үлгінің көмегімен ПТБО құрылымы әзірленді. Орта аталмыш электрондық кеңістік арқылы оқушылардың, оқытушылар және ата-аналар арасындағы өзара байланыстың, үй тапсырмалары, сонымен қатар университеттен тыс семинарлар мен сабақтардың нәтижелерін өлшеуге мүмкіндік береді. Мақала аталмыш үлгіні қолдана отырып "Электр және магнетизм" курсын оқытудың құрылымы мен әдістемесінің тиімділігі көрсетіп, таныстырып, пікірталасқа шақырады. Мақала мазмұнында жаңа әдістемелік тәсіл – педагогика мен технологияның, пән мазмұнының интеграциясы және технологиялық білім берудің жобаланған ортасының нәтижелері және ғылыми зерттеулерді нығайту үшін қажетті әдебиеттердің үлгілері ұсынылған. Электронды технологиялық ортаның апробациясынан соң оның тиімділігін анықтау үшін студенттерге арналған сауалнама жасалынды. 50 студенттің 80,3%-ы аталмыш құрастырылған ортаның оқыту үшін қолдану тиімді деп санайды. Қалған студенттер оқытудың дәстүрлі әдістерін қолдануды қалайды.

Түйін сөздер: білім беру, оқыту, заманауи ақпараттық технологиялар, электромагнетизм.

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Обучение электромагнетизму с НИТ (новые информационные технологии)

Важность аффективного домена в обучении подчеркивается во многих исследовательских работах за счет когнитивного развития студентов, изучающих естественные науки, в частности физику. В статье была предложена структура электронной модели, педагогическая технологичес-

кая комбинированная среда (ПТКС), которая основывается на новом методическом подходе интеграции содержания предмета, педагогики и технологий. Использование технологизированной среды поможет освободить пространство для аффективного домена (эмоциональной области) процесса обучения. Разработана структура ПТКС с помощью многоконтурной модели. Среда позволяет измерять результаты через данное электронное пространство взаимодействия между учащимися, преподавателями и родителями на протяжении ряда этапов, включающих домашние задания, а также семинары и занятия вне университета. Статья призвана познакомить и предложить для дискуссии, показать эффективность предлагаемой структуры и методики обучения курса «Электричество и магнетизм» с применением данной модели. В содержании статьи представлены результаты нового методического подхода - интеграции содержания предмета, педагогики, технологий, и спроектированной среды технологического образования, в которой также представлены образцы необходимой литературы для закрепления научных исследований. После апробации электронной технологизированной среды была разработана анкета для студентов по оценке ее эффективности. Из 50 студентов 80,3% считают, что эффективно использовать разработанную среду для обучения. Другие все же предпочитают ранее зарекомендовавшие себя (традиционные) методы обучения.

Ключевые слова: обучение, преподавание, современные технологии обучения, электромагнетизм.

Introduction

It is known that the traditional education in Kazakhstan is based on continuous and sequential assimilation of knowledge and relies on the reproductive capabilities without regard to personal creativity. The reality is that highly qualified modern specialists have to work in complex, rapidly changing conditions of scientific-technical progress, which requires constant updating of knowledge, erudition, combined with deep special knowledge, skills of conducting scientific research and creative attitude to their professional activities.

Studying at the university can change or improve the not only knowledge but also a way of thinking. The most important that can be turned is not what the teachers teach, but how they teach. In Kazakhstan, the method of teaching is moving to the new technological medium, which helps to exchange experiences in developing mental skills and take advantage of removing to the outside of the country. In this way, weighty influence in science is taking part a physics; almost a branch of it «Electricity and Magnetism».

It is well-known that students of various ages have problems in understanding some basic concepts of electricity and magnetism. This fact has been verified repeatedly by conceptual tests like CSEM (Conceptual Survey on Electricity and Magnetism, Maloney et. al., 2001), BEMA (Brief Electricity and Magnetism Assessment), DIRECT (Determining and Interpreting Resistive Electric Circuit Concepts Test) and others.

Contents

The paper offers that using noveldata technologies (NDT) in teaching physics, and particularly, electromagnetismwill be a promising solution to these problems. There are several factors which cause their use at the present stage of training. First, many high schools have computers due to the social and economic achievements. The quantity and quality of ready-made physics software allows implementing various learning technologies. Secondly, the simulation with the use of any computer technology can give a good dynamic illustration not only of the observed physical processes and phenomena, but also of those processes that are not available for observation in a real experiment; and it also allows providing greater flexibility in conducting computational physics experiments and solving various experimental tasks. The computer with modern equipment connected to it gives us the possibility to conduct research of different studying processes on a high level. Accordingly, the use of new computer experiments (demonstration and laboratory) in training electromagnetism allows overcoming the mentioned related experiment problems. Moreover, the potential benefits of NDT give the opportunity to organize productive learning and make learning process personally oriented and the opportunity to set and solve both traditional and new educational objectives: the formation of model representations, information, communication and other skills of students.

For instance, as a specific tutorial path in Kazakhstan Universities, there is taken place Al-Farabi Kazakh National University. Accepting the English language as a crucial teaching means the leveling up of educational system in Kazakhstan and it is the main requirement of our university. Nowadays, materials and information, scientific researches give opportunity to find out new, qualitative knowledge. The fundamentals of physical thinking are formed and developed in specific forms and methods of training.

Physics course in modern higher education of Kazakhstan includes effective teaching and learning information technology, focused on the formation of key competencies, which in turn develop the motivation, proactive learners. New information technology teaching physics that are the subject of information, promote processes such as design, construction, implementation, analysis, rendering computer systems development methodology of teaching physics at the university. The learning process in higher education should be based on this concept and methodology of training that combines theory of design methodology and theory of mastering practical skills. Some methodological problemsfigures out in the learning process of information, they are performed based on educational technology, using of information-communication technologies and it allows to organize collective and individual students. Active involvement of students in activities to address the challenges of innovation extends content-semantic space of the learning process.

The goal of physical education is to develop students' knowledge of the theoretical basis of the methods of teaching physics. The content and organization of the educational process in physics in the framework of modern educational technology is the training of specialists in discipline physics in the modern school.

The study of theoretical questions has accompanied to the practical training, which works through the implementation of all kinds of physics experiment. The components of the methodical system of teaching physics at the university are learning objectives, content of physical education, methods, tools and organizational forms of education. Methodical system is based on scientific and theoretical positions of the discipline (content of the training material, exercises, laboratory work and demonstration)for the preparation of students of physics.

The listed components of methodical training system are aimed to the creating of motivation and incentives for students to acquire knowledge independently. Methodical system aims to develop skills such as the ability to design a lesson, modeling technology and teaching methods, tutoring and educational activities and other kinds and forms of academic and extracurricular activities.

The most difficult topics, videos were produced explaining the essentials. The complimentary off class study, written material, and the laboratory-based practice should provide the students with a learning route from elemental to advance. This investigation allows evaluating two approaches where students acquire knowledge both prior and after watching the video. Group interviews and surveys to those who watched the video afterward probe the concepts were stated clearlyto us.

Seminars are also conducted using information technology. As additional tasks, special sites are used (with examples and solutions). Seminar develops competence of student's theoretical knowledge from lecture. The cause of more quantity of students and complicated, complex theory of course need using NDT. During the applying of NDT, learners can determine exercises and equations by themselves, in addition managing their time. On this purpose, the seminar «Electricity and Magnetism» is used as shown in the figure 1.

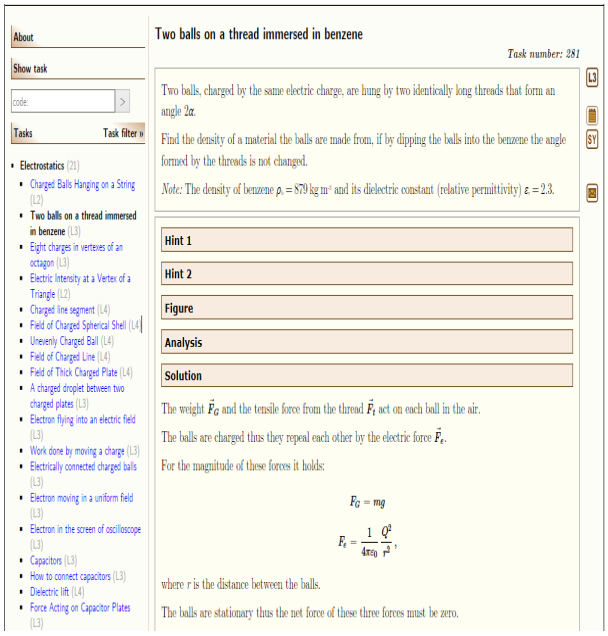

Figure 1 – Extra applied tasks in seminar

As shown in the figure 1, solving the tasks consists of memorizing the lecture, scheme, hint1, hint 2, analysis and solution.

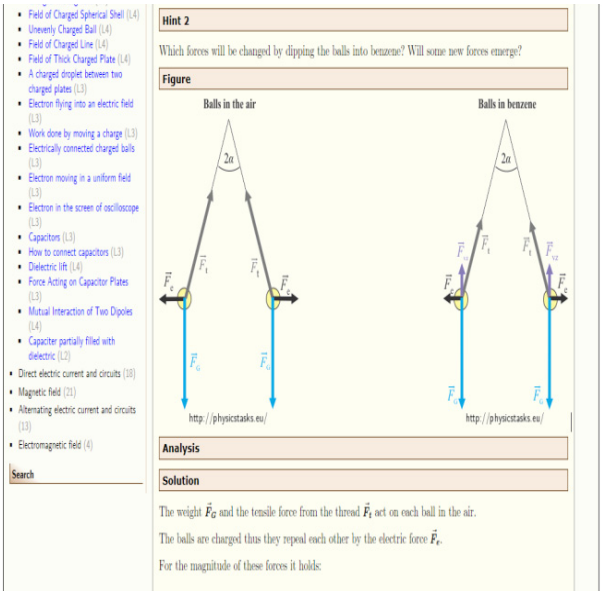

Figure 2 – Representation and solution of task

By this technology, every student can clear up tasks of each topics.

In the laboratory work, the student can practice the theory that he has read in the lecture. The main purpose of the laboratory class is to interest students in conducting experiments, to analyze the results and to make conclusions. At each laboratory studies, the students have to set goals, such as learning all theories about an experiment, to know the rules for working with instruments, to do the work and to calculate, to plot and to find the most convenient way to perform exactly these experiments again. The results of the completion of work task can be shown by different programs. Interpretation is likewise clearly understood and witty indicated. To maximize laboratory-based practice time in an undergraduate course at the Electricity and Magnetism, which was limited due to the number of students, the theoretical topics were transferred to a flipped classroom format, via the production of explicative videos. Preliminary results show that videos achieve the objectives being well accepted by the students. The students watch the video during the class having already been given tools and instructions. The implementation will allow a more profound evaluation. The creation of the videos enhanced the possibility of maximizing the laboratory-based practice time, enabling the syllabus to adapt to the flagging concepts.

In the Figure 3, there is experimentally demonstrated in purpose of additional learning, comprehending of laboratory work as an example. There are written the theoretical, image and the working process in movie form.

Figure 3 – Extra using equipment in the laboratory work.

Results

The use of multiple devices are investigated in the different fields in during class, the various material used in the course ofclass, pedagogical aspects, some general issues and the use of NDT for teaching. The questionnaire was implemented electronically using Google Form, which was a professional web-based freeware tool offering signs. They were used to provide an anonymised questioning with the option to track who had complied the questionnaire already. One remembering mail was sent to people with missing data to bring them to fulfill the questionnaire.

A questionnaire with 12 questions clustered into two different fieds was developed by the exploration group and covered two main research questions: 1. Do students appreciate the used method and do they see it as a modernized way for their learning? 2. Is the learner-centered approach using multiple devices as the central teaching tool a promising method for the students**?**

The following table 1 gives an overview of the questions related to the core features of the teaching method, like the basic texts, the use of presentations and the multimedia material.

The second cluster evaluates pedagogical issues, like the use of hands-on experiments, the role of the teacher or active parts of teaching.

Table 1 – Surveyresults

№	Question Text	I completely agree	Ipartly agree	I do not really agree	I totally disagree
1	The availability of foundation texts supports the contribution in class	36	11	1	1
2	Multimedia presentations which are uploaded on the e- learning platform support studying and reversing learning matters	38	10	2	0
3	The use of videos and animations endures the understanding of learning matters	39	11	0	0
4	Experiments (all thing considered the necessary materials are available) increase the value of class	40	9	0	1
5	The teacher, who instructs in class, should communicate the learning elements to students	40	8	0	2
6	During class the teacher should strengthen students to take part actively in class, for example with the assistance of questions and discussions	38	9	3	0
7	The online learning platform provides students with additional multimedia presentations and the simple presentations which are shown in class. I check and transmit them regularly.	39	8	1	0
8	Function with laptop in class has improved my computer skills	42	7	1	0
9	Engaging with laptop in class has improved my computer skills in different programs (as word, etc.)	43	6	1	0
10	I would use implemented videos for learning matters for studying at home	46	4	0	0
11	I would like to work with my partner, not with laptop or virtual teaching more often together in class, to work out different sections of learning matters	39	8	1	2
12	The use of a computer makes it easy to supply class	42	6	1	1

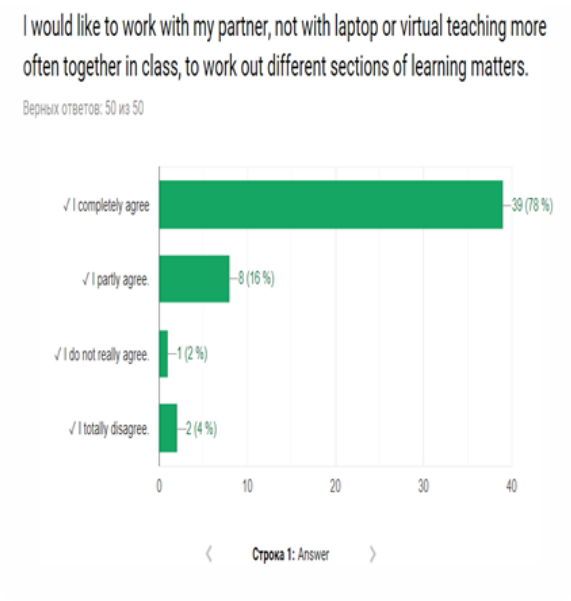

Figure 4 – Example of results

Conclusions

50 students clicked their answers, overall 80,3% of students completely agreed with the NDT system. Others followed the elder system ofeducational work. There are some open questions asked to see the the suggestions of students for better teaching as well as to criticize what has been going wrong during class.

The students highly agreed to the usage of the teaching and asserted a high level of appropriateness of the system for learning science.

The study confirms that from the point of view of the students the teaching method is well accepted by the students and that they see the method as a suitable and well structured way of teaching. The technology enhanced approach can be managed easily by the students and they see an advantage of using technology in being taught science, especially electricity and magnetism.

The study reflects a high level of satisfaction of the students and they feel well supported in their learning process. For instance, there are not existed any problem in using NDT which must be seen as a successful preparation work.

In conclusion, the NDT is useful, easy to understand and there is concrete way to point out one of the most difficult subject as the «Electricity and Magnetism». The purposes of teachers are developing of critical thinking, easy valuing, and also being smart at their subject. There is found not problematic pedagogical technology, which will avoid from difficult situations and keep in mind future goals.

The integration of ICT in university teaching needs serious consideration in order to increase the competency of the country's education system. It will help to increase the national education in the world ranking and produce the better way to the future work.

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