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Design of a University Course for the Training of Biology Teachers in a Virtual Environment (Analysis of Results Taking into Account Students' Attitudes to the E-learning)

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Abstract

Over the last decade, the concept of "designing e-learning" in the field of higher education has been in the focus of various research communities. Given the increasing number of e-learning publications, the issue of a university course model is becoming a widely discussed topic. The aim of the article is to present a specific solution related to the design of a traditionally organized course in electronic, for the preparation of future teachers of biology. The research process of designing a theoretically based model of pedagogical activity within the framework of a university e-learning course, including stepwise steps in its creation, following the phases of the ADDIE model, is briefly described. Using statistical tests to verify hypotheses (relative percentages), a comparison of the results obtained, taking into account the attitudes of the students before and after the e-learning, was made.

Keywords: e-learning; university course; course design; students' attitudes.

1. Introduction

Over the last decade, the concept of "e-learning design" in the field of higher education has been in the focus of various research communities. Because of the increasing number of e-learning publications, the problem of a university course model is becoming a widely discussed topic.

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In most cases, it is mostly related to the quality of electronic materials and student activities within the course. Emerging technologies continually require a change in existing e-learning practices and directly affect applied theoretical frameworks [1,2]. A number of organizations and international projects are committed to creating and researching standards for developing or evaluating eLearning. Criteria and indicators are more closely related to the design of computer software, its elements and relationships, rather than the specifics of the learning process. Emphasis is placed on the technological side of design than pedagogical.

Studies of literature on the subject show the existence of a large number of publications and materials devoted to the design of e-learning courses outside the standardization systems [3, 4, 5, 6, 7, 8, 9, 10, 11, 12, etc.]. It is noteworthy the terminological diversity in the presented models and designs of university courses as well as the different centers in these models [13]. On the one hand, this is related to the specifics of the content of the e-courses, the different objectives, the target groups, and on the other - the specifics of the chosen learning environment and, last but not least, the autonomy of the higher education institutions.

2. Research Methodology

This article presents a specific solution related to the design of a traditionally organized course in electronic, for the preparation of future biology teachers.

The article explores the didactic potential of e-learning in the preparation of future biology teachers. Described is the research procedure for constructing a theoretically based model of pedagogical activity within a university course for e-learning (mixed form), including stepwise steps in its creation, following the phases of the ADDIE model.

Analyzed and systematized is the experience of its application at university level.

There is a wide variety of training product development models. A number of authors [14, 15, 16, 17, 18, etc.]. successfully applied the ADDIE model [19] to the design of a university e-learning course.

It is precisely the sequence of steps of the ADDIE model that serves as a "frame" in the design of two traditional university courses (compulsory discipline - The Experiment in Biology Education and optional - Applied Psychology in Biological Education) in mixed-type electronic courses. The complete redesign and revision were carried out in two successive academic years 2015-2016 and 2016-2017 with a total of 115 students.

In the work process were followed the basic phases of the ADDIE model and the ISO 10015: 1999 standard, which provides guidance for developing, implementing and refining training strategies and systems on which the quality of the product or service provided by an organization depends. The analysis phase identifies the trainees' profile and formulates learning objectives [13, 20].

A questionnaire was conducted to identify the profile of learners - needs and attitudes analysis, which identified the trainees' profile.

The questionnaire includes 18 questions that take into account the motivation, the style of learning and the level of cognitive experience, as well as the preferred ways of obtaining feedback and the knowledge and skills of the students in the field of ICT. The motivation of the learners to participate in the e-course is defined "indirectly" - 8 of the questions are related to expectations, attitudes and readiness to participate in e-courses.

Pedagogical design also takes into account the knowledge and skills of ICT learners as they are not the subject of formation within the course. This is an essential condition that the teacher should take into account when designing the overall design of an e-learning course [21].

Exactly formulated goals, detailed descriptions, clear, specific and measurable learning objectives in the analysis phase are the starting point of the design phase. This phase of the ADDIE model corresponds to an e-course micro design that is related to the planning of each activity individually (its organization, structure and content) and the links between the different activities in the operational plan so that their sequence will lead to the objectives of the course [7, 13, 20, 22, etc.].

The main stages in the development phase are: (a) Course design; (b) Content sequencing; (c) instructional strategies; (d) Course layout; (e) Course management plan.

Moving to the online environment is much more than simply creating electronic versions of paper content.

The pedagogical design of the learning activities in the two courses for the purposes of e-learning is carried out according to the following algorithm:

(1) defining the learning objectives to be achieved and in line with this planning of learning activities (eg to form new knowledge and skills, control, self-control and verification of knowledge and skills, and to assess the level of formation of relevant knowledge and skills); (2) adaptation of the activity to a relevant learning style (which has been previously studied in the analysis phase through a survey); (3) decomposition of the individual actions and operations that constitute the structure of the activity [23].

In the development phase, an electronic environment (Moodle), a methodology, content, key concepts, activities and assignments, modules, and components of each module are selected based on the analysis (the results of the first phase).

The modular approach was chosen for structuring the two courses. The curriculum of the course is divided into separate modules. The module is considered to be "a set of learning situations organized in one whole. This sequence is due to the goals set and the adopted pedagogical strategy " [20, 22].

According to their pedagogical function in the learning process and the specific objectives they make, the modules in the two courses are: introductory, informational, summary, evaluation-result module and module for catching up with sub-modules for the individual information modules (Fig. 1).

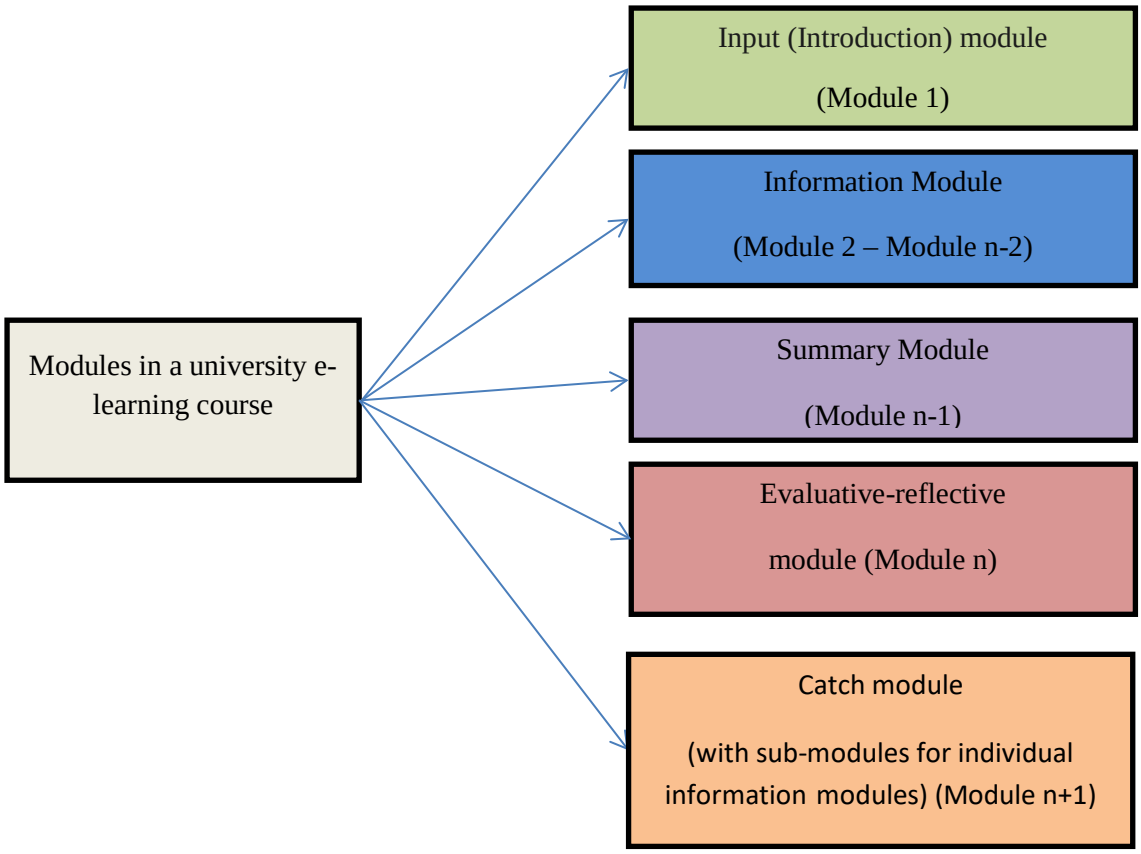

Figure 1: Modules in a university e-learning course

In each module various types of activities are envisaged with the objects of absorption [13, 20, 24].

Both courses use an indirect learning strategy that is based and organized on the knowledge and inclusion of the student in an active transformative activity - learning through research, problem solving and decision making, project creation.

Each information module includes: text and interactive learning knowledge; video-selections; images; animations and simulations; video related to educational content (including video tutorials); video / audio - feedback; different types of learning activities - assignments, workshops, discussion forums, wiki, small project development, analyzes, etc.; interactive learning activities and / or simulations - individual or group. Basic and obligatory literature is mentioned.

E-learning allows the use of specific support methods. Through the tools in the "Moodle" virtual learning environment, the two courses provide students with an administrative and specific support related to the content of the course. Assisting students is done through a variety of sources: the lecturer; support structures of the learning environment; course materials and recommendations; the other students in the target group.

Support is planned to take place at all stages of the course: before starting the course, during the course, after the course.

Before launching the two courses (in the introductory module), "general support" is delivered in the form of course, course objectives and tasks, evaluation criteria, motivation for the need for the training and the possibilities for realization after its completion. The prerequisites for the students to successfully cope with the course's training, as well as the students' entry level, are formulated. There is a presentation of the teacher (s) in the course; a description of the overall objectives and the expected learning outcomes of this course; description of the main topics of the course and the timetable for their utilization, also the evaluation system - current and final in content and time plan, training schedule - the time parameters of the important events in the course (delivery of learning outcomes, other learning events). The main sources of information and resources, as well as the peculiarities of online learning and the expectations and requirements for the students' participation in the course, are presented. An activity for presenting and acquainting students is provided, information on access to the lecturer, including synchronous.

During the courses in the catchment module resources are provided to support each of the information modules; information is provided to students on the pace and quality of their work on the basis of ongoing assessments of individual and group tasks; a discussion forum for general questions on the content of the course is set up, where students can ask questions at any time, as well as a forum for informal communication of learners. The resources for the information modules are basic and additional, each module is provided with basic and additional literary sources.

After the course there are suggestions for further development and how the student can continue his / her training.

The development phase includes the preparation of the resources in both courses, their implementation in the electronic environment and the creation of the "prototypes" of the courses. During this phase, all resources were created within the courses. The product at the end of this phase has been developed a detailed action plan that describes step by step the procedures for introducing the two courses with a corresponding time schedule with deadlines. Depending on the learning styles, the content is presented in different formats in order for the learner to make choices. The materials are interactive. Activities are balanced between individual and collective.

At the implementation phase, a plan is drawn up which establishes the implementation sequence and the training procedures as well as the completion of the final product.

The evaluation phase provides both formative evaluation and summative assessment. Current assessments enabled adjustments during each stage of the redesign process and the entire conversion of the course. Some changes have been made to the content in order to respond to the needs of learners and the style of learning. In online courses, formative assessments are particularly important because the "learning curve" provides information that could enhance the picture of what is being observed in the development and implementation phase.

Periodic feedback from students is provided. Students' comments helped to improve the content of the course and clarify unclear instructions or information while the course was in the process of being implemented.

Summaries have helped to determine the effectiveness of content and activities to help students achieve learning goals. The evaluations provided opportunities to ensure the quality of the two courses and were informative enough about what to change: the content, the activities, the way of communication. The aggregate assessments provided a starting point for improving and redesigning the course, depending on the needs of students [13, 20].

The courses were evaluated by two e-learning experts. According to the expert assessment, "Improvement of the course could be achieved by integrating more learning resources and / or bibliographic, respectively, in the platform and the space of the course. online resources for self-study of students, and by improving the quality of learning resources by including more multimedia elements into them".

Largely, the comments and recommendations of the experts coincided with those of the students. Diversion was observed in two directions: in terms of group activities (experts recommend enrichment with new ones, where applicable, and students - reduction) and bibliographic and online sources for self-study of students (experts recommend enrichment with new ones, and students - reduction).

Recommendations made by experts and students have been met and corrections have been made in both courses.

Developing quality educational products undoubtedly gives an advance. At the core of quality e-learning is the optimal pedagogical design. The constructed model of a university course for the training of biology teachers in a virtual environment is person-oriented and supports the building of lifelong learning skills. It takes into account individual learners' needs.

The developed university-grade technology model is relevant to the development of the following key competences for lifelong learning: knowledge of natural sciences and technologies, general learning skills and digital competence.

3. Results and Discussions

3.1. Analysis and classification of input parameters, taking into account the opinion, attitude and attitude of the students towards e-learning

The data from the survey (taking into account the opinion, attitude and attitudes of the studied students towards e-learning) at the entrance of the two courses gives an opportunity to analyze on the basis of the relevant conclusions about the students' past experience in the context of the research, material delivery, media and format of the materials, way of completing the training in the disciplines, assess the potential students' willingness to actively participate in the virtual environment both in terms of activities envisaged and in terms of communication. On the basis of the conclusions drawn, the main features of the learners are also presented before the start of the training.

The survey of input parameters, taking into account the opinions, regards and attitudes of students, future teachers of biology from the 4th year of the pedagogical specialties at Sofia University "St. Kl. Ohridski", Faculty of Biology (Biology and Chemistry, Geography and Biology and Biology and English) to online

learning includes 16 questions. They take into account the opinion, regards and attitudes of 115 students to e-learning and learning, 92 with a relative share of 80% studying compulsory discipline, and 23 with a relative 20% share - elective discipline.

The sample is representative for each of the three bachelor's programs because the students are randomly divided into administrative groups, their participation in the survey is anonymous, on a voluntary basis.

The results of the survey, measuring the opinions, regards and attitudes of students in Biology and Chemistry, Geography and Biology and Biology, and English before the beginning of the students' training in the transformed courses show that they have a positive attitude towards the use of technology in learning at the entrance of the training in The Experiment in Biology Education and Applied Psychology.

3.2. An analysis of the baseline parameters that take into account the quality of learning and teaching at a university course for the training of biology teachers in a virtual environment (blended form)

The questionnaire for quality assessment of learning and teaching in a virtual learning environment (mixed form) includes 21 questions and contains the following distinct parts (groups of questions): Course macro-design, learning objectives, learning tasks and activities, learning content, learning resources, communication, evaluation, support for online learners, design of electronic resources, overall assessment of the quality of learning in a virtual learning environment (mixed form). The poll takes into account the opinion of 90 students, of which 73 with a relative share of 81.1% study the compulsory discipline The Experiment in biology education and 17 with a relative share of 18.9% - have chosen the optional discipline Applied Psychology.

The results obtained give grounds to summarize that the model of a university course for teacher training in a virtual environment, as part of the design of a mixed-type course based on constructivism, has a positive impact on the learning of the majority of students.

On the basis of the analysis of the initial parameters that take into account the quality of learning and teaching at The Experiment in biology education (obligatory) and Applied Psychology courses (optional) for biology teachers in mixed learning environments, it is possible to construct a generalized theoretically based technological model integrated within the design) of a university course in a virtual learning environment applicable both to the obligatory and to the optional disciplinary disciplines in the education of students, future biology teachers accordance with the specifics of their professional realization.

3.3. Comparative analysis of incoming and outgoing survey results

In order to compare the results, taking into account the attitudes of the students before and after the e-learning, statistical tests were carried out to verify hypotheses regarding relative quantities expressed as a percentage.

The null hypothesis H_0 reads "There is no statistically significant difference between student positive attitudes towards eLearning before and after the eLearning course".

The following are entered:

- p1 - relative share of students, whether positive input response;

- q1 - relative share of students, whether negative input response;

- p2 – the relative share of students, whether positive response to the outcome;

- q2 – the relative share of students, whether negative response to the outcome.

The following conditions are also met:

p1+q1 = 100%, p2+q2 = 100%.

Using these indications, the zero hypothesis is written as follows:

H0: p1 = p2.

In this hypothesis, the alternative hypothesis H1, according to which "There is a statistically significant difference between students' positive attitudes towards e-learning before and after university courses for the training of biologists in a virtual learning environment (blended form)" H1: p1 ≠ p2.

When the positive attitudes are assumed to have increased (or diminished), the alternative hypothesis is formulated unilaterally as follows:

H1: p2 > p1 or

H1: p2 < p1.

The significance level is preset $\alpha = 0.05$ = 5% with a guarantee probability P = 95% ($\alpha + P = 100\%$).

To test the hypotheses, the Z-characteristic is used, which is calculated using the formula:

$$Z_{emp} = \frac{|p1 - p2|}{\sqrt{\frac{p1q1}{n1} + \frac{p2q2}{n2}}}.$$

The table value is $Z_{tab} = 1.64$ for a unilateral critical area and is $Z_{tab} = 1.96$ for a bilateral critical area is at a level of significance $\alpha = 0.05$.

If $Z_{emp} \geq Z_{tab}$, it is assumed to be the true zero hypothesis H_0.

If $Z_{emp} < Z_{tab}$, the alternative hypothesis is believed to be true H_1.

As an example, we will look at the analysis of hypotheses for the Q6.1 "E-learning Saves Time" assertion about learning activities in a virtual learning environment.

Sampling volumes are:

- n1 = 115 at input control and
- n2 = 90 at the exit after the e-learning course.

The relative shares are:

- p1 = 0.591 q1 = 0.409 at input control and
- p2 = 0.778 q2 = 0.222 at the exit after the e-learning course.

The calculated empirical characteristic is:

$$Z_{emp} = \frac{|p1 - p2|}{\sqrt{\frac{p1q1}{n1} + \frac{p2q2}{n2}}} = \frac{|0.591 - 0.778|}{\sqrt{\frac{0.591*0.409}{115} + \frac{0.778*0.222}{90}}} = 2.949.$$

$$Z_{emp} = 2.949 > Z_{tab} = 1.64$$

Consequently, the alternative hypothesis H1 is assumed to be true.

Similarly, the analysis of the hypotheses for all the other characteristics of e-learning "input" and "output" (7 questions with a total of 40 statements) was carried out.

The alternative hypothesis is true, namely that there is a statistically significant difference between students' positive attitudes towards e - learning before and after the biology teacher training courses in a virtual learning environment such as H1: $p2 > p1$.

The results of the input and output questionnaires measuring the opinion, attitudes and attitudes of Biology and Chemistry students, Geography and Biology, and Biology and English, show that students' positive attitudes towards the use of technology are increasing learning and negative attitudes are diminishing. The data prove that, according to the students themselves, learning in virtual learning environments (in the Biology and Applied Psychology Experimentation courses) stimulates them, increases their activity and sense of control over learning activity, facilitates access to learning resources and communication. Also, students appreciate the benefits of "electronic" access to the resources provided.

The results of the statistical processing of input and output questionnaires measuring the opinions, regards and attitudes of students in Biology and Chemistry, Geography and Biology, and Biology and English confirm the hypothesis that there is a statistically significant difference between positive attitudes of e-learning students before and after the courses in a blended form of study.

The results of the empirical study provide the basis for the following conclusions:

Future students of biology have positive attitudes to e-learning and want to be trained in a virtual environment. They value greatly: the spatial and temporal independence provided by this type of training; the ability to learn from their home computer; the opportunity to integrate into the virtual learning environment when there is opportunity and time, thus learning becomes more flexible and adaptable, which is necessary as a conclusion from the analysis of the results of the poll conducted before the students' education in the university courses in a virtual learning environment. This conclusion is evidenced by the survey conducted on the attitudes of future teachers of biology to e-learning after their participation in the transformed university courses.

It is possible to construct a generalized theoretically-based technological model (integrated within the design) of a university course in a virtual learning environment, applicable both in the compulsory and the optional profiling scientific disciplines in the education of students, future teachers of biology according to the specifics of their professional realization. The conclusion is based on an analysis of the baseline parameters that take into account the quality of learning and teaching at university courses (compulsory and optional) for biology teachers in a virtual learning environment (blended form).

Applying a generic, theoretically-based, personally-oriented technology model for designing a university course in a virtual learning environment (mixed form) promotes quality training for students, future biology teachers. This conclusion is evidenced by the statistical processing of results on the input and outcomes questionnaires measuring students 'opinions, regards and attitudes, which demonstrate that there is a statistically significant difference between students' positive attitudes towards e-learning before and after courses in a mixed form of study.

The proposed model, resp. design of a university course for the training of biology teachers in a virtual learning environment is generalized, recursive, each of the elements is interrelated with the others. The model of a university course for the training of biology teachers in a virtual learning environment is legally ensured, theoretically motivated, integrative, generalized, purposeful, open and personally oriented.

The developed and applied generalized, theoretically-based technological model in designing a university course for the training of biology teachers in a virtual learning environment (mixed form) increases the efficiency of the learning process and, hence, the quality of the professional training of future biology teachers.

The presented results, which unequivocally point to the model's effectiveness and its essential place in the professional training of future biology teachers, can help make informed decisions when constructing university courses for the training of biology teachers in a virtual learning environment.

4. Conclusions

The penetration of new information technologies has placed higher education institutions in conditions of even stronger competition. It opened up new opportunities and challenges to universities, allowing them to look for alternatives to distribute their educational product. The development of quality educational products undoubtedly gives an advance and the basis of quality e-learning is the optimal pedagogical design, related to the specific pedagogical environment in which the professional training of the future specialists is carried out.

Qualitative e-learning (including future biology teachers) should be based on standards as well as user needs and experience, to promote student-teacher contacts, to support the collaboration among students and to provide relevant feedback.

Providing the conditions for active learning and the formation of active learning skills among students are among the fundamental factors in the training of future teachers of biology in the context of lifelong learning. The theoretical framework of the model of a university course for the training of biology teachers in a virtual learning environment is based on the constructivist educational paradigm and operationalises the pedagogical activity (according to the main elements of the learning process in a virtual learning environment).

5. Recommendations

The application of the developed model of a university course for the training of biology teachers in a virtual learning environment has the potential that, if used, would also bring positives to the work of teachers. Such are: easy updating of the teaching materials, easy management of a large number of students, the possibility of developing joint courses, as well as increasing the motivation of the students to acquire fundamental knowledge (from the fields of biology and the methodology of the biology training) in practice.

The model of a university course for the training of biology teachers in a mixed-form virtual learning environment could function not only as a complement to the traditional model of learning but to serve as a basis for the upgrade and implementation of a technological model in the preparation of future biology teachers with technology integration, personalized, based on the constructivist educational paradigm and the principle of activity.

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