

Methods of Future Natural Sciences Teachers Training to Use Smart-technologies on the Basis of Learning Apps

Alla V. Stepanyuk¹, Liudmyla P. Mironets², Tetiana M. Olendr¹, Ivan M. Tsidylo¹

¹ Ternopil Volodymyr Hnatiuk National Pedagogical University, 2 M. Kryvonosa str., Ternopil, 46027, Ukraine

² Sumy A. Makarenko State Pedagogical University, 87 Romenska Str., Sumy, 40002, Ukraine

Abstract

The article deals with one of the possible ways of modernization of pedagogical education in Ukraine in order to train teachers of the new generation and to provide conditions for the formation and development of modern alternative models of teachers' professional and personal growth on the principles of SMART-education concept.

The problem of future natural sciences teachers training to use SMART-technologies in the professional activity as the condition for realization of the SMART-concept in education is actualized. The advantages of SMART-technologies use in the study of objects and phenomena of wildlife have been substantiated. They allow the formation of holistic thinking of both students and schoolchildren by combining figurative and logical thinking and strengthen the emotional and value perception of wildlife objects. Methods of formation of future natural sciences teachers' readiness to use SMART-technologies in the educational process, which involves the realization of a dual goal: the formation of the ability to use the resource SMART-concept in education to implement their own lifelong education and providing quality professional activities during teaching natural sciences school course have been highlighted. The foundation of the proposed methodology constitutes module "Methods of using SMART-technologies", which is a component of the discipline "Methods of Biology teaching". The content and means of its studying by students, tasks for the organization of independent work, tests, criteria and indicators of the level of students' abilities and skills formation to use the SMART-complex (motivational-value, cognitive, activity-constructive, reflexive and evaluative) have been developed. The effectiveness of the proposed methods on the basis of determined criteria has been proved experimentally.

Keywords

Education, SMART-technologies, biology, schoolchildren/students, future natural sciences teachers, methods of teaching, professional training.

1. Introduction

1.1 The problem statement.

Present realities made us move to SMART-education concept. It involves complex modernization of all educational processes, as well as methods and technologies used in them. SMART-education means new knowledge and ideas generation, development of SMART-environment, SMART-society – an intellectual environment of people who are specially trained to implement the latest ideas and concepts. A lot of countries in the world, namely Korea, Japan, Australia, the Netherlands have claimed the SMART idea as a national idea of the whole society. According to UNESCO, the use of SMART-technologies provides an opportunity to significantly expand and improve learning opportunities, in particular in higher education institutions. Teachers are responsible for the implementing educational programs of new generation based on advanced pedagogical technologies; they are assigned the mission of preparing the younger generation for life in the future and educating a person with modern thinking,

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EMAIL: alstep@tntpu.edu.ua; mironets19@gmail.com; olendr@tntpu.edu.ua; tsidylo@tntpu.edu.ua

ORCID: 0000-0003-3258-9182; 0000-0002-9741-7157; 0000-0002-1665-6413; 0000-0002-0202-348X



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able to successful self-realization in life. Thus, the tasks of modern education vary in accordance with the requirements of the century by finding new technologies and modernizing the educational environment.

1.2 The analysis of recent studies and publications.

The analysis of literary sources allows to confirm that understanding of SMART in the area of education ranges from the use of smartphones and other similar devices to deliver information to schoolchildren/students to the formation of an integrated intelligent virtual learning environment, including SMART devices. Our study is based on the complex considering of this problem.

Historically, the transformation of educational technologies has taken place within the chain: traditional – distance – e-learning – new information and communication technologies (SMART). The use of SMART-technologies is aimed at achieving the following goals in the learning process: S (Self Directed) – providing opportunities for self-determination of what to learn and effective organization of self-learning; M (Motived) – motivation of active cognitive activity; A (Adaptive) – adapting the methods, place and time for learning for a specific subject who wants to gain educational services; R (Resource Free) – providing free access to educational resources; T (Technology Embedded) – permanent support of the learning process with modern technologies.

According to O. Semenikhina [1, p. 42], the concept of SMART-education correlates with the latest educational trends voiced by FORBS magazine: distance education is becoming a leader in educational technologies – video lessons on YouTube or other services are mega-popular and in demand amongst the younger generation; personalization of learning – individual psychological characteristics of a person should become the basis for individual educational programs; gamification (introduction of game technologies in non-game situations) – reward technologies for what has been done can help to increase the learning motivation and improve its quality; interactive textbooks that should radically change the “traditional” presentation and interpretation of educational material; learning with the help of video games is a unique opportunity to provide knowledge about the real world through an interactive immersion in the virtual world.

The scientists [1,2,3,4] consider that the goal of SMART-education is to ensure the most effective learning process by transferring the educational process to the electronic environment. Such approach provides an access to knowledge to anyone, expands the boundaries of learning. First of all, SMART-education provides flexibility (a large number of sources, maximum media diversity, the ability to quickly and easily adjust to the level and needs of the listener). It involves an active exchange of experiences and ideas, personalization of the course, saving time for refinement (editing existing material instead of creating it from the beginning).

The positive aspects of the use of SMART-technologies in the educational process include: the possibility of their use in the teaching of various disciplines; high efficiency of knowledge acquisition; increasing interest in learning among schoolchildren and students; modern technologies and understanding and perception of them as a natural component of young people, which makes their lives a convenient tool for creative development; ease of combining SMART-technologies with a communicative approach [5].

The analysis of literature sources proved that the problem of using SMART-technologies in the educational process has received some elaboration in the scientific achievements of such scientists as V. Abramov (2007), G. Ahmetova (2013), H. Bonch-Bruievych (2007), V. Bykov (2013), K Bucher, Yu. Hapon, L. Ivanenko, O. Zubova, Zh. Karaev (2013), R. Kozma (7) T. Kosenko (2007), A. Kushnir (2020), S. Muhambetzhanova (2013), T. Pozdniakova (2018), S. Pudova (2018), O. Semenikhina (2015), M. Sharples (2007) and others. Thus, modern SMART-technologies as a means of innovation and a factor of information development of society, which provide the transformation of the teacher from a translator of information to a facilitator of communication in the process of combined activities with students, have been analyzed in the works of A. Kushnir (2020) [4]. O. Semenikhina (2015) states in her studies that the use of SMART approach in the preparation and development of educational materials testifies the learning process with the use of technological innovations. It provides an opportunity to obtain professional competence on the basis of a systemic multidimensional vision and

study of disciplines, taking into account their multifaceted nature and continuous updating of content [1]. The issues concerning the use of information devices in the process of Biology school course studying were described in our previous paper [13]. However, the problem of future natural sciences teachers training for the introduction of SMART-technologies into the process of professional activity has not been properly studied yet.

The goal of our study is to develop a methodology for forming the future teachers' readiness to use SMART-technologies in the process of Biology school course studying and verify its effectiveness. The research was realized through the following tasks: to identify the specifics of the SMART-technology use in the process of studying; to develop a methodology for forming the future teachers' readiness to use SMART-technologies in professional activities; to substantiate the criterion apparatus of the research.

2 Research methods

To achieve the abovementioned goal and tasks, a number of methods have been used, namely: theoretical – comparative analysis to find out different views on the problem, identify areas of study; modeling to develop a methodology for forming the future natural sciences teachers' readiness to use SMART-technologies in professional activities; designing – to develop a criterion apparatus of the research; systematization and generalization to formulate conclusions and recommendations for improving the educational process during future natural sciences teachers training for the introduction of SMART-technology in educational process; empirical – generalization of pedagogical experience, scientific observation, interviews, content analysis, questionnaires in order to determine the state of implementation of the problem in practice and to develop the content of experimental teaching methodology; pedagogical experiment, which provided verification of the effectiveness of the proposed methodology.

Experimental research has been carried out on the basis of Ternopil V. Hnatiuk National Pedagogical University and Sumy A. Makarenko State Pedagogical University. Effectiveness of the proposed methodology was checked during the forming experiment. Forming experiment lasted for two years (2019-2020 and 2020-2021 academic years) in the process of professional and methodical training of future natural sciences teachers. It involved 38 future Biology teachers, who are now students of the second (master's) level of higher education. The goal of the forming experiment was to test the effectiveness of the developed methodology for forming the future natural sciences teachers' readiness to use SMART-technologies in professional activities.

3 The results and discussion

Preparatory stage, the aim of which was to determine the peculiarities of the SMART-technologies use in the process of Biology study preceded the development of an experimental methodology of forming the future natural sciences teachers' readiness to use SMART-technologies in professional activities. To do this, we analyzed the following factors: the essence of SMART-technologies and the expediency of their use in the educational process of secondary schools and universities; the peculiarities of the object of biological cognition (plant, animal organisms and humans); the content of future natural sciences teachers professional and methodological training; the content of Biology school course program.

The results of the conducted analysis showed that the peculiarities of the SMART-technologies use in the process of Biology school course studying are related to the object of its study –integral systems of wildlife in their hierarchical relationships and interdependencies, as well as the necessity to form emotional and value attitude of schoolchildren to the world of nature on the basis of bioethics. Due to emotional and value as well as figurative perception SMART-technologies make it possible to penetrate into the micro world of the cell, to model life processes in systems of different levels of organization, to demonstrate the manifestation of general laws of nature at the level of sensory-figurative perception, to reveal the beauty of wildlife in its uniqueness, diversity and interdependence of its systems, to highlight its self-value, universality and significance in our daily life.

Considering these peculiarities, as well as: the main objectives of training a highly qualified specialist who will show a desire for self-improvement and self-realization in his professional activity through a certain manifestation of self-efficacy, self-reflection and self-correction; expediency and need for integration of educational and self-educational activities in higher education; organization of research, dialogue, discussion, creative nature of relations of subjects of training in all paradigmatic variations of interaction with the help of SMART-technologies: “teacher – student”, “teacher – students”, “student – student”, “student – students”, “student – schoolchild”, “student – schoolchildren” we have developed a methodology of forming the future natural sciences teachers readiness to use SMART-technologies in professional activities.

The proposed methodology involves a combination of the process of future teachers’ general and professional competencies formation through the use of SMART-technologies in the teaching of disciplines (skills are formed by imitation) and purposeful activities to train future natural sciences teachers to use SMART-technologies in professional activities. Herewith, students have an opportunity to study disciplines using electronic materials, watch lectures online or offline, sit tests, participate in telecommunication projects, share experience, improve their professional level, spend more time for scientific experiments, save time, etc. They can do everything independently or using the technology of “flipped learning”.

The basis of the methodology of forming the future natural sciences teachers readiness to use SMART-technologies in professional activities is the subject “Methods of Biology teaching”, the structure of which includes the study of a special module (30 academic hours) on SMART-technologies. It comprises 4 academic hours of lectures and 8 academic hours of practical classes, as well as 18 academic hours of independent work. In particular:

Lecture № 1. SMART-technologies and their main possibilities in preparation for a Biology lesson. LEARNING APPS: features, functions, advantages and disadvantages. Objective: to get acquainted with the world experience of using SMART-technologies and the current state of their development in Ukraine; to identify the main possibilities of using information technologies in education; to provide a characteristic of the LEARNING APPS Internet resource (<https://learningapps.org/>), to single out its main functions and didactic possibilities.

Lecture №2. Modern possibilities of mobile application. The use of video-content in the pedagogical activities of a teacher. YouTube as a modern video hosting. Objective: to get acquainted with the concept of mobile learning; to determine the role of mobile applications in preparing and conducting a Biology lesson; to single out the kinds of video content in pedagogical activities and platforms for their application.

Practical class № 1. Mobile application as a part of modern Biology lesson. Objective: to consolidate students’ knowledge of the use of mobile applications at Biology lessons; to make actual the basic principles of working with a mobile application; to conduct a lesson on the use of mobile learning; lesson analysis.

Practical class № 2. LEARNING APPS Internet resource in future natural sciences teacher preparation to the lesson. Objective: to consolidate students’ knowledge on creating tasks for Biology lessons on the LEARNING APPS online platform; to get acquainted with various templates and additional functions of the resource; to conduct a lesson using SMART-technologies.

Practical class № 3. Main functional potentialities of LEARNING APPS. Peculiarities of creating one’s own class in the Internet resource. Objective: to consolidate students’ knowledge on creating tasks for Biology lessons on the LEARNING APPS online platform; technology of creating work accounts for schoolchildren; development of classroom management skills, statistics and general information; conducting a lesson; to carry out analysis and self-analysis of the lesson.

Practical class №4. SMART-technologies as a future teacher assistant in preparation to Biology lessons. Objective: to consolidate students’ knowledge on the use of SMART-technologies in the future teacher’s professional activities; to compare information technologies; to develop a modern lesson with an approach to working with SMART tools; to analyze the work and to carry out self-analysis of the results; to conduct questionnaires and testing to identify the formed students’ knowledge.

With the aim of consolidation the acquired knowledge the students did corresponding independent work, developed lesson plans, created their own exercises in the LEARNING APPS Internet resource, reviewed the learning opportunities of mobile applications, carried out analysis and self-analysis of the

work and created their own video lessons to implement them in video hosting for distribution and use in own educational practice.

Questionnaires and tests were created to find out the effectiveness of the SMART-complex and the formation of key competencies in the use of information technologies. For example, the students were asked to answer the following question of the questionnaire: "During which type of lesson (acquisition of new knowledge, abilities and skills formation, reviewing and consolidation of knowledge, generalization, testing and correction of knowledge, combined) is the use of SMART-complex (LEARNING APPS, mobile application and video hosting) the most efficient? Place numbers from 1 to 6, where 1 is the most efficient and 6 is the least".

Special blocks of theoretical questions on the studied material were developed to test students in order to check the level of competencies formation. In general, the test includes 20 open-ended questions, which are divided into four blocks. Each question is evaluated from 1 to 5 points. In total, each student can get 100 points for the answers. We have developed special criteria for evaluating responses.

The data objectivity obtained during the forming experiment is ensured by the special conditions of its conducting: 38 students took part in the pedagogical experiment; the best possible acquisition of concepts, laws, regularities of nature by the students and their use in preparation for the lessons; sufficient level of modern information technologies mastering; development of the author's program of mastering SMART-technologies (lectures, practical classes, independent work); using of the criteria for identifying the level of students' skills formation to use the SMART-complex.

At the beginning of the pedagogical experiment we determined the level of students' understanding of the concept of "SMART-education" and their understanding of the role of information technology in pedagogical activities. The students were offered to answer the question "Have you heard of SMART-technologies before working with them?" Analysis of the results proved that 63 % of the respondents (24 students) were partially familiar with SMART-education technologies before and 37 % (14 students) got acquainted with them for the first time during experimental training.

During the pedagogical experiment students were taught according to the experimental methodology. Students were taught how to use an interactive whiteboard SMART Board and its various functions. Special exercises were developed using the LEARNING APPS Internet resource in preparation for lessons and then they were used during all the stages of the lesson. Students downloaded different mobile applications at various world software platforms and added parts of mobile teaching to the lesson plans, applying and testing the effectiveness at different stages of the lessons. The students created their own video lessons and considered the main possibilities of modern video hosting.

During the preparation for lessons as well as during teaching practice students developed their own lesson plans, did author's tasks on the LEARNING APPS platform, introduced mobile learning technology, recorded videos, passed tests, performed independent work, for which they received a certain number of points. Students' learning outcomes were assessed according to the criteria of the corresponding course, and the formation of intellectual skills according to the levels.

The use of SMART-technologies during the development of lesson plans contributed to increasing of students' activity and motivation to work, interest in teaching activities became noticeable and the level of preparation for lessons changed. Students learned to use a SMART Board, create their own accounts in the LEARNING APPS Internet resource, author's exercises on this platform, personal video lessons, learned to use various video editing programs, improved personal skills of lesson planning and analyzed the effectiveness of information technologies use.

After the completing the training according to the experimental methodology, the students were offered to determine the most effective information technology in terms of its implementation in teaching. To do this, they were asked to determine the most effective technology considering their own experience by ranking them from 1 to 3. The results of the study showed that 41.3 % of the surveyed students chose the use of tasks from the LEARNING APPS Internet resource at Biology lessons as the most effective technology. Various video lessons as an effective tool in teaching were chosen by 35.5 % of future teachers. The third place was given to the technology of mobile teaching, 23.3 % of students chose this technology.

The students were offered to choose the most optimal type of lesson for each information technology. Future natural sciences teachers had to rate from 1 to 6 how it is effective the use of a particular technology at different types of lessons (Fig. 1).

We found that the technology of using the LEARNING APPS Internet resource was the most effective when it was used at the lessons of new knowledge acquisition. Students' response mean was 4.15. The least effective was the use of this information platform at the control lesson (1.57). Students recommend using of mobile learning at the combined lesson (4.10). The least effective and appropriate was the use of mobile applications at control lessons (1.84). The use of video materials at Biology lessons was the most effective during the combined lesson (3.47) and at the lesson of abilities and skills formation (3.36). Video hosting was less used at the control lessons (1.31).

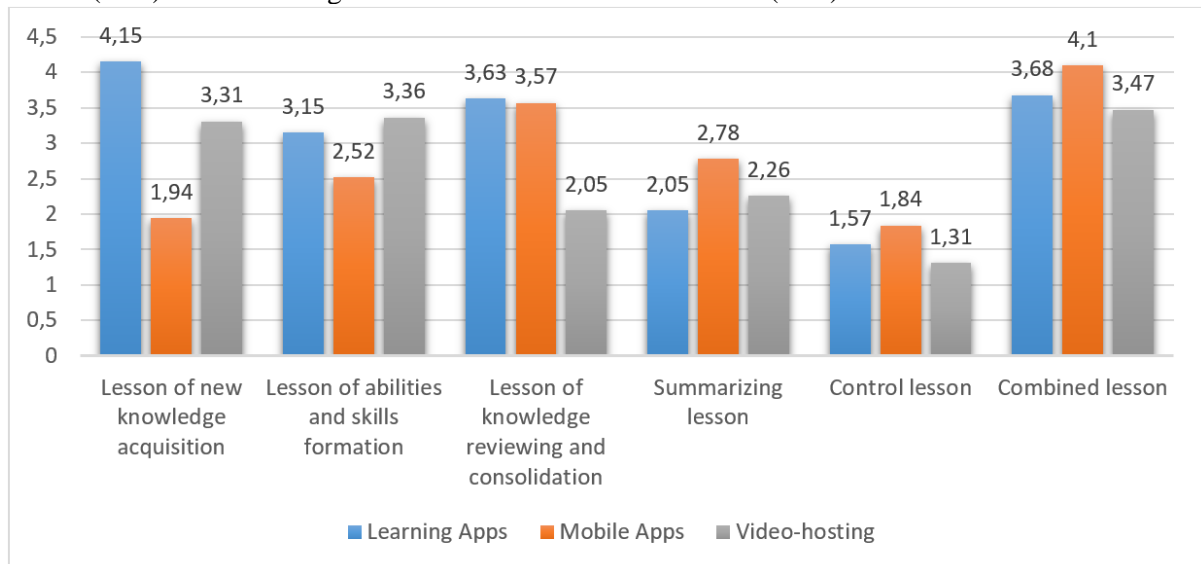


Figure 1: Efficiency of the SMART-complex use at the lessons of different types

The students were offered to prioritize from 1 to 6 choosing the most effective stage of the lesson for the use of the SMART-complex technology (Fig. 2).

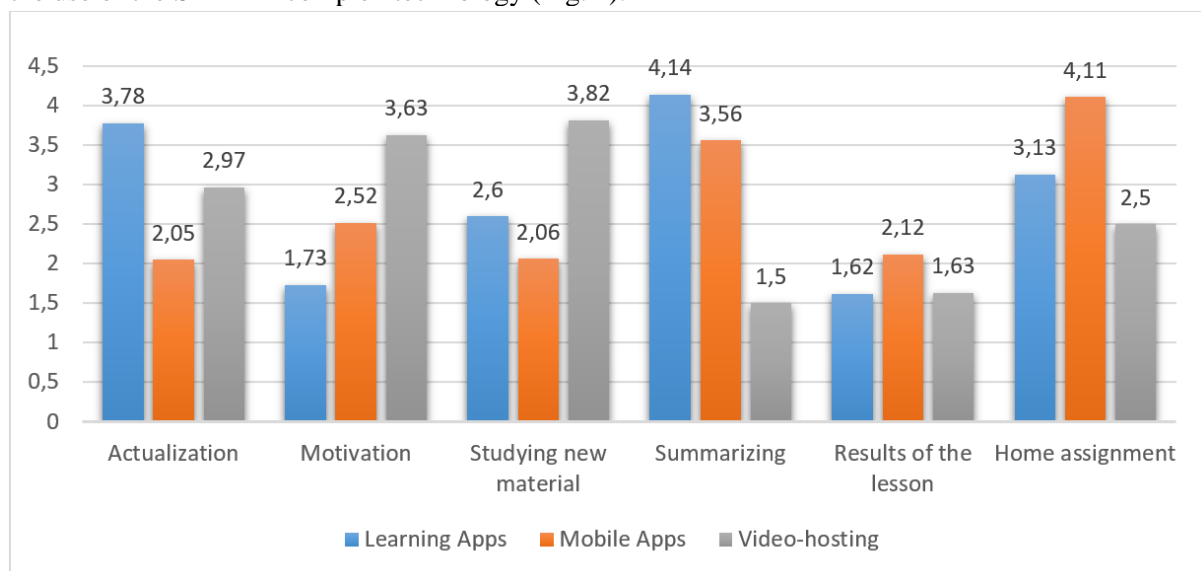


Figure 2: Efficiency of the SMART-complex use at different stages of a lesson

At determination the efficiency of the LEARNING APPS Internet platform use at Biology lessons it was found that the most optimal use of technology was at the stage of summarizing of students' knowledge (response mean is 4.1) and the lowest mean of technology choice was given to the stage results of the lesson (1.57). The use of mobile applications by future specialists at Biology lessons is recommended and has the highest rate during the stage of home assignment and independent work of schoolchildren (4.15).

The work with the mobile learning technology is not effective at the stage of knowledge actualization and studying new material with the same response coefficient of 2.05. During the preparation of a lesson

plan, the use of video-learning was noticed at the stage of studying new material and schoolchildren's knowledge, skills and abilities formation with the index of 3.73. The least use of video-hosting was observed at the stages of summarizing (1.52) and results of the lesson (1.68).

To determine the level of students' readiness to use SMART-technologies, we have developed the following criteria: motivational-value (awareness of the importance of mastering the theoretical foundations of information technology and prospects for their development, highlighting the main benefits of mobile learning in natural sciences teacher work, understanding the role and prospects of modern video-hosting use in pedagogical activities and self-education), cognitive (understanding: the place of SMART-technologies in the educational process and methodology of their use in preparation for biology lessons; functional possibilities of electronic-interactive whiteboard for teachers at biology lessons), activity-constructive (creation of one's own account on the LEARNING APPS Internet platform, understanding and optimal mastery of all the functions of the Internet resource, the ability to create quality author's programs and technology of the own class with statistics to it in LEARNING APPS, the use of various platforms for downloading mobile applications, mastery of the methods of conducting a lesson using video materials and creating one's own fragment of the video lesson), reflexive and evaluative (the ability to analyze, draw conclusions, observe, compare and analyze the fulfilled work).

Having analyzed the level of future teachers' readiness to use SMART-technologies after the pedagogical experiment, we drew a conclusion that 26.3% of students showed a low level, 31.5% of students showed a middle level, and 42.2% of students showed a high level.

4 Conclusions and prospects for further research

Summing up the results of the conducted pedagogical experiment, we can conclude that the obtained data demonstrate the place of SMART-technologies in the pedagogical activity. Peculiarities of their application in the educational process are related to the object of study. It is expedient to combine the process of students' general and professional competencies formation through the use of SMART-technologies by teachers while teaching disciplines and special training of students to use SMART-technologies.

We have found that the technology of using the LEARNING APPS Internet resource is most effective when used at the lessons of new knowledge acquisition. M-learning and video materials are recommended to use at the combined lessons. The formation of students' readiness to use SMART-technologies in professional activities increases the level of learning new material, promotes increasing of interest and activity, the level of motivation to learning and forms cognitive interest to the learning process. The prospects for further study consist in finding the opportunities for the use of SMART-technologies in the formation of critical thinking.

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