






Integrated Use of the LearningApps.org Resource and Information Devices in the Process of Biology School Course Studying

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Abstract: This paper considers the problem of integrated use of the LearningApps.org online resource in the process of Biology studying in secondary schools and information devices. The appropriateness of moving to a mixed form of learning that involves the creation of a polysubjective educational environment has been justified. The article concretizes the essence of the notion “polysubjective educational environment” (teacher, pupil, online resources, and information devices). It has been examined how well the scientific problem is developed in pedagogical theory and educational practice. The methodology of using the LearningApps.org online resource in the process of Biology studying in a basic secondary school, which involves the use of information devices, the PlayMarket server applications, Smart technologies and a website has been created. In particular, a series of exercises of the LearningApps.org online resource has been simulated, the implementation of which should be integrated using a SMART Board, a mobile phone, a computer, a laptop, a tablet or other information devices. Possibilities of their combination with the methodology of using information devices at the lesson in the process of homework checking, learning new material, generalization and systematization of knowledge have been revealed. The proposed assignments can be used as individual exercises for pupils at the lesson and in extracurricular activities. The paper suggests the approach for homework checking, which involves besides computer control of pupils’ learning outcomes, the use of Miracast wireless technology. The methodology of conducting a mobile front-line survey at the lesson on the learned or current material in Biology in the test form, with the help of the free Plickers application, has been presented. The expediency of using the website builder Ucoz.ru for creation of a training website in Biology has been substantiated. The methodology of organizing the educational process in Biology in a basic secondary school using the training website has been developed. The effectiveness of the proposed methodology of using the LearningApps.org online resource in combination with information devices in the process of Biology studying in a basic secondary school has been substantiated.


1 INTRODUCTION


Specificity of the modern information society leads to a change of the ways of human life. This causes significant transformations in the educational system. Its transition to a qualitatively new state requires the optimization and management of the mechanisms of interaction of all the subjects of learning environment.


Its peculiarity is the functioning of multi-vector information flows that need to be taken into account in the educational process. There is a replacement of the subject-subjective educational paradigm by a polysubjective one (Spivakovska, 2016). Within such a system of relations, all the subjects of the educational process interact with each other as active mutually influential participants. They interact with modern information technologies (IT), social networks, Internet services, and others. That is why a new educational communicative paradigm is actualized, which means communication in a polysubjective learning environment.

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New challenges, which face the society related to the COVID-19 pandemic, have forced biology teachers to reconsider the technical capabilities of information technologies in distance learning (Bobyliiev and Vihrova, 2021). One of the advantages of using the LearningApps.org online resource is the possibility to integrate tasks into distance learning systems and self-directed learning: pupils can remotely perform a variety of tasks of biological content. The teacher does not need to spend time checking assignments, because the assessment automatically goes to his personal account.

Modern IT involve wide opportunities of various social networks to the development of pupils. In consequence of the potential of mass interactivity, immersion, learning in joint activities, they become an effective tool of learning. The appropriateness of IT use in the process of Biology school course studying is caused by the specifics of the object of biological cognition (life in all its manifestations) and the concept of bio(ecoc)entrism, which recognizes the life of any organism as the highest value (Komarova and Starova, 2020).

Biology studying at secondary schools in Ukraine is aimed at the formation of ten major key competencies (Shokaliuk et al., 2020), among which are the following: information and digital competence and key competencies in natural sciences and technologies. It is relevantly to form such competencies using modern information devices in the educational process. We consider a computer, an interactive whiteboard Smart Board, a multimedia projector, a tablet, a smartphone, Google Chromecast adapter, and others to be the modern information devices.

A works (Doroshenko et al., 2005; Lavrentieva et al., 2020; Matiash, 2004; Mironets and Torianyk, 2018; Savosko et al., 2021; Nevedomska, 2007; Shcherbakov, 2006; Stepanyuk, 2011) have dealt with the possibilities of using a computer in the process of Biology teaching. Matiash (Matiash, 2004) underlines the necessity of using a computer during Biology school course to increase the effectiveness of the lesson and the efficiency of the learning process. Stepanyuk (Stepanyuk, 2011) studies the problem of using computer learning tools in the methodological training of future biology teachers. Nevedomska (Nevedomska, 2007) considers the positive and negative aspects of the use of computer technologies in Biology teaching while examining the levels of information and computer systems that form the quality criteria of the theoretical and practical implementation of pedagogical computer tools.

Theoretical aspects of mobile learning are disclosed in (Horbatyuk and Tulashvili, 2013; Kosyk,

2014; Malchenko et al., 2021; Mironets and Torianyk, 2018; Skrypka, 2015). Methodology of website using in the process of Biology teaching in a basic secondary school is revealed by Stepanyuk and Mironets (Stepanyuk and Mironets, 2019). The essence and possibilities of using the LearningApps.org online resource are described by Aman (Aman, 2019). Fedosenko (Fedosenko, 2020), Bonch-Bruievych et al. (Bonch-Bruievych et al., 2007) studied the use of the LearningApps.org builder as one of the means of SMART technologies in the process of Biology teaching.

However, the analysis of scientific and pedagogical works shows that the practical aspect of using the LearningApps.org online resource for conducting educational studies in biology with the help of information devices was not the subject of a separate study and is not enough described. Therefore, there is a contradiction between the innovative nature of the development of information devices, online resources and the development of scientific and methodological support for their implementation in the educational process in biology.

The *objective* of this paper is to outline the possibilities, as well as the appropriateness of using the LearningApps.org online resource in the process of Biology school course studying with the application of information devices.

The objective was realized through the following tasks:

1. To clarify the state of development of the problem at the levels of pedagogical activity and personal property of pupils.
2. To develop and substantiate the methodology of using the LearningApps.org online resource in the process of Biology school course studying with the application of information devices and to test experimentally its effectiveness in a basic secondary school.

2 RESEARCH METHODS

To achieve the abovementioned objective 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 using the LearningApps.org online resource in the process of Biology school course studying with the application of information devices; systematization and generalization to formulate conclusions and recommendations for improving the educational process in biol-

ogy; 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 general secondary schools No. 24, 26, 28, Terebovlia general secondary school No. 1 (Ternopil region) and Sumy general secondary schools. Summative experiment involved 528 pupils, 212 biology teachers and 68 future biology teachers, who are now students of the second (master's) level of higher education of Ternopil Volodymyr Hnatiuk National Pedagogical University and Sumy State Pedagogical University named after A. S. Makarenko. Forming experiment lasted for two years (2018–2019 and 2019–2020 academic years) in 6th grades in the process of Biology school course studying. 1006 pupils participated in it.

Effectiveness of the proposed methodology was checked during the forming experiment.

The goal of the forming experiment was to test the effectiveness of the developed methodology of using the LearningApps.org online resource in combination with information devices. We drew a conclusion about the quality of the experimental methodology according to the criterion “coefficient of completeness of knowledge acquisition” (A. A. Kyverialg's method). It was determined using formula 1 (Kyverialg, 1980):

$$K = \frac{\sum I_0}{n \cdot I_a} \cdot 100\%, \quad (1)$$

where K – the coefficient of completeness of knowledge acquisition;

n – the number of pupils who performed the work;

$\sum I_0$ – the sum of elements of knowledge acquired by each pupil;

I_a – the number of elements of knowledge communicated to each pupil.

According to the criteria of completeness of knowledge acquisition, developed by Bepalko (Bepalko, 1968), the educational material was considered to be acquired, and knowledge formed if the coefficient of knowledge acquisition was higher than 70%. It is believed that a pupil with such a coefficient of knowledge acquisition is able to further improve his knowledge through self-education.

The forming experiment was carried out in the conditions of real educational process on Biology studying in the 6th grade. It involved the creation of experimental (EG) and control groups (CG) of pupils.

In EG pupils absorbed botanical knowledge (anatomical, physiological, systematic, agronomic and ecological notions) in the process of studying themes according to our experimental methodology of using the LearningApps.org online resource in combination with information devices. Experimental training was carried out during the study of Theme 3 “Plants” (approximately 20 hours) and Theme 4 “Plant diversity” (approximately 12 hours) (MON, 2017). Pupils in CG studied according to the traditional, dominant in modern secondary school, methodology of forming biological notions.

Thematic controls of the results of pupils' from control and experimental groups acquisition of elements of botanical knowledge (notions) – morphological, anatomical, physiological, systematic, agronomic and ecological were carried out in three stages: Stage I – after studying the themes “Root, stem: structure and basic functions. Variety and modifications of vegetative organs. Photosynthesis as a characteristic feature of plants, nutrition, respiration, plant movements”; Stage II – after studying the themes “Plant reproduction: sexual and asexual. Vegetative reproduction of plants. Flower. Inflorescence. Pollination. Fertilization”; Stage III – after studying the themes “Algae. Mosses. Gymnosperms”.

The choice of these themes is determined by the carried out content analysis of their content and the results of the summative experiment. It proved that the acquisition of anatomical, physiological and systematic notions causes significant learning difficulties for schoolchildren.

After conducting each stage of thematic control, the mistakes made by pupils, their causes, ways to adjust and improve the methodology were analyzed.

3 RESULTS AND DISCUSSION

With the aim to study the state of the problem in the practice of Biology teaching we carried out a survey of 212 biology teachers and 528 pupils of the city schools in Sumy and Ternopil regions. We analyzed the way teachers train pupils to work with different sources of information. Thus, 43.87% (93 teachers) train pupils how to work with the catalogue, 73.58% (156 teachers) train how to work with the textbook orientation apparatus, 24.53% (52 teachers) form the ability to search the necessary information on the Internet.

198 teachers (93.40%) use computer as a tool for Biology teaching, an interactive whiteboard Smart Board is used by 46 teachers (21.70%), 86 teachers (40.57%) use multimedia projector, a tablet and

a smartphone is used by 10 teachers (4.72%), and 8 teachers (3.77%) use Google Chromecast Adapter. All the 212 teachers (100%) use computer during the preparation to the lessons. However, only 154 teachers (72.64%) give their pupils home task to search for the additional information on the Internet, and 198 teachers (93.39%) offer pupils to prepare presentations in the form of a report on the performance of a specific task. There are the following reasons for the inadequate use of modern information devices by teachers in the educational process: insufficient level of their own computer literacy – 104 teachers (49.06%); lacking of material and technical as well as educational and methodological support for Biology school course teaching– 148 teachers (69.81%); the reluctance of teachers to study phenomena and processes of wildlife using a computer – 52 teachers (24.53%). Only 10 teachers (4.72%) know that a mobile device can be used as a tool for teaching Biology. Only 23 respondents (10.85%) use the LearningApps.org resource in the process of Biology school course studying. At the same time only 13.04% out of them are aware of the feasibility of integrating this resource with mobile devices at the lesson.

With the aim to find out main advantages and disadvantages of using the LearningApps.org software in school practice, a survey of 64 future biology teachers, who are now students of the second (master's) level of higher education was carried out. The students were introduced to the LearningApps.org resource during practical classes in advance and completed a teaching practice, in the process of which they modelled and conducted lessons using this online resource. The results of the questionnaires showed that future biology teachers identified the following positive aspects of working with LearningApps.org: many opportunities to create a variety of didactic tasks (90.63%); expanding opportunities for the use of visual and illustrative applications (67.19%); doing exercises it is possible not only to check, but also to correct mistakes (56.25%); exercises are effectively used to train pupils' attention and memory (39.06%); it is not necessary to print the material on paper, it is enough to send it to the pupils' personal account on the phone (100%); a large number of convenient templates that are available and easy to use (90.63%); the ability to view pupils' learning outcomes statistics and control their knowledge (78.13%); the exercise can be accessed using a special QR-code, which facilitates pupils' access to the exercise and saves time at the lesson (75.00%); the online resource is completely free (100%); possibility to create tasks in Ukrainian (100%); possible acquaint-

tance with exercises from different countries, which were previously developed by other teachers and use them in the own work (56.25%); availability of video, audio and graphic materials (89.06%); the use of the online resource is easy and saves a lot of time at the lesson and when the teacher checks tasks (46.88%); convenient use of the program during remote work (100%); it is always possible to change, improve, expand and differentiate already created tasks by the teacher (78.13%); the online resource is easy to use for pupils' independent work and learning additional material (90.63%).

Among the disadvantages of using the LearningApps.org resource future biology teachers named: the main condition for using the program is the Internet connection (not all pupils may have sufficient access to the Internet and not all schools still have full access to the Internet) (100%); when updating the interface of the LearningApps.org site, some tasks may not work if there were changes in the structure of the task template (56.25%); in some templates, in the instructions to them the translation into Ukrainian is not completely available (18.75%); not all the exercises that are available for use are true and may contain mistakes (39.06%); the teacher can use only ready-made exercise templates, but cannot create templates himself (18.75%); logging in to the program is possible only through an Internet browser, there is no specially created application that will facilitate logging in (45.31%).

All the respondents had a positive attitude towards the opportunity to use the LearningApps.org resource in the process of practical activities and its combination with mobile devices.

The majority of pupils have shown moderate interest to the TV programs about nature (77.65%). Only 7.20% claimed that they are not interested in such programs at all. 60.23% of pupils like observing plants and animals and 16.10% demonstrate moderate interest in such an activity. 74.43% of pupils sometimes address the Internet sources to answer questions during the lesson and 19.70% of the pupils often address various information sources in this case. 5.87% of the pupils stated that they don't search for the answers in additional sources.

The majority of teenagers (87.31%) possess mobile devices (smartphones, tablets), but they use them mainly for fun or socializing with peers in social networks. 18.56% of pupils know that a mobile device can help in conducting a research both at school and beyond it, but only 4.55% of respondents use smartphones for this purpose.

However, the study of the practice of modern secondary schools and personal teaching experience

show that the use of the Internet facilitates better learning of education material by pupils. The LearningApps.org online resource is designed for developing and storing didactic multimedia interactive tasks, through which the teacher can form, consolidate and test the acquired knowledge, skills and abilities of each pupil in educational, play-based form, which contributes to the formation of cognitive interest, motivation to learn, critical thinking and independence. At the same time the effectiveness of lessons increases significantly and it encourages pupils to study. The educational process is intensified through the increase of its informativeness. Due to this, pupils improve their ability to orient themselves in the information space and, in this case, the teacher acts as a mentor, consultant. All the above mentioned actualizes the necessity in the development of the methodology of Biology studying using the LearningApps.org online resource in combination with information devices.

Our experimental methodology involves the use of the LearningApps.org online resource in combination with the following information devices: a computer, an interactive whiteboard Smart Board, a multimedia projector, a tablet, a smartphone, and Google Chromecast adapter. The main attention is paid to the use of the m-learning technology. It is caused by the main advantages of its use, namely: bringing new technology into the classroom; possibility to use portable devices to support the learning process; possibility to use the technology as an additional tool for learning; as a useful add-on tool for pupils with special needs; available synchronous learning experience; allows widened opportunities for timing, location, accessibility and context of learning (Striuk et al., 2015).

The challenges of introducing m-learning technology were also taken into account. Among them are as follows: accessibility and cost barriers for users; incompatibility of some mobile devices with other applications and devices; frequent changes in device models, technologies, functionality; number of file (asset) formats supported by a specific device; risk of distraction and fragmentation of learning; restriction of educational information visualization; required bandwidth for nonstop and fast streaming; tracking of results and proper use of the information and the lack of well-developed pupils' self-control skills; insufficient "technical" training of school teachers in creating of mobile application (Tsesarska, 2002).

Smartphones and tablets based on the Android operating system allow you to use online resources and various free applications that are downloaded from the PlayMarket server. Analyzing the PlayMarket

server, it has been found that it contains a lot of applications that are permanent helpers in the biology learning with the possibility of free downloading. All applications are installed on the teacher's smartphone, and using Google Chromecast adapter, they are displayed on the multimedia projector screen.

There are some examples of using templates of the LearningApps.org online resource for teachers to create their own exercises at the Biology lesson:

Exercise "*Find a pair*" is a universal task that can be used by the teacher at any stage of the lesson and in the process of studying various themes. Pupils like images, text information, or videos to help them match the right pairs. A bright example is to match the image of the plant to its name (which taxonomic link it belongs to). If a pupil forms a pair correctly, the colour is green, but if a mistake is made, the pair is shown in red.

Example: you can see images of the main representatives of the Gymnosperms group and their species names on the Smart Board (figure 1). Pupils come up to the board in turn and try to match an image and a species name. There is an exercise check at the end (highlighting correct and incorrect answers in colours).

Exercise "*Classification*" is used for selective sorting of statements, notions, videos, audios, or images according to a corresponding common theme. Preparing for a Biology lesson a teacher can use it for the systematization of knowledge, matching, or consolidating of the corresponding educational material.

Example: you can see statements on the board, which can be referred to two groups: Gymnosperms and Ferns. Pupils classify the statements, explaining which of the groups it can be referred to. There is answers check at the end (correct answer is highlighted in green and incorrect answer is shown in red colour).

Figure 2 presents an illustration of the exercise "Classification", which should be used when studying the types of inflorescences with the help of the LearningApps.org online resource at different stages of the lesson: perception of information, clarification and expansion of knowledge, reproduction of information, generalization and systematization of knowledge.

Another bright example of this exercise is classification of statements. Pupils are offered to sort all the statements according to their belonging to a certain class: Monocotyledons and Dicotyledons. If the pupil's answer is correct it is highlighted in green and incorrect matching is shown in red colour.

Exercise "*Simple ordering*" the main goal of which is to arrange the proposed statements, images in a certain order (establishing a sequence). There is a



Figure 1: Illustration of the exercise “Find a pair”. Learning of plant species “Gymnosperms group” in the LearningApps.org online resource (<https://learningapps.org/display?v=pk1msmk7321>).

numbering in the upper left corner, which is changed, when you move the statements. It can be used during Biology lessons for the sequential arrangement of development cycles, body structure, physiological processes, and others.

Example: during the lesson on the theme “Subclass Equisetidae” pupils get acquainted with different stages of the equisetum development cycle. It is necessary determine the correct sequence. The stage which was correctly determined is highlighted in green, false stage is shown in red (figure 3).

Exercise “Quiz (1 correct answer)” can be practically used when the teacher develops test tasks. Using clear instruction, the teacher can create questions with different numbers of answer options. Questions can be in text, audio or video format. The teacher decides on the number of questions himself. Pupils’ answers are sent to the teacher’s personal account, which makes it easier to check the tasks and does not take much time.

Exercise “Fill in the blanks” is used for filling in certain parts of the text. Pupils are offered certain part of the text with blanks in it. It is necessary to fill in the blanks: choosing from the list of proposed options, or choose the statement independently from the learned material. Each of the pupils can do this exercise us-

ing his mobile phone. Advantages of use: each of the pupils can test his knowledge himself, online discussion of this exercise is possible and the results of the answers are automatically sent to the teacher’s account, pupils can also see and analyze the correctness of the completed tasks themselves. The exercise can be used at the stage of motivation, homework checking, consolidation of knowledge, or reflection.

Another example of this exercise is the work with a textbook (Matiash, 2004). Pupils should study a part of the theme on the basis of the textbook, namely on the example of the main features of flowering plants (Angiospermae). The text without answer options is provided on the board, or on the mobile phone (if the teacher sends the task to pupils in advance), pupils in turn at the board (or on the mobile phone independently) fill in the answers, according to the learned material. The correct answer is highlighted in green; the incorrect answer is shown in red colour. The answers are sent to the teacher’s account, then there is a mutual reflection with the class and correction of mistakes with pupils’ explanations and if it necessary the teacher may add something.

Exercise “Crossword (puzzle)” has a user-friendly interface for building a layout and creating tasks. Using the template, the teacher only needs to create

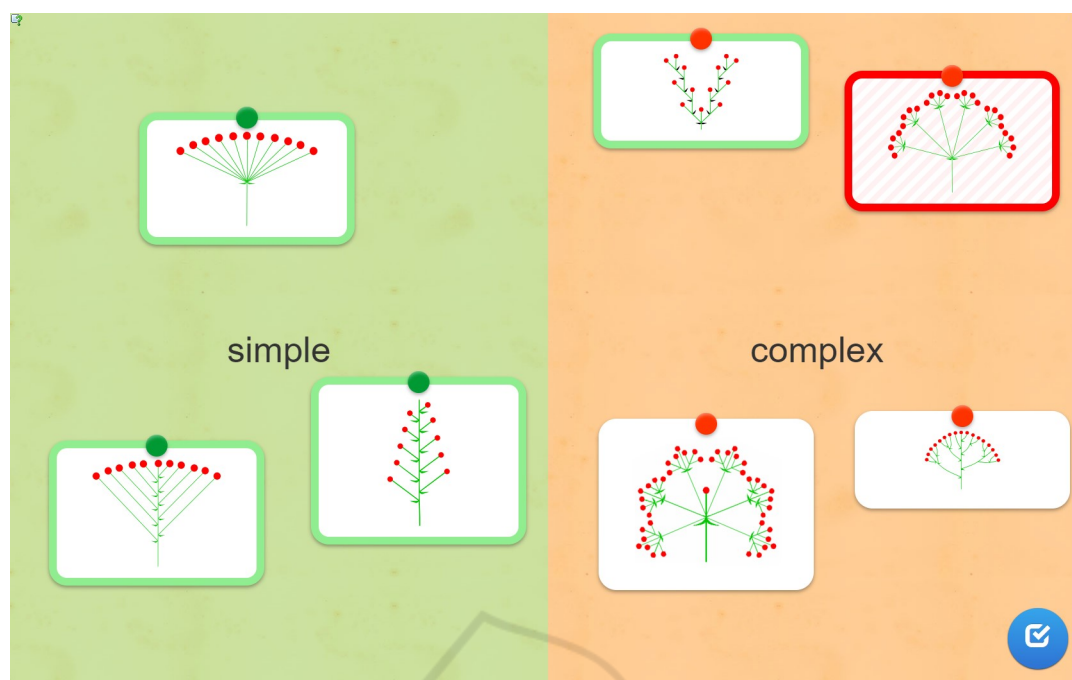


Figure 2: Illustration of the exercise “Classification”.

questions and choose the correct answers to them. The program itself builds a crossword puzzle by placing words vertically and horizontally and determines the appropriate intersections of words. The teacher can also choose a keyword that is relevant to the theme of the lesson. The exercise can be used at the stage of motivation, revision of the learned material, consolidation of knowledge. The development of this exercise is quite easy and clear and can be used for independent pupils’ work, in the case of sufficient knowledge how to use the LearningApps.org online resource. Example:

1. In the life cycle of the considered groups prevails... ? (Sporophyte)
2. What do extinct plant species form? (Coal).
3. Where does photosynthesis take place in horsetail (Equisetum)? (Stem).
4. What is the limiting factor in fertilization of the considered groups (Water).
5. What is the underground part of Lycopodium? (Root).
6. How are horsetails (Equisetidae) dispersed? (In groups).
7. Where are spores of the considered groups formed? (Strobilus).
8. Give a clear name for the sexual generation of horsetails (Equisetidae) and lycophytes? (Gametophyte).

9. What is the photosynthetic organ of Lycopodium? (Leaf).
10. What do young steams of horsetail (Equisetum) contain in great amounts? (Starch).
11. What part of lycophytes is used to make baby powder? (Spores).
12. What is the indicator for soils with high acidity? (horsetail (Equisetum)).

Pupils can see the illustration of crossword puzzle on the Smart Board, and they immediately answer the questions on it, checking the correctness of the answers at the end.

Exercise “*Find the words*” is used as an educational game. Pupils are offered a list of questions to answer and find them on the word search board one next to the other. The program creates the word search board itself where the words are arranged horizontally, vertically and diagonally. This exercise is used at all stages of Biology lessons, especially it is offered for knowledge actualization. Example:

Questions:

1. Embryonic leaves that are found and developed in the seed? (Cotyledon).
2. Modified steam of flowering plants (Angiospermae) group? (Flower).
3. What fertilization (give the name) leads to the formation of a seed and fruit? (Double).

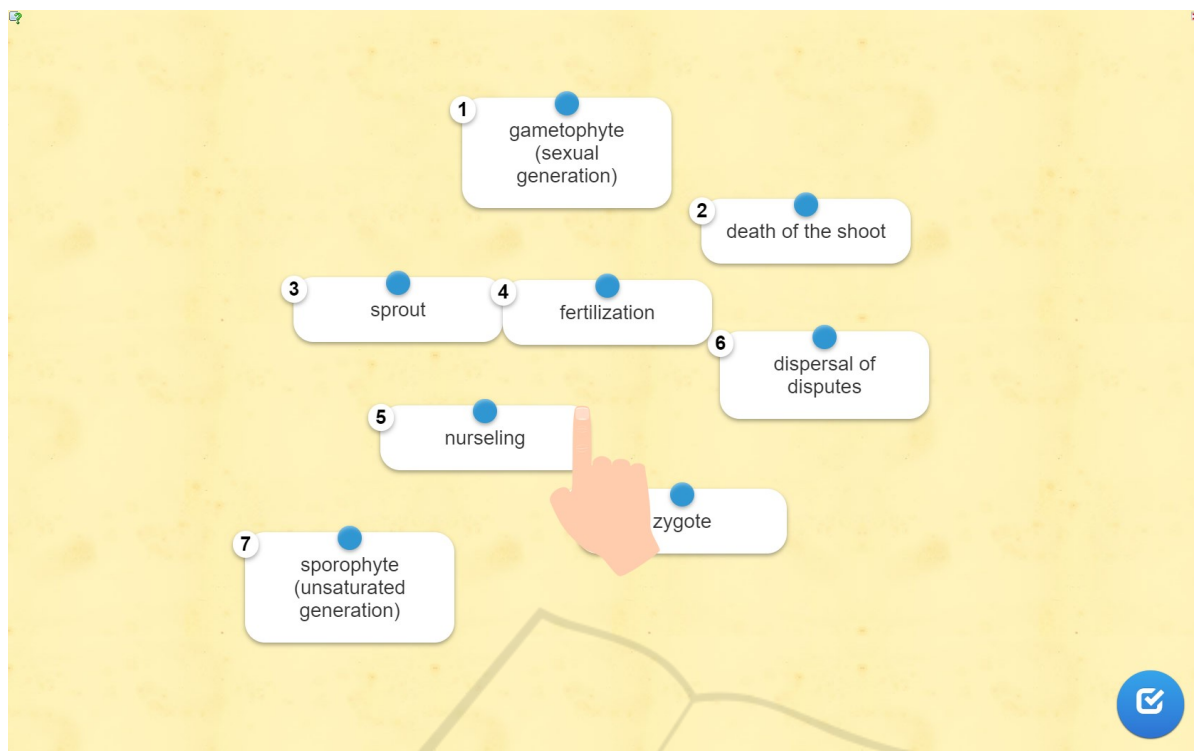


Figure 3: Illustration of the exercise “Simple ordering” – arrange stages of the life cycle of field horsetail (*Equisetum arvense*) in the right order using the LearningApps.org online resource.

4. Which class do the Lily and Cereal families belong to (give the name of the class)? (Monocotyledons).
5. What type of root system do Dicotyledons have? (Taproot).
6. The diversity of which organs of flowering plants (Angiospermae) group improves and increases the species composition of vital functions performing? (Vegetative).
7. What class do Rosaceae and Asteraceae families belong to? (Dicotyledons).
8. Name the type of Dicotyledons venation? (Reticulate).
9. The root system of Monocotyledons is...? (Fibrous).
10. Where is the seed protected by a pericarp that has an adaptation to the dissemination? (Fruit).

Pupils are given a table with encrypted words and questions to them. They answer the questions and find the appropriate answer in the table. The correct answer is highlighted in colour.

We present examples of educational applications, involved in our methodology.

In our previous research (Stepanyuk et al., 2019) the effectiveness of using such free applications of the

PlayMarket server as “Anatomy 4D”, “Animal 4D+”, “Augmented Reality Dinosaurs – my ARgalaxy”, “BioInc – Biomedical Plague, BioInc”, “Plan+Net” in the process of Biology studying in a basic secondary school was proved. Their choice is caused by the specifics of the object of biological cognition (life in all its manifestations) and the concept of bio(eco)centrism, which recognizes the life of any organism as the highest value. Comparison of the content of these applications with the content of the program material in Biology for the 6th grade allowed us to conclude that it will be the most appropriate to use the “Plan+Net” application for our experimental methodology, which is a powerful tool to identify plants in the photo. During an excursion the teacher takes a picture of an unknown plant by his smartphone and then using the mobile application analyzes the received information. After the work completing, plant details can be checked using printed version of a plant catalogue. Pupils can use such an educational application not only at Biology lessons, but also during their individual work in the process of research at the centers of research and experimental activities.

The use of information devices at a lesson at the stage of homework checking allows to diversify the forms of pupils’ learning outcomes control. Thus, in

addition to computer testing, Miracast wireless technology can be used for this purpose. This requires the owning of a smartphone, a multimedia projector and Google Chromecast adapter. There is a great deal of educational content available on Google Play Market application of your smartphone, including programs for pupils' learning outcomes control. One of them is Plickers. This web server lets you survey your class at the lesson and conduct instant checks for understanding of the learned and current material in a test form.

To start working with it, it is necessary to download a free application Plickers to the teacher's smartphone. Then, in a separate application, prepare the tests and print a set of cards. One set of cards can be used for different classes. Each pupil is assigned a unique Plickers card that has a black and white image similar to a QR code. The number of the card corresponds to each pupil (according to the list). Then you will need to take your smart device, choose the Plickers application.

Choose the class and necessary question from the list. The chosen on your mobile device question will be automatically displayed on the screen with the help of a projector. Using the scanner of your smartphone scan your pupils' cards and record their answers. Pupils should hold their cards so that the letter of the correct answer is located at the top. Colored highlighting helps to find out how well the pupils answer the questions quickly: grey marks the pupils who haven't answered yet, red means incorrect answers of pupils, and green stands for correct answers.

The use of Smart technologies makes it possible to solve the following topical issues: use the latest IT in training; improve the skills of pupils' independent work in information databases, the Internet; improve the pupils' knowledge, skills and abilities; make the learning process more interesting and meaningful; develop creative potential; control through testing and a system of questions for self-control; increase the cognitive activity of pupils due to various video and audio information (Doroshenko et al., 2005).

Smart Board is a touch screen, which is connected to a computer. Multimedia projector transmits an image from the computer screen to the Smart Board. The latter acts as an interactive touch screen monitor for the computer. By touching the Smart Board, the user is able to click on buttons, highlight text and drop and drag items right from the Smart Board.

An interactive whiteboard helps the teacher to work with a variety of multimedia visual aids that allows you to display an object in a variety of ways. In the course of his work a biology teacher can use everything that the pupil is able to perceive clearly.

While working with the Smart Board, there is a

rapid increase in the amount of visual information, which in its turn increases the quality and effectiveness of the lessons. Unique possibilities of Smart involve pupils in active cognitive activity and enhance their creative potential. There is a chance to work with a large amount of information at the lesson that creates the optimal conditions for pupils' individual research work in biology. Pupils work with computer models, during such work they can carry out experiments and check hypotheses.

During the work with the Smart Board a number of traditional didactic principles are being implemented: sequence, systematic character, scientific approach, visual training, pupils' activity and consciousness, connection of theory with practice, availability and duration of knowledge. The principles of visualization, availability and systematicity are realized through adding tables, video and audio materials, and analysis of materials of electronic textbooks during the explanation of new material. However, the interactive whiteboard is mostly used during the principle of visualization due to which you can present educational material in the form of schemes, dynamic algorithms or generalizing tables, which are a concise statement and an illustration of the main conceptions of the material and its use at the lesson.

Our methodology involves the use of a website as a means of increasing the effectiveness of the learning process. Nowadays any teacher can create a website. There are hundreds of different website building platforms and website builders. You can get either free or for the payment information-technological base and real resource in the form of electronic space, modules, templates, control systems.

Site pages can be simple static file sets or created by a special computer program on the server. It can be either custom-made for a specific site, or be a ready-made product designed for a specific class of sites. The structure of a website consists of two parts: internal and external. The internal part of the structure is represented by the headlines, sub sections, site sections, labels and other navigation elements. The external part of the structure of a website is a scheme of the content blocks, that is, how the header, the main content, the comment block, and other elements of the site are located. A well designed website layout, where convenient and interesting interface is combined with actual information is a very important point in the development of this resource and it is better perceived by users (Skrypka, 2015).

Having analyzed the functions and tasks of various websites, we chose the website builder Ucoz. The appropriateness of this website builder choice is caused by the fact that it contains all the necessary

components for creating namely a training website and allows to create multi-functional universal websites free of charge. It involves a sufficiently large number of educational category templates, with an appropriate interface, convenient ways to add and edit existing web pages, site management options from both the control panel and the admin panel that rejects force majeure during learning, because if you have problems with logging into the admin panel, the teacher will be able to manage the site through the control panel. This builder contains a specific, comprehensible control panel which requires registration and has a definite password used to log in. It will protect the site against hacking, illegal spreading of information which is stored on it, as the website administrator has certain copyrights.

In the context of experimental learning we have developed a methodology for organizing a biology teaching process in a basic secondary school using the LearningApps.org resource and various information devices. We used them variously at lessons of different types: at the introductory lesson, to activate the cognitive process and to report new knowledge; at the lesson of studying new material; at the combined lesson in order to expand and deepen the pupils' knowledge; at the lesson of checking and correction of knowledge for final control and correction of knowledge.

The LearningApps.org resource was used together with other information devices at different stages of the lessons: at the stage of actualization basic knowledge: tests (Plickers application), video clips (Smart Board), models of objects and phenomena (Smart Board); at the stage of learning activity motivation: coloured drawings, animated snippets, virtual biological experiments, website; at the stage of learning new material: photos, slideshows, animated plots, interactive models (website), video clips (Smart Board); at the stage of summing up of the studied material: multiple-choice tests (Plickers application), mute pictures (Smart Board), establishment of sequence of biological processes (Smart Board); at the stage of generalization and systematization of obtained knowledge: thematic control with automatic verification (Plickers application), control – diagnostic tests (website).

They were also used in various forms of learning: during the class work and practical classes (website); during virtual excursions (Smart Board); during pupils' individual work and research (website); while doing pupils' homework (website, mobile applications).

Conducted research allows to make a conclusion that using a training website in biology teaching pro-

cess greatly facilitates pupil-teacher interaction. It is advisable to use a training website to prepare pupils for independent work on the tasks that the teacher places in advance in the suitable section on the website. At the lesson preceding the lesson of generalization and systematization of knowledge, the home assignment will be as follows: the pupils should refer to the website, the address of which is reported by the teacher, and in the section "Preparing for independent work" do the assigned tasks (there may be different variants). At the lesson of generalization and systematization of knowledge it is necessary to do the tasks placed on the site, or to use them as a plan for the survey of pupils. Thus, they can revise, generalize, systematize the obtained knowledge and fill in the gaps. By using the website in preparation for the pupils' independent work, we give them more time to prepare and diversify the process, which will then have a positive impact on the learning outcomes.

Using a website is also productive at the lesson that precedes practical work. Biology teaching involves performing such practical work that requires certain conditions that cannot be created in the classroom. For the fairness of the experiment and obtaining accurate results, it is better to ask pupils to carry out this practical work at home with the help of their parents, and to place the plan of work and instructions how to carry it out in the section "Practical work" on the website before conducting it and, to discuss the results at the stage of actualization knowledge at the next lesson.

It is convenient to place some research themes on this training website, as this will help to prepare for pupils' conferences, because they will be able to get the theme at the beginning of the academic year and work at it throughout the year and after that to defend it at conferences. The website can store all the theoretical information necessary for conducting lessons so that the pupil can access it at any time. This way of placement is convenient for pupils who were absent from the lesson, as they can independently study the material which was missed in the home environment.

Generalized results of the thematic assessment on the themes, during which the experimental methodology of using the LearningApps.org online resource in combination with information devices in the 6th grade was implemented are presented in table 1.

Analyzing the data of table 1, we can see that pupils acquired knowledge in all the themes which were taught using experimental methodology. This is evidenced by the average value indicator of the coefficients of teaching information acquisition (76.42%).

The results of the Stage I of pupils' thematic assessment on the themes "Root, stem: structure and

Table 1: Results of acquisition the elements of knowledge by pupils of the experimental group.

No.	Program themes	Elements of knowledge (notions)	I_a	n	$n \cdot I_a$	$\sum I_0$	$K, \%$
1	Root, steam: structure and basic functions. Variety and modifications of vegetative organs. Photosynthesis as a characteristic feature of plants.	morphological	6	491	2946	2254	76.51
		anatomical	3	491	1473	1089	73.93
		physiological	6	491	2946	2185	74.16
		agronomic	1	491	491	405	82.48
2	Plant reproduction: sexual and asexual. Vegetative plant reproduction. Flower. Inflorescence. Pollination. Fertilization	morphological	11	503	5533	4188	75.69
		anatomical	1	503	503	386	76.73
		physiological	3	503	1509	1104	73.16
		agronomic	1	503	503	437	86.87
3	Algae. Mosses. Gymnosperms	morphological	2	482	1928	1467	76.08
		anatomical	2	482	964	773	80.18
		physiological	5	482	2410	1695	70.33
		agronomic	2	482	964	710	73.65

basic functions. Variety and modifications of vegetative organs”, Photosynthesis as a characteristic feature of plants, nutrition, respiration, plant movements” are shown in figure 4.

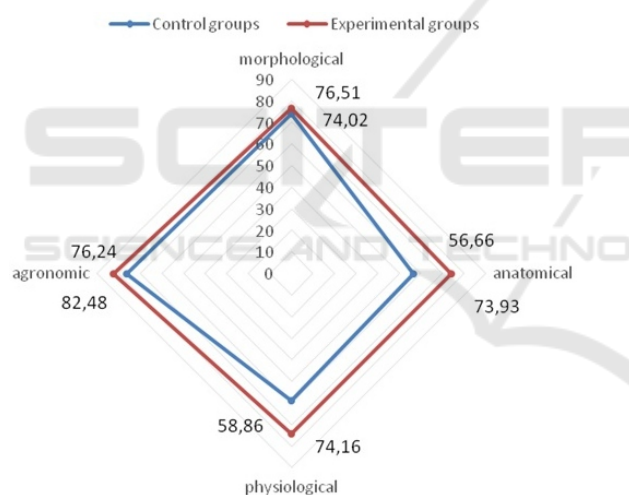


Figure 4: Coefficients of pupils' acquisition of the elements of botanical knowledge (Stage I of the thematic assessment).

According to the state requirements for the level of pupils' general educational background, laid down in the current program in Biology, the study of the themes “Root, steam: structure and basic functions. Variety and modifications of vegetative organs”, Photosynthesis as a characteristic feature of plants, nutrition, respiration, plant movements” involves pupils' learning of morphological, anatomical, physiological and agronomic notions. Analysis of the results of doing the tasks with morphological content showed that pupils have learned this educational material ($K = 74.36\%$ – in CG and $K = 76.51\%$ – in EG).

As it can be seen in figure 4, the coefficient of pupils' acquisition of the anatomical and physiological notions has considerably increased in EG (from 56.66% and 58.86% to 73.93% and 74.16%, respectively). We believe that the effectiveness of knowledge acquisition is connected with the proposed methodology of teaching pupils using the LearningApps.org online resource. The formation of such notions as “photosynthesis”, “respiration”, “evaporation”, “transportation of substances in the plant” is possible only with a rational combination of traditional visual aids (tables, diagrams, experiments) and the use of multimedia fragments, that what the experimental methodology included.

A comparison of the answers to the questions with agronomic content showed that the results of thematic assessments of pupils' academic achievements from CG and EG did not differ significantly (76.21 and 82.48, respectively).

A comparison of the thematic assessment results on the themes “Plant reproduction: sexual and asexual. Vegetative plant reproduction. Flower. Inflorescence. Pollination. Fertilization” is shown in figure 5.

The results of pupils' educational information acquisition proved that the most significant impact the proposed methodology of using the online resource LearningApps.org in combination with information devices has on the formation of anatomical ($K = 76.73\%$) and physiological notions (73.16%). At the same time the difference in coefficients of knowledge acquisition in CG and EG is + 11.38% and + 16.31%, respectively. It can be explained by the fact that for the pupils of this age group (12-13 years old) the physiological processes of “pollination”, “fertilization” and “plant development” are difficult to understand and remember. It is difficult to show these processes and to form the holistic visual representa-

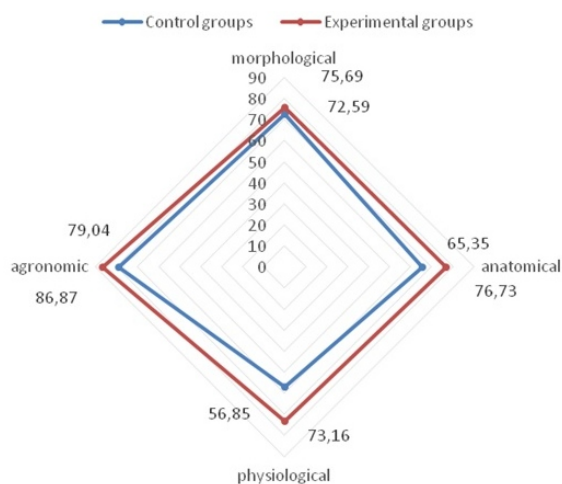


Figure 5: Coefficients of pupils' acquisition of the elements of botanical knowledge (Stage II of the thematic assessment).

tion of the mechanisms of their occurrence with the help of traditional static means of visualization.

The results of the Stage III of pupils' thematic assessment on the themes "Algae", "Mosses", "Gymnosperms" according to the coefficients of knowledge elements acquisition (morphological, anatomical, physiological, systematic, and ecological) in control and experimental groups are shown in figure 6.

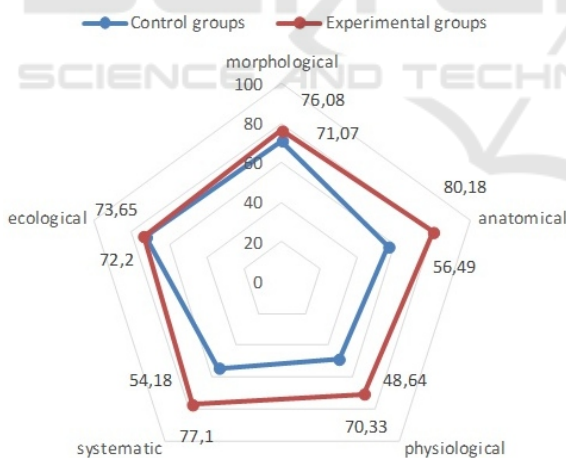


Figure 6: Coefficients of acquisition of the elements of botanical knowledge (Stage III of the thematic assessment).

The analysis of the results of tasks on the themes "Algae", "Mosses", "Gymnosperms", which involved the acquisition of morphological knowledge (figure 6) showed that this knowledge is acquired by pupils at a sufficient level ($K = 71.07$) using traditional teaching. Undoubtedly, using of the LearningApps.org online resource for training, in particular, the demonstration of images of the organs of higher sporophytes and

gymnosperms promotes better memorization of educational information, as evidenced by the coefficient of knowledge acquisition ($K = 76.08$).

The most significant impact of using the online resource LearningApps.org in the process of studying we observe at those stages where anatomical ($K = 56.49\%$ in CG and $K = 80.18\%$ in EG) and physiological ($K = 48.64\%$ and 70.33% respectively in CG and EG) notions are formed. It is difficult to form these notions using traditional mediums of instruction (tables, microscope, textbook). The use of pedagogical software with dynamic multimedia fragments helps to illustrate the complex processes of reproduction of higher sporophytes and algae, their better visual perception.

In the process of pupils' systematic notions acquisition, it is important that they possess already formed morphological, anatomical and physiological notions. Since after using the LearningApps.org online resource in EG, the coefficient of these notions acquisition increased, this can explain the increase of the coefficient of systematic notions acquisition ($K = 54.18\%$ in control groups and $K = 77.10\%$ in experimental groups).

Analysis of the answers to the questions with ecological content allows to confirm that this material can be considered to be learned as the coefficient of educational information acquisition both in CG and EG is higher than 70%.

Thus, the comprehensive analysis of the results of the forming experiment allowed us to conclude that proposed by us methodology of using information devices in the process of Biology school course studying is effective.

4 CONCLUSIONS AND PERSPECTIVES OF FURTHER RESEARCH

Modern IT allow to create a single information environment, the basis of which is integrated computer networks and communication systems, which gives an opportunity to accompany and coordinate educational processes. When introducing online resources and information devices into the educational process in Biology, the principle of reasonable conservatism and continuity must be observed. The computer cannot substitute a teacher in the process of teaching; it is only a means of broadening possibilities to acquire new knowledge. The teacher always has to play the key role in any educational innovation. This justifies the appropriateness of moving to a mixed form

of training that involves the creation of a polysubjective educational environment (teacher, pupil, online resource, information devices).

The LearningApps.org resource has a lot of advantages: availability of the service in different languages (including Ukrainian), access to unregistered users, the ability to use tasks created by other users, a wide range of task types, tips for completing and developing tasks, easy to use, accumulation of own exercises in a personal profile, creating pages to work with different classes.

There are a great number of benefits of using this digital app, but there are also some negative qualities: some templates do not support Cyrillic script, the school must be connected to the Internet, there are some errors in the templates that cannot be corrected manually, some exercise templates change or they are removed from the site.

The use of the LearningApps.org service helps in versatile and purposeful formation of pupils' educational competencies and allows to achieve the goals more effectively by involving each pupil in cognitive, creative, active activities, combination of logical and figurative thinking.

The methodology of using the LearningApps.org service in combination with information devices in the process of Biology studying in a basic secondary school involves the use of the PlayMarket server applications, Smart technologies and a website. It is relevantly to use free applications of the PlayMarket server while studying Biology in a basic secondary school. They are as follows: "Anatomy 4D", "Animal 4D+", "Augmented Reality Dinosaurs – my ARgalaxy", "BioInc – Biomedical Plague, BioInc", "Plan+Net". Their choice is caused by the specifics of the object of biological cognition (life in all its manifestations) and the concept of bio(eco)centrism, which recognizes the life of any organism as the highest value. During homework checking it is advisable to use Miracast wireless technology besides computer control of pupils' learning outcomes. This demands the owning of a smartphone, a multimedia projector, and a Google Chromecast type adapter. It would be appropriate to use the website builder Ucoz for creation of a training website in Biology.

Based on the synthesis of the obtained data, recommendations for the use of a Biology training website were developed: the use of the website should not be the only means of training; each lab work using a training website must be preceded by a mandatory introductory instruction; the information in the sections should be precisely matched to the relevant theme of the lesson; the answers to the questions for self-examination should be mandatory checked, ei-

ther in the course of group activity at the lesson or individually, in order to trace the gaps in the knowledge of a particular pupil; take into account wishes of the pupils, because in order to enhance their academic performance, socialization and improvement, such a training website is created.

The educational process which involves the use of the LearningApps.org service and information devices encourages the independent work of each pupil, creates a favorable communication situation and conditions for the development of creative abilities of the individual, which are especially important for each pupil; increases the motivation and cognitive activity of pupils, improves the individualization, differentiation and intensification of the learning process, broadens and deepens interdisciplinary links, systematizes and integrates knowledge of certain subjects, organizes systematic and reliable control, avoids subjectivism in assessment. In addition the use of the methodology of the LearningApps.org service and information devices integration in the process of Biology studying significantly simplifies the interaction between pupil and teacher, allows to combine the formation of logical and figurative pupils' thinking.

The prospects for further study consist in the studying of the influence of the methodology of the LearningApps.org service in combination with information devices on the formation of pupils' general and subject-based competencies in the process of Biology studying; preparing of future biology teachers to model educational activities using the LearningApps.org service in combination with information devices.

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