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SYNERGY BETWEEN GAMES AND TECHNOLOGY IN PRESCHOOL ENVIRONMENTAL EDUCATION

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Abstract. The paper presents the results of a research focused on the synergetic effects of game-technology collaboration in preschool environmental education. The parameters of an author's multimedia game model are presented, with the model being promoted as an opportunity to innovate ecological-educational interaction in kindergartens. Trends and perspectives for educational innovations related to the formation of natural science competencies and competencies for sustainable development in an e-environment are presented.

Keywords: game; IT; multimedia game model; natural science competencies; sustainability; quality of preschool environmental education; innovations in an e-environment

Introduction

Changes in the lives of modern children make technology an accessible and necessary means of exploring the world. In the digital age, it is a key tool for improving education and ensuring its quality, which is at the heart of the prosperity of high-tech societies. Its integration in The World Around Us classes in kindergartens is an investment in the future which will significantly change the parameters of pedagogical interaction and its environment. Its synergy with games is an innovation with a complex developmental effect multiplied by the new stimuli for exploration and transformation of the surrounding natural world. It sets the vector of children's self-development and self-improvement in the context of modern education in the digital age.

The multifaceted nature of synergetic functioning of game technology and information and communications technology (ICT) creates prerequisites for the implementation of modern educational application solutions based on the balanced combination of the didactic orientation of interactivity with the subjective value of gaming. It is in this intersecting field where it is possible to reveal the essential forces of the growing individuality and realize its complex self-expression and self-realization as a protected right to make choices and play (Gyurova, 2012: 14). In this context,

this paper promotes options for innovating preschool environmental education by integrating new methodological tools and solutions based on the synergy between games and technology.

Methodology

The realization of a manageable transition to the society of knowledge is impossible without guaranteeing equal opportunities for obtaining quality educational services through the use of ICT. Its application in kindergartens is dominated by the integrative functions of games as a leading strategy for building a complete picture of the world. The synergy between games and technology transforms the traditional educational environment in kindergartens and changes the possibilities for fixing and transmitting experience by expanding the horizons of children's thinking. It provokes a change in the structure of mental activity based on the various educational interaction that increases the effectiveness of pedagogical subjects and stimulates the motivation to learn.

The synergetic charge of the game-technology collaboration has specific projections in the pedagogical interaction oriented towards the formation of natural science competencies and competencies for sustainable development. Their knowledge allows to manage the quality of early environmental education with greater certainty and accuracy. This is a leading argument that sets the vector of research interest towards discovering and justifying opportunities for innovating the environmental education practice based on the synergy between games and technology.

From these starting points, the design of the author's research was developed. The main **goal** of the research is focused on the systematization of theoretical-methodological and educational application grounds for the substantiation of the developing functions of game-technology collaboration as an innovation for quality management of preschool environmental education.

The ***object*** of the research is the process of formation of natural science competencies and competencies for sustainable development through synergy between games and technology.

The ***subject*** of the research is to reveal the patterns of the process of improving environmental education in kindergartens through game-technology collaboration.

It is assumed that the discovery and justification of opportunities for innovation of environmental education practice through the synergy between games and technology will stimulate the application of multimedia game models in The World Around Us classes and encourage useful interaction between the pedagogical subjects engaged to support interactivity in the multimedia educational space.

To achieve the goal, in accordance with the specifications of the object and subject of the research, the following main ***tasks*** were outlined:

1. Systematization of theoretical grounds for collaboration between games and technology.

2. Assessment of the developmental effects of application of interactive multimedia game models for the formation of natural science competencies and competencies for sustainable development.

3. Derivation of trends and prospects for the innovation of preschool environmental education through the synergy between games and technology.

The research was realized through a set of methods:

1. *Analysis of scientific literature:* with a focus on the works of contemporary authors that are thematically related to the research problem.

2. *Conceptual-terminological analysis:* through it, the specification of the essence of the pedagogical phenomena studied is achieved by revealing and meaningfully concretizing the conceptual-terminological apparatus.

3. *Causal analysis:* oriented to the disclosure and justification of the complex of regular connections between the different aspects of the phenomenon studied.

4. *Discursive reflection*: involves the formulation of theoretical evidence and scientifically based conclusions about the essential characteristics of the synergy between games and technology in the context of preschool environmental education.

5. *Pedagogical extrapolation:* applied in order to concretize the theoretical knowledge and enrich the scientific ideas for game-technology collaboration with new research nuances designed in early education in the field of environment and sustainable development.

6. *Pedagogical modelling:* provides a model presentation of a multimedia game model based on the synergy between games and technology. It was developed in the context of the competence paradigm and is oriented towards the preparation and manifestation of natural science competencies and competencies for sustainable development in the conditions of preschool environmental education.

7. *Pedagogical forecasting:* outlines prospects and trends for the innovation of ecological education in kindergartens.

Results

Games are the most accessible cognitive strategy through which children discover the diversity of the natural world. Their pedagogical value is related to their integrative functions in educational interaction. They guarantee a variety of options for the complex realization of didactic goals, the focus of which are key new formations as significant trends for prosperity of the growing individuality. They are related to updating and improving the personal experience in the conditions of play functioning of children, who, by playing, test and express what they have learned about the world of nature by transferring it to new situations. This gives subjectivity which should be purposefully and consistently supported and protected by pedagogues as a valuable sovereign right of the children's personalities to realize their potential for cognitive, social, and creative self-development by playing. The synergetic charge concentrated in games is multiplied by the variety of game technologies. Their flexibility makes

them applicable *"... not only for entertainment purposes in kindergartens, but also for changing the knowledge, attitudes, and behaviour of children"* (Petrova, 2020: 44). The dominance of games guarantees unobtrusiveness and ease of educational interaction and, in the context of the modern vision of the peculiarities of children's' development and the role of children in it, presupposes *"... compliance with the emotional element and parallel acquisition of knowledge and formation of skills based on expression and sharing"* (Chuhovska, 2016: 253).

The realization of the ecological-pedagogical interaction through games ensures the achievement of two main tendencies: from the point of view of the mediation of pedagogues and from the point of view of the possibilities and prospects in building the global children's experience (Gyurova, 2009). This gives grounds to consider the play orientation of the subjective culture of children as a distinctive feature of positive educational environment in kindergartens, as it reveals the potential for self-development of the growing individuality that protects this sovereign right of its by playing. The building of capacity for its facilitation is the responsibility of the institutions and professional communities involved. In the current educational context, this means permanent renewal of all parameters of the educational environment and the functioning of the pedagogical subjects in it, because *"the innovation processes, the rapid dynamics in social development inevitably impose new conditions, standards, and priorities of the educational process in kindergartens..."* (Doncheva, 2014: 29). Their development, approbation, and justification are focused on the transition from information-reproductive education to education that forms the competencies needed in the digital age (Gyurova, 2020). Accomplishing this responsible task is impossible without technology. Its integration into the ecological educational interaction is an innovation that transforms the traditional educational environment in kindergartens. Through technology, it connects the participants in the educational process, with the help of modern material, technical, and pedagogical resources. Their use presupposes the approbation of new educational application solutions the provision of which is connected with the change of the forms and methods of teaching, with the improvement of the didactic means, with the transformation of the interaction between the pedagogical subjects, with the promotion of new educational resources. Multimedia products are especially promising here. It is them that *"stimulate the formation of a new cognitive interest and generate motivation for learning ... Through the means of multimedia, information can be presented in the most appropriate and easy to learn way by using sound, video, animation, graphics, and text"* (Nikolova, 2012: 110). At the same time, *"a large part of the technologies can be considered from an ecological point of view as well, with an emphasis on their possibilities for preserving nature and its riches"* (Stefanova, 2020: 322).

In scientific research, there are different interpretations of the concept of multimedia. According to St. Lazarova and L. Lazarov, the common in them is the

understanding *"...that multimedia is the use of computer information technologies for integrated presentation of text, graphics, sound, video, and animation"* (Lazarova, Lazarov, 2017: 138). Multimedia games are a type of electronic educational resource that operates on the basis of information and communication technology. They are created taking into account the principles of developmental learning and are designed to complement traditional kindergarten playing activities and exercises. They assist in the inclusion of children in information technology and in the preparation and demonstration of related competencies. They play a key role in the paradigm of lifelong learning. Their educational opportunities are due to the fact that multimedia *"... unites media of various kinds in a mode of dialogue with the subjects in education. This mode of exchange of information between the user and the programme in the multimedia allows for selection, interruption, repetition or change of the course of the operations"* (Stoyanova, 2019: 207).

Multimedia game technology provokes the cognitive activity of young nature explorers. It is easily applicable in the realization of topics related to the animal and plant world, as well as the natural physical environment and natural phenomena. ICT expands the learn-through-play space, in which natural science competencies and competencies for sustainable development are purposefully formed through new resources: videos, short animations, art paintings, 3-D drawings and models, animated plots, interactive model images, development programmes. Audio-visual information greatly facilitates the processes of perception and memorization, develops thinking and speech in unity with visual, auditory, motor, and emotional memory.

The use of the game material, mediated by modern ICT, prepares the mastery and improvement of skills for the use of schemes and models and contributes to the development of self-regulation of cognitive activity. At the same time, children master skills and abilities to realize the exchange of ways of action, experience, and information in the conditions of active communication and connection with their peers and pedagogues. Thus, they assess their own ability to apply appropriate cognitive techniques when comparing with others and to evaluate their individual cognitive experience by experiencing its significance and value in the successful solving of cognitive tasks. And this is a valuable reserve for optimizing the ecological-pedagogical interaction, which multiplies the synergetic effects of the game-technology collaboration in the *"... interactive communication between the participants in a pedagogical process, ... subjective relations between the teachers and the children, partnership and cooperation in learning cognitive and social information and in sharing and empathizing with peers ..."* (Hristova, 2007: 79).

The ambition to improve the pedagogical systems provokes the authors to supplement them with a variety of multimedia resources developed taking into account the synergetic relationship between games and technology. Their main idea is to support the efforts of the pedagogues to offer attractive multimedia game models through which to purposefully develop a set of important competencies related

to ecology and sustainable development. From these starting points, the author's experience related to the development of multimedia games in The World Around Us educational field offered as part of the electronic resources to the pedagogical system *Molivko – Igraya i Znaya [Molivko - I Play and I know]* is shared.

The work on creating the multimedia game model was realized, stage by stage, in six consecutive and interconnected steps: primary analysis, design, development, implementation, evaluation, and subsequent analysis.

The purpose of the first stage was to systematize the scientific and theoretical foundations for the development of the multimedia game model. They were linked to the results of modern research proving the developmental effects of the game-technology synergy – Gyurova (2009 – 2020), Stoyanova (2019), Stefanova (2020), Lazarova, Lazarov (2012 – 2020), Doncheva (2020), etc.

In the focus of the next-stage research work was the design of the multimedia game system. It was designed in accordance with the competence paradigm as the main one in modern preschool environmental education. Starting point for systematizing the educational goals was the taxonomy of B. Bloom. It guaranteed complex developmental effects in terms of cognitive, affective, and psychomotor spheres of children's personalities.

In the development of the system, variants of games were structured, with different degrees of complexity of the cognitive tasks. This allows to *"... develop the cognitive operations, strategies, and procedural features of mental activity ..."* (Legkostup, 2006: 104). They are related to identification of natural objects from the immediate environment, to indication, naming, and description of their external features, to their grouping and arrangement on various grounds, to their comparison with the standards and by essential features, to their recognition by typical parts or characteristics. They support the development of manipulative and exploratory skills, attention, thinking, memory, and imagination. Variable application of a system of objective, perceptual, mental, and verbal actions is provided. Manifestations of resourcefulness and observation are stimulated. At the same time, mastering of skills for substituting objects in a subject plan, reproducing connections through subject models, and modelling in a visual action plan of essential visible features of known plants and animals is prepared. At the level of knowledge, children perceive, name, show, remember, and recognize natural objects and phenomena. At the level of understanding, children compare, explain, transform, distribute, describe, characterize, tell, discuss. At the level of application, they solve problem situations by choosing, completing, demonstrating, modifying, operating, correlating, grouping, using their own cognitive strategies for finding connections and for mental experimentation. At the level of analysis, children differentiate parts, discuss, reveal signs, explain, arrange, express doubts, ask questions, relate, choose, check. At the

level of synthesis, they summarize, compile, connect, create, establish, offer, initiate, model, modify. At the level of assessment, they comment, motivate, criticize, prove, formulate judgments and conclusions, substantiate, predict, coordinate, share opinions, confirm, review, check, rank, convince.

The implementation of the multimedia game model was associated with the availability of interactive hardware and software technologies. The minimal technological equipment presupposes an educational software package and a multimedia system: a computer and a projector. A better option is to combine an educational software package and an interactive whiteboard, and the optimal solution is an educational software package and an interactive system that includes a computer and tablets in a network, an interactive whiteboard, and a projector. This provides a variety of opportunities for variable combination of organizational forms and facilitates the independent work of children.

The approbation of the multimedia games followed the methodological algorithm below:

– creation of an emotional attitude and meaningful preparation for solving the cognitive task;

– presentation of the game and formulation of the idea of the game;

– setting the rules and creating a cognitive need for their application;

– problematic communication in the course of the game and assistance in adhering to the rules;

– presentation, evaluation, and co-experiencing of the achievements;

– gymnastics for the eyes and fingers to relieve tension after the game.

The evaluation of the multimedia game model was based on the expert opinion of pedagogical specialists who participated in its approbation. There were eight evaluation markers: objective need for the multimedia game model; innovation; conceptuality; applicability; functionality; richness of content; efficiency, and sustainability. They were rated on a five-point scale. According to all eight criteria, the model received a very high score, with a mean value of 78% and a mean relative share of high scores of 22%. The quantitative data were supported by qualitative assessments through which the pedagogues outlined the following advantages of the system of multimedia games:

– provides an opportunity for children to apply in a new situation what they have learned about the world of nature and to experience their achievements emotionally;

– offers different ways to solve cognitive tasks: by clicking on an object, moving an object, placing it into the respective outlines (shape sorting), etc.;

– provokes the little discoverers, in a fun and interesting way, to join the world of information technology through beautiful images, animation, sound, movement;

– helps children to decide on the correctness of their actions and react adequately in case of inaccuracy through additional stimuli - image and sound effects in case of correct or wrong answers. In some of the games, there is an automatic return to the starting position. The element of surprise in them encourages the desire for quick adjustment;

– stimulates the improvement of the control in the implementation of the actions by overcoming difficulties. Children adhere to the rules and strive to achieve the right result. Thus, in parallel with the development of cognitive competencies, volitional qualities are nurtured and manifestations of independence, adequate self-esteem, and critical thinking are encouraged.

The analysis of the results of the approbation of the multimedia game model allows to systematize the developing effects of the synergy between games and technology. They find expression in provoking interest in the world of nature through sound, movement, and colour as well as in providing selective presentation of information about natural objects, phenomena, and processes in a form that is attractive, accessible, and understandable for the children. They correspond to the increase in the personal commitment to manifestations of love of nature and ecology-centred behaviour. They are multiplied in new motives for learning about nature and discovering connections and dependencies in it by transforming familiar techniques for solving cognitive tasks with the help of ICT. They are concretized in stimulating the cognitive activity and facilitating the cognitive process and the memory when orienting in the diversity of the natural world. They correlate with the increased observation and stability of attention in the perception of natural objects, processes, and phenomena. They are manifested in the improvement of the skills for planning, control, and evaluation of the results of an independent activity related to revealing connections and dependencies in the natural world. They are associated with overcoming the fear of error in the use of environmental experience based on the transformation of the control options which allow children to check results, fix inaccuracies, and receive indications of incorrect answers and wrong decisions. On this basis, emancipation is achieved, which is reflected in the demonstrated confidence in their own ability to master the natural science competencies through the use of computer programmes.

These results clarify and supplement the assessment of the opportunities for effective learning in a digital educational environment shared by St. Lazarova. According to the author, *"in the conditions of educational activities unfolding through computer didactic games ... favourable opportunities are created for activating mental activity and for the formation of cognitive skills and practical experience in students"* (Lazarova, 2012: 191). This opinion is supported and concretized by the derived developmental effects of the author's multimedia game model in the context of its possibilities to prepare and manifest natural science competencies and competencies for sustainability through the game-technology synergy.

Discussion

Computers are not just modern toys but a means to innovate preschool environmental education and build a positive modern educational environment. They are valuable tools for knowledge that support the preparation and expression of fundamental natural

science competencies and competencies for sustainable development as accents of lifelong learning. In this context, according to O. Petkova, *"... the integration of ICT is a significant aspect in the innovation of the educational system. It began with the increasingly active application of interactive educational products in kindergartens as a prerequisite for continuity with the stage of school education, where computers are an integral part of children's daily lives"* (Petkova, 2019: 252).

The importance of technology for improving the quality of preschool environmental education in the dominant function of games determines the interest in the issue of scientists from different fields. Current discussion topics related to various aspects of the development, approbation, and justification of options for integrating modern game and information technologies in the environmental education are derived. Vectors for sustainable development are set, oriented towards the future of education in the digital age, which is being transformed through the increasingly active application of multimedia educational resources. They are a valuable tool of good educational practices, as *"the use of e-learning tools affects modern education and culture and creates conditions for the development of innovative teaching methods"* (Lazarova 2013: 135). Their integration into the ecological educational interaction is connected with the possibilities of the technologies for modelling different situations with natural science content and presenting video cases and visual mysteries on topics related to nature. Video clips provide perception of processes and phenomena, the observation of which in a real environment is difficult to achieve (the blooming of flowers, development of leaf buds, hatching of birds, movement of celestial bodies, etc.). Electronic encyclopaedias and books with natural science content stimulate the independent search for information about interesting natural objects and phenomena. Multimedia tools encourage the use of various graphics editors. With the help of programmes such as Microsoft Office, Paint, and Power Point, it is possible to create various exercises, cognitive tasks, travel games, presentations. Technology can be successfully integrated with games in the project activity context. It is also applicable in the context of role-playing situations with ecological content, where it can create augmented reality. It would fit successfully into the positive inclusive environment, as in synergy with the game technology for orientation in the natural world it functions as *"... the main means to increase the motivation to perform various tasks"* (Popova, 2019: 84). In each of these specific educational contextual fields, current prospects for the use of the game-technology synergy can be outlined. As an aspect of the innovation of the ecological-educational interaction, its functioning versions have an open character that correlates with the dynamics of the rapidly developing high-tech world.

Conclusion

Solving various educational tasks related to the orientation of preschool children in the world of nature is impossible without the use of modern play-

and-entertainment tools. The synergy between games and technology offers reserves for optimizing the environmental education practice in kindergartens, as it functions at the natural intersection of pedagogical goals and children's interests in the digital age. Among the examples of experimentally protected educational application innovations, the author's multimedia game model can be promoted as an add-on to the pedagogical system *Molivko – Igraya i Znaya [Molivko – I Play and I know].* Its approbation confirmed experimentally the multiplying effects of the synergy between games and technology in the context of modern environmental education in kindergartens. Shared experience is a starting point for initiating useful interactions between engaged pedagogical subjects in support of interactivity in the multimedia educational space. Professional cooperation can generate energy and ideas for permanent innovation of environmental education interaction through the application of modern information technology. Its synergetic connection with games is a challenge and responsibility for our pedagogical community and part of our mission to prepare children for the world of the future as well as for the prospects of learning in an e-environment.

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