

Use of Visual Digital Media to Develop Creativity: The Example of Video Games

V. Zabolotnyuk^{1†}, S.Khrypko^{2††}, I. Ostashchuk^{3††},
D.Chornomordenko,^{4†††} A.Timchenko^{5††††}, T.Motruk^{6†††††},
K.Pasko^{7†††††††} and O.Lobanchuk^{8††††††††},

^{1†} Hetman Petro Sahaidachnyi National Army Academ, Ukraine

^{2†† 3†††} Department of Philosophy and Religious Studies, Faculty of Social Sciences and Humanities, Borys Grinchenko Kyiv University, Kyiv, Ukraine

^{4†††} National University of Life and Environmental Sciences of Ukraine Kyiv, Ukraine

^{5††††} Kyiv National University of Construction and Architecture, Kyiv, Ukraine

^{6†††††,7†††††††} Educational-Scientific Institute of Pedagogy and Psychology of Sumy State Pedagogical University named after A.S. Makarenko, Ukraine

^{8††††††††} National Pedagogical Dragomanov University, Kyiv, Ukraine

Summary

In the post-information era, most of technologies have a visual part, or at least some functions related to visualization. It is also one of the popular means of presenting materials in education area. However, despite its popularity, the impact of visualization on the effectiveness of learning still remains controversial. Even more controversial is its usefulness in developing creativity, which is one of the most important skills for today's employee. The authors considered the use of visualization as a tool for the development of children's creativity on the example of learning video games, in particular, ClassCraft to distinguish features that, from the point of view of psychology, may lead to developing creativity even being not useful for educational purposes. It is concluded that video games useful for learning may have features, that are inappropriate in formal educational context, but important to develop creative thinking.

Keywords:

visualization, creativity, IT in education, video games, guardian of virtual culture virtual dimension, virtual culture, cyber security.

1. Introduction

Today, visualization is one of the widely used tools to analyze and exchange data, show results of studies, findings and solutions to problems. Many professionals use visualized data, for example, to represent the effectiveness of their work for some period. Starting from Gantt charts and ending with development maps, its elements accompany different processes of information exchange, making them clearer and more convincing. Even in everyday life, people use visualization for decision-making, many information is presented pictorially during political votes, advertising and promoting goods, companies and events, and so on. It can be stated that we live in the world

consisting of pictures and visual effects. They take part in almost all life processes of contemporary societies, and education is not an exception [15].

Even being well-known tool in learning for many centuries, visualization is still one of the most controversial means in education at all levels. Its usefulness, as well as benefits are often considered obvious, however, not all surveys confirm the enchantment of learning effectiveness with the use of visualized materials and practices in a classroom [16]. Despite this, various means of visualization are still widely used on different stages of learning. With active spread of IT-technologies, an increase in the number of the educational software aimed at visualizing what is being studied can be observed. Many applications used for self-education are based on pictures and visual objects, and even formal education usually requires the use of visual presentations, video materials and graphic models during lessons. Many of them, however, are used without considering their real effectiveness and impact on students. Therefore, there is a strong need to study real effect of teaching with the use of visual materials in general. Specific parts of education and upbringing involving pictures, models and other visual objects are also insufficiently studied. Research on this topic may be decisive in creating new learning materials and toolkits, especially digital ones, as they may serve as a guide for designers, who are aware of technical, but not psychological requirements in most of cases.

Creativity is one of the skills that are among the most important ones in contemporary labor market. Different means of developing it are especially popular in education area. Visual exercises aimed at completing pictures and finding as many solutions as possible are well-known in the

area of developing creative thinking. However, the question related to the possible impact of visualization on the development of creativity, especially in youth and children, also receives controversial answers. While possible usefulness of pictures, tables and charts for learning something is at least partially shown during empirical studies, there relation between visual materials and creative thinking remains unclear.

Another question is raised about features needed to develop a visual tool for educational and creativity-developing activities. Are they one and the same, or tools for developing creativity should differ?

Answers to these questions need consideration from the point of view not only of technical specialists, but also of psychologists, sociologists and philosophers, who may formulate the necessary criteria for further adjustment of developing digital visual tools involved into the process of developing creative thinking.

The purpose of this article is to reveal the key features of digital visual learning tools that are aimed at developing creativity, not just learning, on the basis of main mechanisms of creative thinking. The example of video games as a complex media popular among contemporary youth have been used to analyze its possible learning impact and involvement into creativity development.

2. Methodology

For achieving the stated purpose, an interdisciplinary approach has been used. Analyzing the content of theoretical materials dedicated to studying the effectiveness of visualization allowed us to make conclusions on characteristics of visual tools needed for the formation of creativity. With the help of analysis and synthesis, we connected these characteristics with stages and factors of creativity. Then, through the consideration of general impact of video games on learning, their specific features as a visual media tool for educational purposes have been distinguished. After that, the comparison of the impact on general learning and formation of creative abilities has been made.

Video games have been used as an example in this research not accidentally. They often have a high level of different visualization techniques involved into creating game spaces and interacting with a player. Some learning games are based precisely on pictorial materials, therefore, the results of their use may show the impact of visual tools on students.

3. Results and discussion

3.1 Psychological requirements to the effective use of visualized elements

Basically, visualization is a psychological process of imaging an object or situation; in learning, it may be used to find a solution of a task, to remember some information etc. Visualized information may also be presenter as a drawing, map, chart or other physical medium that serves as an aid in data consideration.

Visualization as a means of enhancing learning quality was known long before the information era. On the example of learning mathematics, A. J. Bishop [4] described possible aims of visualizing the studied material, as well as some limitations of this method. The main limitation mentioned by him, was the difference between the most effective methods working with different types of psychical activity.

Other limitations and, therefore, characteristics that should be inherent in visual tools, are their appropriateness and usefulness. Visual materials should be representative for every particular case of studies. However, it is hard to achieve this level in one tool, if it is not complex. In digital products, which are usually created with several visual layers or parts, reaching wide appropriateness of materials is easier. The biggest question of developing programs for educational purposes is their correlation with a certain task.

Talking about possible classification, generally, visualization tools may be divided into categories, namely:

- 1) *Static materials*, which has been a dominant tool so far. Drawings, photographs, maps etc. belong to this category.
 - 2) *Animations*, like videos, tutorials or even simple changing text.
 - 3) *Interactive models*, which have become especially popular after the emergence of VR technologies [14].
- Division according to types of data can also be found. Thus, 1-dimensional, 2-dimensional, 3-dimensional, temporal, hierarchical, multidimensional data have different impact on people's perception and, therefore, should be used differently in learning processes [12].

In digital products, mentioned tools are usually combined into a general interactive toolkit. This toolkit of visualization is usually evaluated according to technical characteristics, namely: being designed for platform independence, corresponding to existing resources, having user-friendly interface and supporting Web site [12]. All this provides the simplicity of their use by instructors and teachers. One of the most popular types of evaluating such tools is students' feedback and review of their formal results. It may be helpful to cover the impact of digital visualization tools as aids in learning processes, but not to state clearly their usefulness as separate means. The issue with creativity lies even deeper, because not only the quality of knowledge received, but also the amount of ideas produced and

developed in the process of interaction, as well as further impact should be measured.

3.2 Why children's creativity?

In contemporary world, both tools for the development of adults' and children's creativity are quite popular. In our study, we are focused on children, because childhood is an extremely important age for the development of a person's creative abilities. Children actively learn about the world, showing interest in everything around them, receive knowledge and try to use in on practice. In this period of life, basic stereotypes and patterns of thinking are formed. We would also like to explain what we mean talking about creative abilities. Creativity is usually defined as an ability to produce new useful ideas or solve problems. This term refers both to the process of generating ideas and solving problems, and to created ideas and found solutions themselves [3]. The so-called "vocabulary definition" of creativity, supported by its researchers, involves two parts of the definition: creativity requires novelty (originality) and utility (or effectiveness) [19]. Creativity researcher S. Russ describes it as the ability to produce original ideas, combine existing ideas, image or experience in a new way and synthesize existing knowledge in an original way using imagination [20].

The author of the original theory of creativity G. Wallas, reflecting on the creativity and creative abilities of a person, in his work "Art of Thought" proposed the following stages of idea formation based on the work of the French mathematician H. Poincaré: 1) Preparation (stage of accumulation of information and comprehensive study of the idea), 2) Incubation (the time when consciousness works on another problem, and the idea is passively understood), 3) Illumination (the moment of "insight", when the right solution or idea is found; this stage is uncontrollable, illumination can come at any moment), 4) Evaluation (the validation of the idea, weighting it against other alternatives and an initial task), 5) Verification (further conscious work with the idea and its implementation) [21].

The multidimensional approach defines four main components of creativity: a cognitive factor (intelligence or knowledge), an impact factor (personality or motivation), an emotional factor (the influence of emotions on creative potential) and an environmental factor (family, school environment, etc.) [1]. All these components should be taken into account when choosing tools for the development of creativity. Activities can be aimed not only at the development of creativity as such. Different types of activities include both stereotyped (what has already been studied, learned), and improvisational (new) type of thinking. It is in the combination of stereotypical and improvisational ways of thinking that may enhance the development of children's creative activity.

Forming a child's creativity and supporting their creativity during learning is one of the main priorities of educational strategies, especially today, when creativity is considered a key factor of innovation and professional success [7]. The ability to be creative allows a person to actualize themselves in almost any field of activity.

Being creative is especially important in contemporary society, which may be called post-information society. It helps coping with working tasks effectively, and it is also one of the necessary skills in IT-sphere, web design and other developing areas. Starting developing such skills since the very childhood is one of key factors for basic competitiveness nowadays. And games have always been one of creative children's activities, while video games can be considered a contemporary form of playing activity.

There are studies proving that various creativity dimensions are developed in different ways while using visual tools. It has been proven that scientific creativity has the direct relation to visual images and visualization as a person's ability, however, the situation with verbal creativity did not change with involving visualization [13]. Using different tools to develop visual skills and form creative thinking through them is ambiguous in such areas as architecture, despite seemingly obvious usefulness of them [2]. Relationship between visual tools and creativity may also vary depending on the environment where people study or work, their interests etc. [6].

To develop creativity, a visual digital product should provide non-stereotyped images and associations, which usually does not correspond to educational purposes. It should give some freedom as well, as creative thinking is aimed at solving tasks without previously learned templates and ways. Some games provide such space, therefore considering their usefulness is required.

3.3 Video games: general aspects of use in education and creativity development

Digitalization of processes has moved a significant part of the educational process into the virtual space, which led to the search for new forms and methods of education. At the time of transferring education to a virtual basis, one of the most common elements of creative communication in the virtual space was a video game space [11]. Moreover, this type of virtual interaction is one of the most complex phenomena among modern arts and media. The main feature of video games is that the player does not simply contemplate something, as in the case of cinema or literature, but becomes a partial accomplice, the so-called "spect-author" [17], who can act as both as a passive observer and as a co-creator of virtual reality. Thanks to such features, the potential of using video games in the formation of children's creativity increases.

Video games are a complex phenomenon that consists of the so-called hardware and software components, can have

video and audio components, a certain narrative and game process (gameplay), and sometimes may not have one or more of the listed characteristics. The significant genre diversity of video games allows their wide use both for entertainment and in educational activities [18], as material for practice, motivational tools, etc. [10].

Creativity and play are naturally linked as children use their imagination, symbolism and divergent thinking to connect context, story and characters into a coherent whole. The researcher S. Russ comes to a conclusion about five possible ways in which the game helps to develop children's creativity: 1) the game includes the practice of forming associations, which is an important part of divergent thinking, 2) the game promotes the use of symbols, combining ideas and manipulation of representations of objects, which are part of creative abilities, 3) the game allows children to express and experience positive affect, which is important for the formation of creativity, 4) the game allows players to express and understand positive and negative emotional themes, which over time facilitates access to associations that help in creative problem solving, 5) the game helps children develop a cognitive structure that helps work with emotions [9].

Most of these ways are relevant to video games. Gameplay is often built on finding ways, associative perception of the information offered and the ability to combine the received objects. The player can interact with the game and the game world for the first time both with and without instructions. When designing levels for games, the learning process of the player in the game is important. Even a video game in which there are no instructions, and the gameplay is built on the player receiving information about how he should interact with the game world, implies a process of learning. In game design, the concept of "growth" is also important [8], in the process of which the player learns to combine acquired skills in different ways, based on previous gaming experience. The ability to superimpose the experience of one video game on another transforms into the ability to find approaches to solving new problems clearly demonstrates the combination of stereotyped and improvisational approaches to acquired skills, which in particular becomes a key to the formation of creativity.

The most vivid example of free interaction that stimulates creativity is the so-called "sandbox" genre, the most famous representative of which is Minecraft. In this video game, the world can be explored in any direction. According to previously acquired experience, game and real, the player will choose one or another game strategy that reflects their own state and inner world [5]. In addition, Minecraft gives players a platform for their own free creativity – the so-called "creative mode", which allows free placing of objects and building from them everything that players' imagination is capable of. Minecraft also allows creating even simple circuits similar to electrical

circuits, and applying modifications to it expands players' capabilities.

Thus, in contemporary educational processes, based on the virtual interaction of subjects, video games allow to significantly develop children's creativity skills, as well as creative attitude to learning. Thanks to a properly constructed educational method of using video games, it is possible to achieve significant success in motivating children to study, to form appropriate educational skills and abilities not through coercion or imposing new knowledge through traditional memorization, but through formed interest, competitiveness, and collaboration, as well as other skills that are traditionally positively perceived by students and make it much easier to learn new knowledge and skills. Talking about the case of Minecraft, this game was not meant as educational since the beginning. However, its visual part and mechanics allowed using it in education processes. Education games, main goals of which are usually providing a space for learning and creating virtual classrooms, may obviously serve as a helping tool for education, however, the possibilities given by them to develop creativity should be considered as well.

3.4 Game parts aimed at education or creativity development: the case of ClassCraft

In video games, we can observe a combination of various visualized data, presented in one game world. There are combinations of 1-, 2- and 3-dimensional objects, temporal and spatial visualization, and many of them are interactive. There are also limitations on the use of them, as many video games do not provide a player with a response on actions that were not added as triggers before. One of the most popular education games, ClassCraft has been taken as an example to analyze. It was chosen due to its direct educational purposes. After analyzing gameplay videos, tutorials and reviews, the following conclusions have been drawn.

General transforming the game process into a kind of a role-playing game is not close to the formal education approach. However, it may be helpful in developing students' imagination. Therefore, even being a learning tool that is not designed as a visual aid for a certain subject area, it may form creative thinking while mastering it.

There are many pictures that are inappropriate in case of considering this game as a tool for formal learning. One of the examples is pictures reflecting classmates as fantasy heroes, teachers as epic creatures etc. Despite an informal approach, it may create strong associative ties with learning and make students think wider while solving tasks. As ClassCraft promotes students to cooperate, with the unusual visual environment, it may lead to the formation of new approaches to solving educational tasks which would be considered inappropriate in the process of formal communication.

Gaining levels, losing character's health and earning in-game points is also away from classic visualization of studied materials. It may, however, deepen students' immersion into the game world and production of further ideas related to it. It can also have a negative impact as such approach may lead to association of mistakes with health damage on the basis of visual effects and a corresponding game mechanic.

Generally, visual environment combining RPG-interface with learning elements may help students develop imagination and perceive tasks differently than just duties or receiving knowledge. It may also give rise to spending additional time in catching visual environment.

On the example of ClassCraft, it can be summarized that many possible "weak" points of it as a visual learning tool are helpful in forming creative thinking. There is still lack of freedom that is provided by "sandboxes" like Minecraft, but generally, this game may have a positive impact on children's creativity. The level of its impact should be studied further empirically to provide the necessary adjustments in developing other games aimed at learning and / or skill enhancement.

3. Conclusions

As can be seen, there are several conditions to make a visualization tool effective for learning purposes. Among them, relevance, effectiveness and content are the most important. They provide the opportunity to strengthen the studied material and motivate students, as well as make learning more practical. However, the development of creativity, especially in children, needs innovativeness and openness of visual materials, making some of them inappropriate for this task if they are developed for learning purposes.

At the same time, some games that have visual part that can be considered excessive for learning may serve as a tool for forming creativity. Putting children in an environment that is not directly visually related to the subject of study may not strengthen their knowledge of it, but may change their approach to studying, lead to unusual conclusions and increase motivation to stay in such an environment for additional time. All this may impact positively on creative thinking, promoting unusual behavior and decisions that are felt inappropriate while working formally in a classroom. Visual digital tool cannot serve to both purposes – education enhancement and creativity development – simultaneously as they pose contradictory conditions for further usefulness.

References

- [1] Ahmadi, N., & Besancon, M. (2017). Creativity as a Stepping Stone towards Developing Other Competencies in Classrooms. *Education Research International, Volume 2017*.
- [2] Allen, A. D. (2010). Complex Spatial Skills: The Link Between Visualization and Creativity. *Creativity Research Journal, 22*(3), 241–249. <https://doi.org/10.1080/10400419.2010.503530>
- [3] Amabile, T. M., Barsade, S. G., Mueller, J. S., & Staw, B. M. (2005). Affect and Creativity at Work. *Administrative Science Quarterly, 50*(3), 367–403. <https://doi.org/10.2189/asqu.2005.50.3.367>
- [4] Bishop, A. J. (1980). Spatial Abilities and Mathematics Education: A Review. *Educational Studies in Mathematics, 11*(3), 257–269. <http://www.jstor.org/stable/3481801>
- [5] Blanco-Herrera, J. A. (2017). *Mining Creativity: Video Game Creativity Learning Effects*. Graduate Theses and Dissertations. 15263. <https://lib.dr.iastate.edu/etd/15263>
- [6] Blazhenkova, O., & Kozhevnikov, M. (2016). Types of Creativity and Visualization in Teams of Different Educational Specialization. *Creativity Research Journal, 28*(2), 123–135. <https://doi.org/10.1080/10400419.2016.1162638>
- [7] Čábelková, I., Strielkowski, W., Rybakova, A., & Molchanova, A. (2020). Does Playing Video Games Increase Emotional Creativity?. *International journal of environmental research and public health, 17*(7), 2177. <https://doi.org/10.3390/ijerph17072177>
- [8] Feil, J., & Scattergood, M. (2005). *Beginning Game Level Design*. Thomson Course Technology.
- [9] Hoffmann, J., & Russ, S. (2012). Pretend play, creativity, and emotion regulation in children. *Psychology of Aesthetics, Creativity, and the Arts, 6*(2), 175–184. <https://doi.org/10.1037/a0026299>
- [10] Horban, O., & Maletska, M. (2020). Videogames as Means of Increasing Students' Motivation. *The Modern Higher Education Review, 4*(4), 66–74. <https://doi.org/10.28925/2518-7635.2019.4.8>
- [11] Horban, O., Martych, R., & Maletska, M. (2019). Phenomenon of Videogame Culture in Modern Society. *Studia Warmińskie, 56*, 123–135. <https://doi.org/10.31648/sw.4314>
- [12] Klerkx, J., Verbert, K., & Duval, E. (n.d.). *Chapter #: Enhancing Learning with Visualization Techniques*. 42.
- [13] Kozhevnikov, M., Kozhevnikov, M., Yu, C. J., & Blazhenkova, O. (2013). Creativity, visualization abilities, and visual cognitive style. *British Journal of Educational Psychology, 83*(2), 196–209. <https://doi.org/10.1111/bjep.12013>
- [14] Libarkin, J. C. (2002). Visualization and the Geosciences. *Journal of Geoscience Education, 50*(4), 8.
- [15] Loveless, A. M. (n.d.). *Literature Review in Creativity, New Technologies and Learning*. 40.
- [16] Naps, T., & Anderson, J. (n.d.). *Evaluating the Educational Impact of Visualization*. 14.
- [17] Nardone, R. (2017). Videogames between ethics and politics. *Ricerche Di Pedagogia E Didattica. Journal of Theories and Research in Education, 12*(2), 41–55. <https://doi.org/10.6092/issn.1970-2221/7072>
- [18] Pesare, E., Roselli, T., Corriero, N. et al. (2016). Game-based learning and Gamification to promote engagement and motivation in medical learning contexts. *Smart Learn. Environ, 3*, 5. <https://doi.org/10.1186/s40561-016-0028-0>

- [19] Runco, M.A. & Jaeger, G.J. (2012). The Standard Definition of Creativity. *Creativity Research Journal*, 24:1, 92-96, DOI: [10.1080/10400419.2012.650092](https://doi.org/10.1080/10400419.2012.650092)
- [20] Russ, S. (1993) *Affect and creativity: The role of affect and play in the creative process*. Hillsdale: Lawrence Erlbaum Associates.
- [21] Sadler-Smith, E. (2015) Wallas' Four-Stage Model of the Creative Process: *More Than Meets the Eye?*, *Creativity Research Journal*, 27:4, 342-352, DOI: [10.1080/10400419.2015.1087277](https://doi.org/10.1080/10400419.2015.1087277)

Volodymyr ZABOLOTNYUK (Candidate of Historical Sciences) is the Deputy Chief of Research of the Land Forces Scientific Center, Hetman Petro Sahaidachnyi National Army Academy. His areas of interest include social philosophy, military history, philosophical analytics, political analytics, legal culture. Zabolotnyuk is the author of more than 40 scientific publications. Recent publications: "National-educational activity of the Ukrainian military-sanitary mission for the affairs of prisoners in Germany (1918-1920)", "Territorial Defense Battalions in the period from 2014 to 2015", "The issue of compulsory military service of Ukrainian citizens during the "hybrid" aggression of the Russian Federation".

ORCID iD: <https://orcid.org/0000-0001-8195-9974>

Svitlana Khrypko received the B.E., M. E., and Cand. of Philosophy degrees. She has been an associate professor at Department of Philosophy, Faculty of History and Philosophy, Borys Grinchenko Kyiv University since 2018. Her research interests include axiology, culturological studies, ethnic studies, philosophy of education.

ORCID: <https://orcid.org/0000-0001-9426-4549>.

Ivan Ostashchuk Ph.D., Doctor of Philosophical Sciences, the Head of the Department of Philosophy and Religious Studies, Faculty of Social Sciences and Humanities, Borys Grinchenko Kyiv University since 2022. His research interests include semiology, sacred symbols, hermeneutic analysis.

<https://orcid.org/0000-0002-6115-0884>

Dmytro Chornomordenko,

PhD in Philosophy

Senior lecturer of the Department of Philosophy and International Communication

National University of Life and Environmental Sciences of Ukraine

Kyiv, Ukraine

<https://orcid.org/0000-0002-5026-8799>

Andrii Timchenko

Graduate student at the Department of Philosophy

Kyiv National University of Construction and Architecture,

Kyiv, Ukraine

<https://orcid.org/0000-0001-6621-1079>

Motruk Tetiana (Candidate of Psychological Sciences) is the Associate Professor of the Department of Psychology Educational-Scientific Institute of Pedagogy and Psychology of Sumy State Pedagogical University named after A.S. Makarenko. ORCID iD: <https://orcid.org/0000-0002-0165-4458>

Katerina Pasko is Candidate of Philosophical Sciences, the Associate Professor of the Department of Psychology Educational-Scientific Institute of Pedagogy and Psychology of Sumy State Pedagogical University named after A.S. Makarenko. Her research interest includes

ORCID: <https://orcid.org/0000-0003-0488-9719>

Olena Lobanchuk

PhD, Associate Professor, Department of Ethics and Esthetics,

Faculty of History and Philosophy, National Pedagogical Dragomanov University

<https://orcid.org/0000-0002-1466-0398>