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Infographics As a Tool for Improving Effectiveness of Education

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Abstract

This paper defines the criteria of effective infographics for education. Visualizing information, including that with the help of infographics, is one of the mechanisms to optimize the learning process both in traditional and online format. In the first part of the paper, the author gives a theoretical definition of infographics as a contracted multi-level polysemantic thing. The methodological basis for discussion is provided by the cognitive approach in psyhology and philosophy (R. Arnheim, R. Solso, Y. Valkman) and visual studies (I. Itten, B. Latour, D. Roem, H. Schiffman). Deriving the properties of effective infographics, the author seeks to harmonize empirical data and the results of theoretical studies. The infographic aspects formulated by E. Tafti, L. Priego, and F. Verbitsky are compared with the results of a survey by L. Harrison on the aesthetic properties of effective infographics. Features of infographics such as scalability, structure-based, focusing on the key points, visual simplicity, and emphasis on the relationship between elements, are by author defined. The difference between infographics and other graphical products is demonstrated. For education it is particularly important that the logic of a structure or image ensures the contraction of information. In turn, the contracted information looks compact and concise. "Real" infographics have a visual clarity, presence of composition, colour, and image-bearing reference points. Systematic manner enhances the process of developing additional meanings. Aesthetics of the designer's infographics represent the reverse side of expediency and logic of a project decision. Th3e article concludes with a discussion of the need to use a cognitive approach to infographics by designers who create effective educational products.

Keywords: design, graphic design, infographics, definition of infographics, infographics for the on-line course, participatory design, survey

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1. Introduction

Learning is now understood not only as access to information, but also as the acquisition of certain knowledge and skills [1, 2]. The efficiency of perceiving and learning the educational material largely depends on the structure of the course and the format of its content, which, in turn, match the learners' cognitive abilities. Visualizing information, including that with the help of infographics, is one of the mechanisms to optimize the learning process.

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The experience of using infographics in education does not have any conceptual approaches and clear techniques. As a result, the visualized data used in modern education, often do not increase the efficiency of learning.

2. Methods

The idea of visualization and knowledge [3] served as a general humanitarian basis. In the last 500–600 years, the format of meaningful information carriers has become smaller. New forms of recording and transferring knowledge contribute to the progress in European science and education, and this experience is gradually spreading throughout the world. The 21st century infographics, which is now being created but not yet fully formed, is one of these forms.

The process of visual perception was studied by D. Roam [4]. The works on the issue of perception, including the visual one [5–8], quote relevant data for designing the elements of infographics.

Speaking about the design, the article primarily focuses on the ideas expressed by the cognitive scientist and design theorist Donald A. Norman [9], as well as representatives of a systems approach to design [10].

3. Results

We give an original definition of infographics as a design product, taking into account the cognitive processes of its creation and perception to the greatest extent possible. We emphasize once again that, being a multi-level contracted polysemantic visual image, infographics are always created with a clear understanding of their communicative, educational and other goals and peculiarities of contents of the text being contracted.

The main characteristics of effective infographics – scalability, structure-based, focusing on the key points, visual simplicity, emphasis on the relationship between elements – listed in the text of the paper were defined in the process of studying how learners and participants of on-line courses perceived and interpreted infograms. Experts can use them as recommendations and/or criteria for evaluating existing visual products, and only some of them can be called infograms.

4. Discussion

4.1. Peculiarity of Infographics as a Design Product

A number of authors understand infographics as a means of visualizing information [11–13], including digital. Their definitions are also not complete enough, because the material can be visualized not only through infographics, but also with the help of figures, charts, etc.

Infographics as part of information design should: show data; stimulate understanding of the information itself rather than of the ways to create visual elements; not distort the source information; be informative and concise, represent data arrays clearly; encourage comparison of data; have several levels of detail; serve a certain purpose (research, analysis, tabulation); be integrated in the context [14].

The quality of contraction [15], i.e. of multiple-level system of the infographic way to present the teaching material, is particularly interesting. Each higher level of information arrangement looks more concise than the previous one. It is perceived as simple but at the same time it has certain depth. For education it is important that infographics can help make the information more detailed while preserving its original picture. L. H. Priego believes that infographics can make the process of cognition more emotional [16]. Some authors emphasize axiological ("telling a story on the subject" – without deviating from the topic and, therefore, be valuable) and, in particular, ethical aspects, referring to the perception of infographics as a "moral act" [17].

The authors understand infographics as a graphic design product representing a contracted multi-level visual message, and its visual and verbal elements and connections help to structure information (knowledge) and facilitate the recipient's ability to perceive and memorize it.

4.2. Opposition of Infographics and Pictures as Design Products

If we compare infographics and pictures in any "traditional" textbook, they appear to have completely opposite functions in the process of learning. Pictures belong to visual arts and, as a rule, are the artist's attempt to express the contents of the text by means of images.

We point out that it is unacceptable, including for educational purposes, to use imitation infographic images that simply fill in the visual space without giving any information. Design products in which the use of all expressive means (colour, image, image symbols,

presence or absence of dynamics, etc.) greatly multiplies their information potential are the opposite of this kind of infographics.

The conceptual analysis allows us to indicate the essential features required for proper functioning of infographics as a contracted multi-level text. Its design should possess the following features:

- The logic of a structure or image ensuring the contraction of information and its multi-level nature. In turn, the contracted information looks compact and concise;

- Visual clarity, presence of composition, colour, image-bearing reference points ensuring that the learner's attention will be attracted and kept;

- Systematic manner enhancing the process of developing additional meanings. A combination of isolated signs cannot be considered as actual infographics because each of them has to be decoded out of the context from scratch, which impedes cognitive activity;

- Aesthetics as the reverse side of expediency and logic of a design decision.

These features should be tested at the theoretical and empirical levels of research, and this is what was done in the following parts of the article.

4.3. Comments on the L. Harrison's survey

An on-line survey [18] was used as a basis for discussion at the stage of theoretical deepening of the infographic concepts in education. The scholars specified the relationship between the aesthetic level of infographics and the degree of the perceiver's involvement in learning and memorizing information. Commenting on the survey, we shall compare them with the facts that researchers mention about visual perception in order to relate theoretical and empirical levels of our research.

The survey by L. Harrison was conducted on-line. It involved 1278 participants, which enabled the researchers to collect 83,000 appraisal ratings.

The participants had a 10-minute on-line test in which they viewed 30 infographics. Each person had 500 ms to view each infographics; subsequently, they had to evaluate its attractiveness on a 9-point Likert scale. At the second stage of the survey, the participants were shown the same infographic samples in different randomized order for re-evaluation. The results of the study showed that most people form a reliable opinion of the appeal of an infographic within the first 500ms. This has a significant effect on the engagement in the process of learning information and its memorization.

The first impression is largely based on colour diversity, saturation ("colourfulness") and visual complexity of an infographic. Here, colour determines attractiveness more than visual complexity. This result suggests that people can simultaneously store a total of 7±2 objects in their short-term memory [7].

A number of infographics were rated as very appealing, but most infograms made a mixed impression on the respondents. The authors of the survey may have underestimated how quickly modern audiences change their reaction and, therefore, attitudes and ratings. Thus, when studying the peculiarities of perception of the Generation Z, the authors of the Russian survey found that their perception parameters included impatience, technological dependence, desire to be involved, priority of communication over other activities, etc. [19]. Besides, the authors say that it is impossible for Generation Z representatives to hold their attention for long.

A number of issues can be taken into account extending the data of L. Harrison's survey to the purposes of designing and engineering infographics for modern education. Thus, in order for infographics to make a strong and positive first impression, the designer should ensure that the objects should be of low and intermediate visual complexity (this can be achieved by limiting the number of graphic and text areas, while using simple shapes and patterns), and of moderate or high colourfulness (e.g. by increasing the saturation and contrast of colours). According to the survey, it is generally necessary to look for simple shapes, clear structures and consistent connections.

The theory of "natural design" [9] analyzes numerous examples of everyday things a person is constantly in contact with (more than 20,000 such things on average per person in the 1980s). The clarity of shapes and their harmony, due to the completeness of archetypal structures, are more likely to lead to inertia and a state of rest than to action. They should be deliberately used when designing a scenario for the learner's interaction with infographics, for example, in those parts of the course that are overloaded with abstract information, or for a short pause during an intense perception of complex structured content.

R. Arnheim [20] speaks a lot about perception as active learning. If we consistently develop his ideas, we can approach the concept of simplicity of forms in a slightly different way – simple forms will more likely contain typical features of an object than have a basic arrangement. It is these features that have emerged on the basis of past experience that are recognised by the object ("general structural features are the primary data of perception" [20]. D. Roam [4] speaks about the most important human ability "to see parts of the world and the whole picture". We will indicate a general statement for all approaches: a person sees structural elements and their configurations. The clearer they

are arranged, the more effective the process of learning and memorizing information will be. Technological charts, graphs for visualizing cause-effect relationships, etc., which are made as infograms, can have a rather complicated internal arrangement, but be well structured and understandable.

5. Conclusion

In the course of the work empirical and theoretical levels of the cognitive approach were used to substantiate the understanding of infographics as a contracted multi-level visual message helping to make information (knowledge) more organized and emotional. This facilitates the process of perceiving and memorizing this information in the learning process. Effective infographics, including that for on-line education, can and should be developed by an expert in graphic design, because professional design guidelines (relevance, functionality, expressiveness and aesthetic appeal of the product) comply with the required features of infograms.

Sign correspondence is enhanced by using an approach based on participation in the process of designing infograms. The desire to minimize the working elements of infographics used by the teacher and the learners while developing and mastering a course brings us to the idea of creating a system of semantically concise infograms, which in each case have their own generally accepted meanings by the participants of the learning process.

References

[1] Nonaka, I. and Takeuchi, H. (2011). *The Company is the Creator of Knowledge. Origin and Development of Innovations in Japanese Firms*. London: M., Olimp-Business.

[2] Gudova, M. Y., Guzikova, M. O. and Rubtsova, Y. V. (2018). Polilingval'noe i polikul'turnoe obrazovanie v universitete: kriticheskij diskurs gramotnosti. *Izvestiya Ural'skogo federal'nogo universiteta*, Ser. 3, Obshchestvennye nauki, vol. 13, issue 4 (182), pp. 221-228.

[3] Latour, B. (1986). Visualization and Cognition: Drawing Things Together. *Knowledge and Society: Studies in the Sociology of Culture Past and Present*, issue 6, pp. 1-40.

[4] Roam, D. (2008). *The Back of The Napkin: Solving Problems and Selling Ideas with Pictures*. New York: Portfolio.

[5] Itten, J. (2007). *Kunst der Farbe - Subjektives Erleben und objektives Erkennen als Wege zur Kunst*. Ravensburg: Verlag Maier.

[6] Raushenbakh, B. V. (2002). *Geometriya kartiny i zritel'noe vospriyatie,* SPb.: Azbuka-klassika.

[7] Solso, R. L. (2004). *Cognitive Psychology.* Delhi: Pearson Education.

[8] Schiffman, H. R. (2003). *Oshchushchenie i vospriyatie*. SPb.: Piter.

[9] Norman, D. A. (2013). *Design of Everyday Things*. New York: MIT Press.

[10] Jones, J. C. (1992). *Design Methods: Seeds of Human Futures.* Hoboken: John Wiley & Sons Ltd.

[11] Smiciklas, M. (2012). *The Power of Infographics: Using Pictures to Communicate and Connect with Your Audience*. Indianapolis: Que Publishing.

[12] Valkman, Y. (1994). Definition of Cognitive Graphics and its Methods. *International Journal on Information Theories & Applications*, vol. 2, pp. 30-36.

[13] Solovyeva, T. V. (2012). Infographics in Media and Academic Texts. *Bulletin of Novgorod State University*, vol. 57, pp. 76-79.

[14] Tufte, E. R. (1990). *Envisioning Information.* Cheshire: Graphics Press.

[15] Verbitskiy, A. A. (1991). *Aktivnoe obuchenie v vysshej shkole: kontekstnyj podhod*. M.: Vysshaya shkola.

[16] Priego, L. N. (2012). Infographics: The New Way to Communicate with Graphic Descripcion. (Master of Fine Arts in Illustration, Illustration Department, Savannah, GA, 2012).

[17] *Bloq Staff*. (2014, March). Retrieved July 30, 2018 from www.creativebloq.com/design/10-steps-creating-perfect-infographic-3145672.

[18] Harrison, L., Reinecke, K. and Chang, R. (2015). Infographic aesthetics: Designing for the first impression. Presented at *the 33rd Annual ACM Conference on Human Factors in Computing Systems.* ACM – Association for Computing Machinery, New York, NY, United States, pp. 1187-1190.

[19] Bodrov, V. N. and Magalashvili, V. V. (2008). Orientirovannaya na celi vizualizaciya znaniya. *Obrazovatel'nye tekhnologii i obshchestvo,* Kazan', vol. 11, issue 1, pp. 420-433.

[20] Arnheim, R. (2004). *Visual Thinking.* Berkley: University of California Press.