

Annales Universitatis Paedagogicae Cracoviensis

Studia ad Didacticam Biologiae Pertinentia V (2015)

ISSN 2083-7267

SCIENCE, CULTURE, SOCIETY – INNOVATIONS FOR EDUCATION
AND TRAINING IN THE MUSEUMS

Małgorzata Nodzyńska, Paweł Cieśla

Visualization of natural processes – one of the skills of animator of nature culture

“The horse is what everyone sees” – a popular statement seems to contradict the idea of visualization of reality, especially that available to our senses. However, the practice of everyday life shows the opposite trend – we are surrounded by images of advertising from illustrated magazines, visual information, instructions, plans, diagrams, graphs, maps to the widespread use of emoticons, or even the entire language of pictorial. The beginning of the story of Adam and Eve in Zlango language (Fig. 1) can serve as an example.

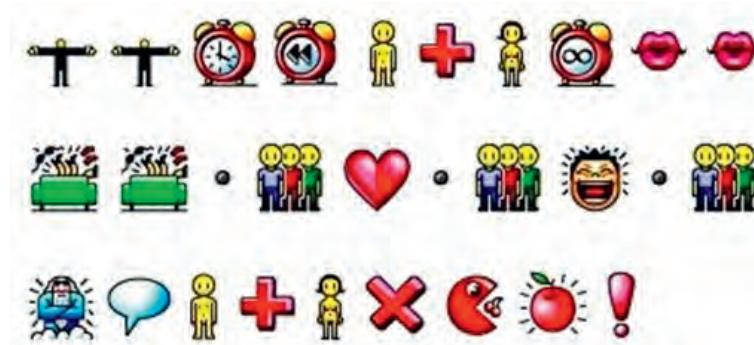


Fig. 1. Fragment of the story of Adam and Eve in Zlango

Source: <http://www.mgsm.pl/pl/aktualnosci/199/Nadchodzi-Zlango.html> [access: 20.12.2015]

Even a glance shows how much the image, which main purpose is to provide information (we are not talking about paintings, which main purpose is aesthetic experience) is present in our daily lives.

This is not only the practice of our time. Even from the earliest years man was accompanied by a picture. The oldest known paintings are paintings of the Chauvet cave in France dated $31\,000 \pm 1300$ BC. Informative role of the images is reflected

the most in the oldest known writing – pictographic writing. The first pictograms appeared around 3500 BC, however, the first experiments with the presentation of longer stories in pictures/frames arranged side by side can be found in the first Bibles, even before the year 400 AD. Special educational role of visualization can be seen in the Middle Ages. Paupers' Bible (Fig. 2.) can serve as a typical example of contemporary “pictorial education”.



Fig. 2. Page of The block-book *Biblia pauperum* from the fifteenth century. In the middle of “The Annunciation” left “Eve and the serpent” right “Gideon’s miracle”

Source: http://pl.wikipedia.org/wiki/Biblia_Pauperum [access: 20.12.2015]

Combining the image with text for a fuller description of the history caused that for centuries in images the text or replacing it symbols allegories and emblems appeared, while the text was also accompanied by a picture, even in the form of initials or illumination.

Sometimes the relationship between image and text was complemented even by same object on which they were made - this applies especially to church pulpits equipments, baptismal fonts. In 1658, John Amos Comenius, a great Czech pedagogist, philosopher, reformer and Protestant thinker, formed *Orbis Sensualium Pictus* (Visible Word in Pictures – Polish translation 1667). Through that he became one of the representatives of the tradition of teaching through picture.

Today, when science develops faster and faster and when its findings need to be available to a large part of the population (universality of education) it seems to be necessary to prepare students to coping with this task and to choosing from the sheer volume of scientific information the most important content and necessary to others and being able to present it in an understandable way. It seems

that one of the methods is to visualize science understood as a representation of scientific information using a static image or a dynamic one. For the purpose of such visualization infographics can be used.

Infographics are graphic visual representations of information, data, knowledge for comprehensive, clear and fast delivery of the facts. Infographics can improve cognitive functions through the use of graphics to enhance the capacity of the human visual system to see formulas and trends (Wikipedia.org).

Infographics as a graphic technique of presenting and gathering information has been known for a long time. Below are the most characteristic of the old infographics (Fig. 3, Fig. 4).

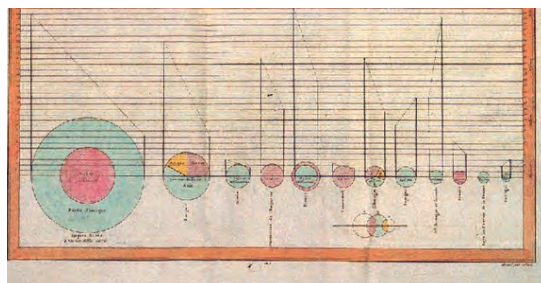


Fig. 3. The chart from the year 1801 prepared by William Playfair showing the comparison of taxes in the UK with the taxes in other countries. In the figure a single wheel represent a different country. The quantity is coded by areas of the wheels. The line to the left of each circle represents the cardinality of the population in a given country. The line on the right side of the circle reflects tax revenues. William Playfair "Statistical breviary", London, 1801

Source: https://commons.wikimedia.org/wiki/File:Playfair_piecharts.jpg [access: 12.06.2015]

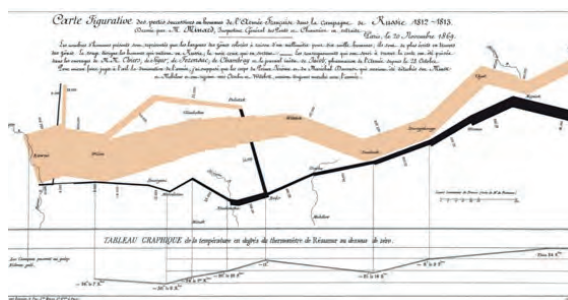


Fig. 4. Carte figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812–1813, a map published in 1869 by Charles Minard showing the course of Napoleon's Russian campaign in 1812. The graph shows multiple variables in a single two-dimensional image:

- location of the Army on the terrain map and directions in which the divisions were moving,
- reducing the size of the army,
- the temperature during the campaign.

Source: http://en.wikipedia.org/wiki/Charles_Joseph_Minard [access: 06.12.2015]

Transmission of information through images was an important part of the natural sciences. Even today without visualizing certain information it is hard to get around, for example it is difficult to imagine teaching chemistry without modern form of the periodic table or so called tables of solubility.

The image shows two versions of the periodic table of elements side-by-side. The left version is the 1891 Mendeleyev table, which is a long, narrow grid with many handwritten annotations and a complex layout. The right version is a modern, compact version of the periodic table with a legend indicating element states: gases (blue), liquids (red), solids (green), and synthetic elements (yellow). The modern table is much easier to read and navigate.

Fig. 5. Comparison of the readability of the Mendeleyev's periodic table of the elements with the contemporary version based on Werner's project. On the left the English version, made strictly according to the 5th edition of the table prepared by the Mendeleev in 1891.

Source: http://pl.wikipedia.org/wiki/Uk%C5%82ad_okresowy [access: 20.12.2015]; On the right temporarily used so called long form of the periodic table https://upload.wikimedia.org/wikipedia/commons/8/8f/Periodic_system_extended_format.svg [access: 20.12.2015]. There is no denying that readability and ease of finding information is much greater in the contemporary version

The use of the images to provide information also causes various problems. One is the amount of information conveyed by the image. Often the reasons for the cardinality of illustration in all sorts of publications are justified relying on the Chinese proverb that "one picture is worth a 1000 words". However, this proverb can be understood in a negative way too. The image can carry so much information that it creates informational chaos. It is often forgotten that image actually carries a lot of information (sometimes not only irrelevant but also unnecessary and wrong) – this informational noise is difficult to assimilate by recipient, which is why it is difficult to select the right information from the whole excess. The recipient also may not be able to read from the image the very information that he needed. These considerations imply that if the drawing is going to comprise more information than written text it must be firmly formalized and the student needs to learn how to read it. Currently, the use of computers to create a modern infographics require prior education on how to read graphically complicated information. Examples for the above thesis are the following images that are not clear to the average consumer and understanding the contents requires more consideration and analysis.



Fig. 6. The virtual map of the world with information regarding geographical distribution of grants and frequency of granted research patents. The Worldprocessor-globe, 2006. Author: Ingo

Source: http://scimaps.org/maps/map/zones_of_invention___38/ [access: 06.12.2015]

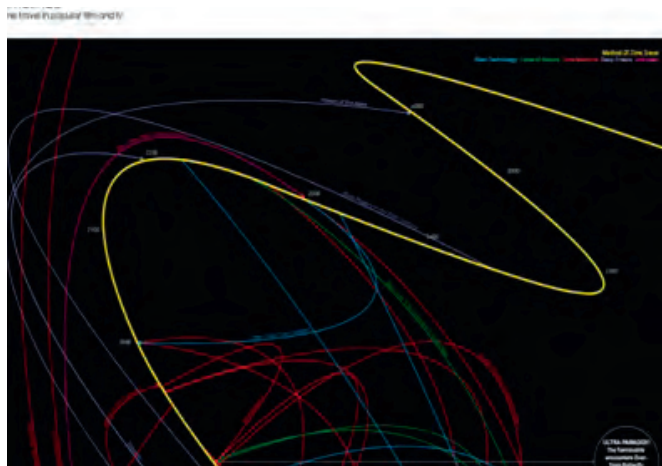


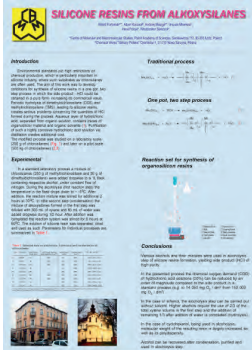
Fig. 7. Graphics showing time travel in film and TV. David McCandless, Dominic Busby, Alices Cho in 2009

Source: <http://www.informationisbeautiful.net/visualizations/timelines/> [access: 06.12.2015]

Another problem in creating infographics is possible confusion with similar at first glance other forms of graphics – such as a poster or a scientific poster. Computer infographics are between the posters and the scientific posters taking into account techniques used, the color, and the ratio of text information to the drawing (cf Table 1).

The paper presents students works prepared in frames of the classes “Visualization of natural processes and phenomena” realised as a part of the project “Animation of nature culture (Animacja kultury przyrodniczej)”. During the classes students were to learn how to visualize natural phenomena or natural processes, as well as how to transform knowledge into a form available and understandable to wider society.

Tab. 1. Comparison of the poster, infographics and scientific poster

Poster	Infographics	Scientific poster
 Poster by Henri de Toulouse-Lautrec. Source: Wikimedia Commons https://pl.wikipedia.org/wiki/Plakat#/media/File:Lautrec_moulin_rouge_la_goulue_(poster)_1891.jpg	 The example of the infographics - Willingness to travel of the school youth (Infografik, Lesefreudigkeit der Schuljugend). Source: Wikimedia Commons; https://de.wikipedia.org/wiki/Informationsgrafik#/media/File:Bundesarchiv_Bild_183-1987-0618-016_Infografik_Lesefreudigkeit_der_Schuljugend.jpg, Authorship: Bundesarchiv, Bild 183-1987-0618-016 / CC-BY-SA 3.0	 Exemplary scientific poster Source: Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Plakat_Naukowy.png#/media/File:Plakat_Naukowy.png Author Polimerek, The license CC BY-SA 3.0
A form of a propaganda or an advertisement (never only of informational character), an art form. It presents emotions. As a whole it is provided in a graphic form. The size is usually at least A2. If printed it fills the entire surface of the medium (paper, fabric etc.) Graphic elements dominate over the text. The text, if present, is often processed artistically.	Visual presentation of information or knowledge. Should be emotionless. Usually similar proportions of graphical elements and the text. Should make the receiver to think about the presented data and encourage him to compare the different sections of presented data Should present only information, not its interpretation.	Form of scientific presentation. One of the most popular forms of presenting research results during conferences. Size is usually similar to the A0 or B1 format. It usually includes the following parts: – short introduction – a brief description of the purpose of the research – a brief description of the methodology of the research – the results obtained, usually illustrated or equipped with charts or schemes – conclusions – references Background and layout are variable. In addition to the text an important communicative function if played by images and aesthetics of the whole poster.

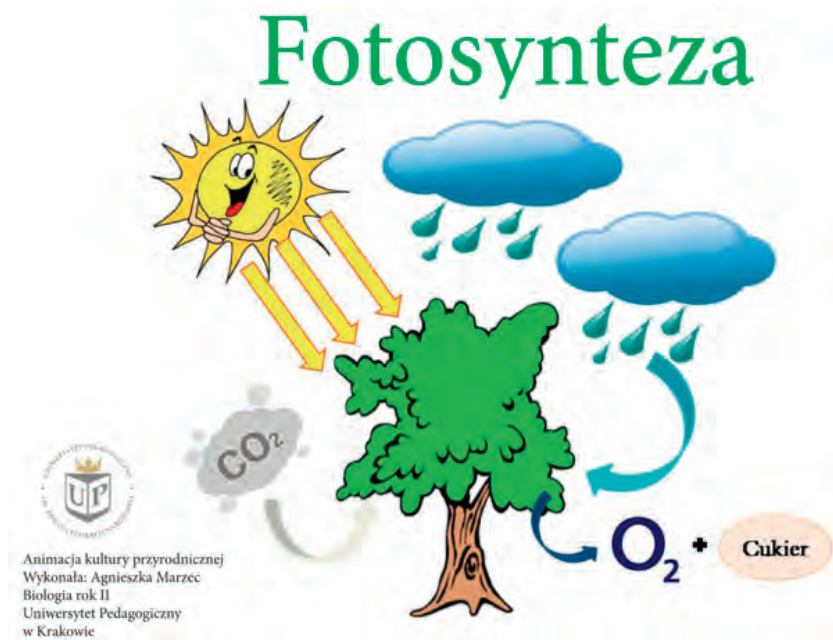
Students learned about the history of visualization in the sciences, requirements, capabilities and limitations of imaging natural content and also learnt the technical side of preparing graphics. They also were able to use professional software for desktop publishing (DTP).

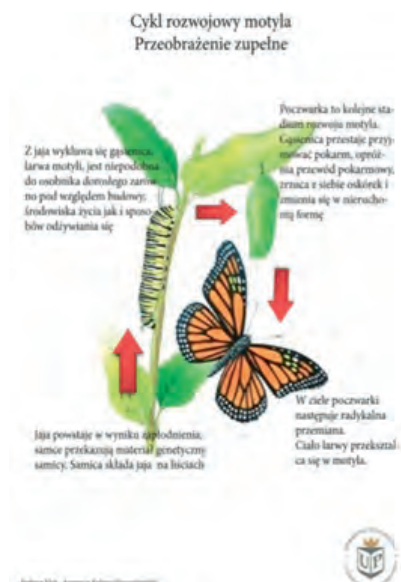
Not all Infographics created by students in frames of the classes met the requirements of infographics – some showed emotions, some contained more images or more text, but most of them matched the requirements. It can be assumed that for the first meeting of students not only with a new form of graphics but also with a tool for creating it the achievements were quite good. Hopefully their further works in this direction will be even better.

Examples of students' work:

Students preferred cycles:

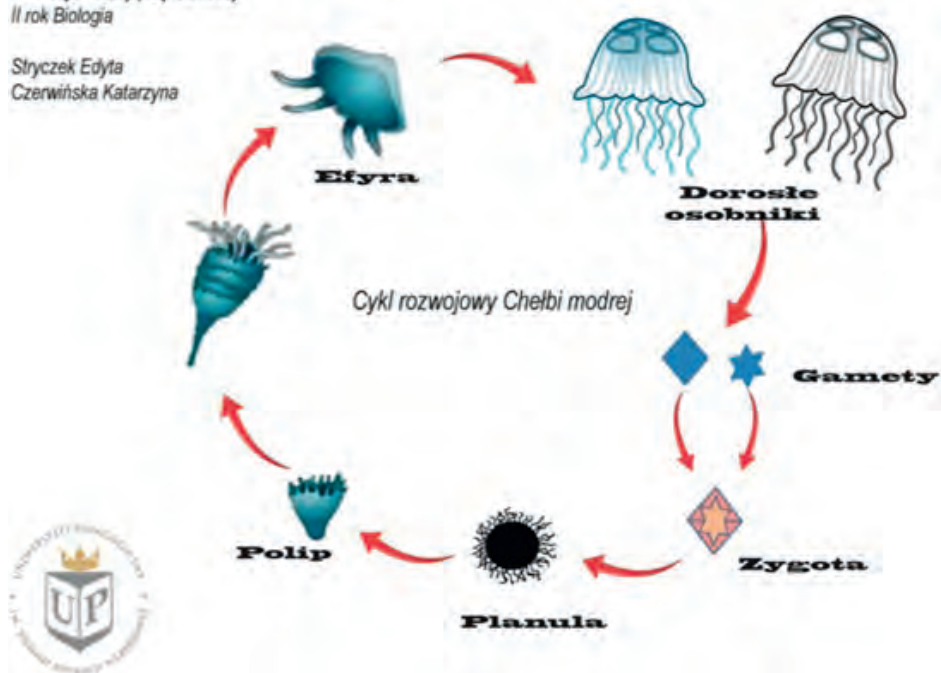
- “Photosynthesis” is kept in a uniform graphics style, but the amount of information contained in this infographic is small. It could present information about the process of photosynthesis for elementary school students,
- “The life cycle of a butterfly - complete transformation” in the correct manner combines visual information with the text,
- another infographic relates to the same subject – but its recipients are intended to be children (preschoolers and students in grades 1–3 primary school) and therefore the author used colored items (flowers) instead of the text,
- the infographics “Life Cycle of Aurelia aurita” and “Water cycle” properly operate the image, however, it seems that the information layer of presented infographics is too weak.

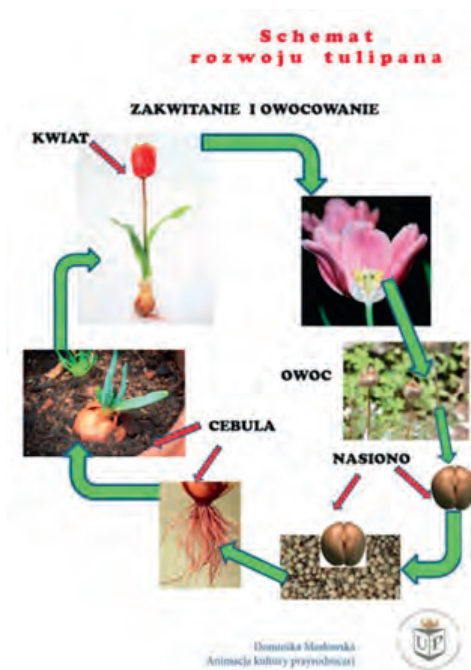




Animacja kultury przyrodniczej
II rok Biologia

Stryczek Edyta
Czerwińska Katarzyna

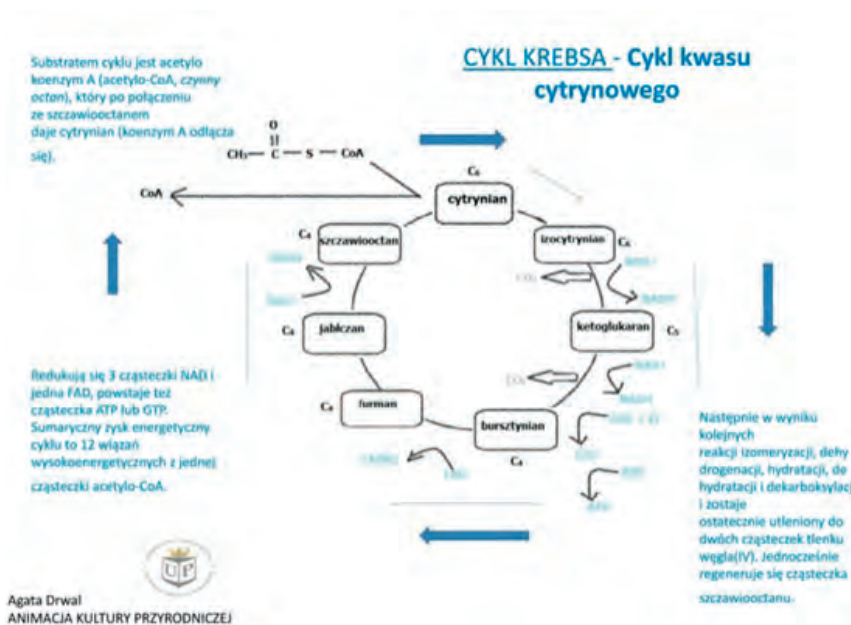




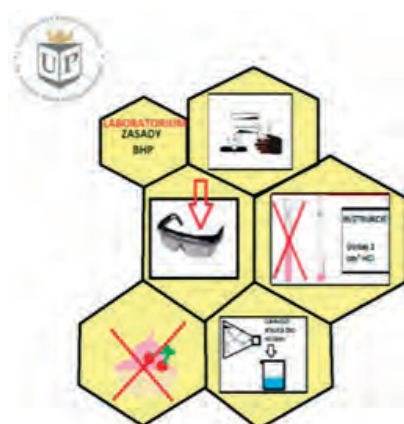
Both infographics on this page show the process of flower development, however, the process is presented using different techniques (photography, freehand drawing). Authors also use different concepts – in the first infographics the process is shown in cyclical form in contrast to the second one that shows the process linearly.

In both graphics the image outweighs the text.

Placed above infographics is a typical scientific scheme. The proportions of the text to the image are correct - but it is difficult in this case to talk about the role of popularizing scientific knowledge.



The aim of another infographics was to create graphical form of safety rules in the chemical laboratory. The idea seems interesting, but it can be assumed that the author did not manage to finish the job because of lack the time.



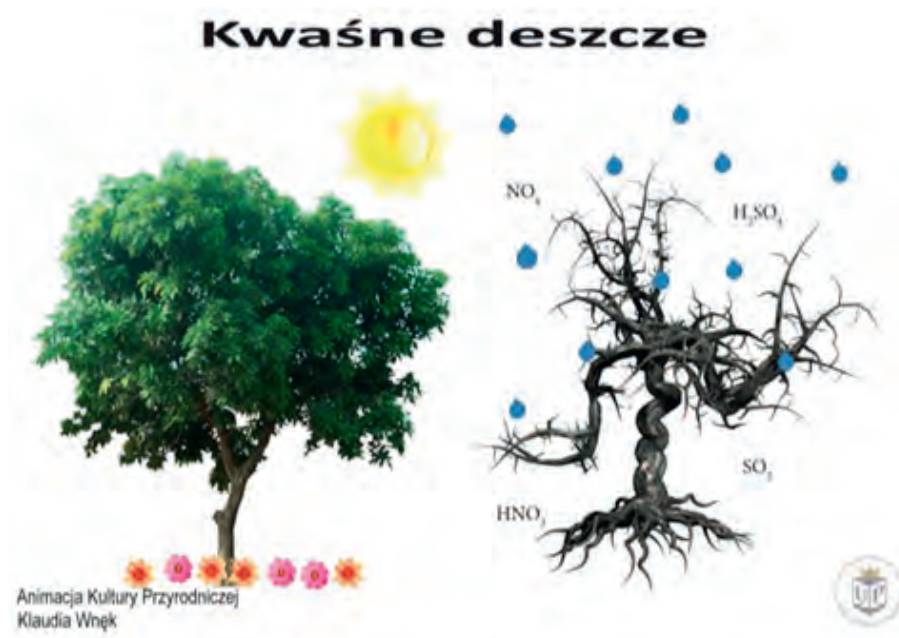
Animacja Kultury Przyrodniczej
Włodzisław Szymański



Animacja Kultury Przyrodniczej
Tomasz Jankowski

Other infographics concerned environmental problems.

The first infographic touches upon the problem of global warming, however, formulated topic and used graphic elements (upset dinosaur) correspond more to a poster than infographics. Alternatively, this type of graphic solutions are found in popular magazines rather than in scientific journals.



Animacja Kultury Przyrodniczej
Klaudia Wnęk

Graphics “Acid rain” is a nice poster unfortunately lack of information prevents it from being categorized as infographics. It must be admitted, however, that the graphic form and elegance of preparation speak in favor of this work.

Infographics “Forests in Poland over the years”: most of all the works follow the rules of infographics:

- a graph of afforestation areas in Poland depicted with trees of varying sizes is very suggestive - allows even young children to understand the information (adults are given numerical values),
- equating the size of the forested area to the size of National Stadium - also highlights the magnitude of the problem.



The next four works relate to human:

- „What happens during stress?”,
- “Fruits and vegetables as valuable vitamins for the body”,
- “How alcohol affects your body?”,
- “Why are you deliberately killing yourself?”.

Two infographics “What happens during stress?” and “Fruits and vegetables as valuable vitamins for the body” in a graphically effective and transparent form present the information relevant to their titles. The title of the first one should be slightly changed to “Changes in the human body during stress” (instead of question the affirmative sentence and specifying that the graphics concerns the changes in the human body). In the second infographics colloquial statement “Yum yum” should be removed. However, taking into account the overall work these corrections are of minor importance.

OWOCE I WARZYWA
CENNE WITAMINY DLA ORGANIZMU



ChOROBY ZWIĄZANE Z NADMIAREM ALKOHOLU występują u około 10% kobiet i 30% mężczyzn. Lekarze, do których przychodzą osoby mające problemy alkoholowe nie od razu rozpoznają przyczynę doległości. Alkohol ma szkodliwy wpływ na prawie wszystkie tkanki i narządy





Graphic entitled “How alcohol affects your body?” is not the infographic. It is rather a poster. There is predominance of the text over the graphic forms, which are used as elements highlighting the text and they do not illustrate the content. It is a very good example of a poster to be placed at the doctor’s waiting room where patients waiting in line can read the information presented on in.

Graphic “Why are you deliberately killing yourself?” is a typical poster – referring to emotions. The idea and preparation are very good.

The last infographic is rather a joke, or a traditional map of thoughts that can occur when there is a bacon for breakfast.

In terms of graphics and proportions of the text to the image, however, it meets the criteria of infographics.

Summary

The works presented above show that, despite the time limit and previously unknown software, students completed the task with good results. There were no significant errors in presented works and the layout was unified. Moreover, most of the works met the requirements of infographics and those that did not fully comply with the rules were also valuable works. Sometimes maybe the authors’ emotions prevailed over the task and showed a lack of emotionless approach to the presented problem and the desire to impose the views of the author.

Overall, it appears that such classes should permanently access the curriculum even in wider form, so that students have the opportunity to learn how to prepare scientific poster presenting results of their research (for example the research carried out in order to prepare master thesis), as well as infographics - to be able to disseminate the knowledge and finally the poster inviting to various events popularizing science.

References

- <http://www.mgsm.pl/pl/aktualnosci/199/Nadchodzi-Zlango.html> [access: 20.12.2015]
- https://commons.wikimedia.org/wiki/File:William_Playfair#/media/File:Playfair_piecharts.jpg [access: 12.06.2015]
- http://en.wikipedia.org/wiki/Charles_Joseph_Minard [access: 06.12.2015]
- http://scimaps.org/maps/map/zones_of_invention__38/ [access: 06.12.2015]
- <http://www.informationisbeautiful.net/visualizations/timelines/> [access: 06.12.2015]
- [https://pl.wikipedia.org/wiki/Plakat#/media/File:Lautrec_moulin_rouge_la_goulue_\(poster\)_1891.jpg](https://pl.wikipedia.org/wiki/Plakat#/media/File:Lautrec_moulin_rouge_la_goulue_(poster)_1891.jpg)
- https://commons.wikimedia.org/wiki/File:Plakat_Naukowy.png#/media/File:Plakat_Naukowy.png
- https://de.wikipedia.org/wiki/Informationsgrafik#/media/File:Bundesarchiv_Bild_183-1987-0618-016,_Infografik,_Leseleidigkeit_der_Schuljugend.jpg,
- http://pl.wikipedia.org/wiki/Biblia_Pauperum [access: 20.12.2015]
- https://upload.wikimedia.org/wikipedia/commons/8/8f/Periodic_system_extended_format.svg [access: 20.12.2015]
- http://pl.wikipedia.org/wiki/Uk%C5%82ad_okresowy [access: 20.12.2015]

Visualization of natural processes – one of the skills of animator of nature culture

Abstract

Image and text as co-existing and interdependent sources of information are linked from the Middle Ages. Today, infographics appear as another tool to combine text and images. The paper presents students' works prepared in frames of the classes "Visualization of natural processes and phenomena" realized as a part of the project "Animation of nature culture (Animacja Kultury Przyrodniczej)".

Keywords: visualisation of science, infographics, didactics of natural sciences

Dr hab. Małgorzata Nodzyńska

Institute of Biology, Faculty of Geography and Biology
Pedagogical University of Cracow
e-mail: malgorzata.nodzyska@gmail.com

Dr Paweł Cieśla

Institute of Biology, Faculty of Geography and Biology
Pedagogical University of Cracow
e-mail: pawel.ciesla.33@gmail.com