THE ROLE OF ICT FOR THE VISUALIZATION OF THE HISTOLOGY EDUCATIONAL CONTENT IN HIGHER EDUCATION

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Abstract:
In the present study, students' attitudes towards visualization of histology content are monitored by an e-based course in Moodle. Through questionnaires and narrative interviews at the beginning and at the end of the practical course of histology, regular (full-time training) and extramural (part-time training) students' attitudes were studied on the use of various means of visualization and, in particular, the importance of ICT in the visualization of the histology course. Students are divided into two groups - in the first group they are trained in the traditional way and in the second - by an additional electronic course in Moodle. There was a preference for students to visualize the material by electronic means, as it is more significant for students in the part-time form of study.
***Key words**: ICT, visualization, histology, Moodle*

Introduction:

There are various learning styles and techniques and people use them in a different way. Most often, learners use multiple learning styles, but usually one or two are preferred and dominate. In other cases, learning styles change with the situation or type of learning content. In the learning process, under suitable conditions, learners can learn and develop different and most appropriate learning styles. Many biological sciences are morphological, and learning is based on observations. Similar is the case with histology (the science of animal tissues), where the learning content besides verbal exposure is based on observations of the structures of different types of tissues, most often on patterns, drawings or microscopic preparations.

It has been proven that using different learning styles different areas in the brain are used. The greater part of the cerebral cortex is involved in the learning process, the greater the efficiency of learning. It was found that the visual perception involved the occipital and parietal parts of hemispheres of the cerebrum while the verbal perception involved the temporal and frontal parts, and in particular the so-called Brocca area and Wernicke area located on the left side of the brain.

The use of the term "visualization" according to some authors means only an array of information [1], but this implies a naively realistic picture of the world: what is "there" must have the same impact on all brains.

However, the ability to build knowledge personally is supported by the facts that are known about how the brain processes optical phenomena. The proximate association, if not the merging of the terms associated with this type of brain the activity is not surprising, as there is evidence that visual perception and visual image involve similar mental processes and that they support each other [2].

In spite of the similarities, the two operations differ as the visual perception is selective, which contributes to the qualitative differences in the playback of the visual objects / images. There are also differences in the reasons and the context of the visual perception and the visual image. In short, the "reality", the product of visual perception and the visual image can vary considerably.

While the difference in these two terms is important to psychologists, to scientists and science teachers it is not so essential, and the term "visualization" in this sense can be used in terms of both visual perception and visual imagery [3].

Recently, many data has been accumulated to prove that the achievement of students in science is directly influenced by their direct access to multimedia knowledge delivery methods [4, 5, 6, 7].

Visual perception tracks events that occur at the object level by providing information that originally creates a pattern of the object being perceived, and then preserves (or alters) the meta-level in the brain. Control exercised on the meta-level, causes either unchanged retention or changes in what it is perceived at the object level. Observation and control are believed to work at the same time [3].

The visualization is directly related to the way of thinking and according to Peterson, [8] there are four categories of relationships between thinking and visualization:

Reflection. One form of reasoning involves the creation of new images by recombining items from existing images. This is the basis of the visual analogy. For example, the perception of waves on water leads historically first to the development of the wave model of light and later on to the wave pattern of the sound.

Learning physical skills. By studying a certain physical skill one first produces his visual perception, which determines the nature of the physical movements in the exercise of this skill. This is done by observing an expert demonstrating the skill. This model is used by the learner to guide the development of the physical movement; by refining the original visual perception combines with the visual image that has evolved. Examples of learning such physical skills in biology are learning how to handle a pipette, curing a biological object (worm, fish, toad, etc.), making microscope slides, etc.

Understanding verbal descriptions. Visual memory is different from linguistic memory [9]. However, visualizations can be generated from a series of propositional statements, a process that for many makes the understanding of the relationship between linguistic and visual perception easier. For example, the structure of the crystalline substance can be understood by creating a mental image for it after reading the corresponding description. Despite the many statements that the verbal presentation may be phased out because of the possibility of directly perceiving concepts through "visual understanding," the meaning of the verbal description is great even if only in addition to the visual memory.

Creativity. This can be done either by interpreting the meaning of an existing image or by changing the frame of the reference in which the image is assigned [2].

Since visualization as an important aspect of learning, especially in science, where the world perceived by it is in the main focus of interest, the inability to develop meta-visual competence would have serious consequences.

Although many of the research on the implications of bad meta-visual skills have been made with students in the middle-class course, it is likely that similar problems will also occur in university students. Wu & Shah [10] identified several types of chemistry training problems, of which the most important are:

- while chemical phenomena can be represented by students at macro level, it is difficult to present them at sub-micro level or through symbols [11];
- students have difficulties in understanding concepts represented at submicro level for at symbol level [12]. In particular, they have difficulty in interpreting chemical reaction on submicro level represented by symbols [13];
-it is problematic to shift between modes and sub-modes of presentation of a molecule [14], what Siegel [15] called "relocation".

From what has been said so far, it is clear that the development of visualization skills is a key step in advancing the learning of scientific knowledge.

Materials and Methods

In this study the impact of visualization by means of traditional methods and ICT in training histology students is traced. The students were in their second year Bachelor's Degree course of education. For the purposes of the study questionnaires, narrative interviews, and analysis of results were used. Participants in the survey were 88 full-time students and 20 part-time students. All of them were surveyed after a traditional learning process and additional e-course in Moodle.

Results and Discussion

In the studied groups, their relation to the role of the images for their preparation in histology and in particular for their practical examination is approximately equal (Fig.1). The percentage of people who consider the image to be leading is greater in regular course students. There are about 5% of "no matter" answers in this group. There are no "no matter" answers in the group of part-time students, with the answers "subordinate" and "leading" being fairly the same number.

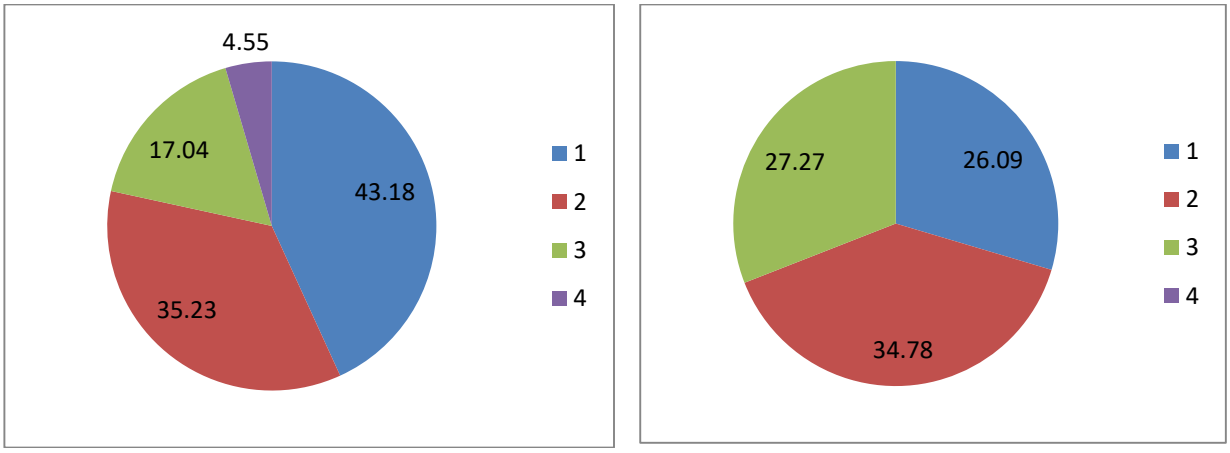

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Fig. 1

For full-time students, the role of the images during the lecture course is the leading - 35.23%. Close to this percentage are the answers "equal" (32.95%) and subordinate "to the text (27.27%). A small percentage (4.5%) indicated the answer "no matter". In the group of part-time students the answer "no matter" is not present (Figure 2). A much smaller number of respondents gave the answer "subordinate" to the text and almost double the percentage of people who answered that for them in the preparation for the practical exam the images presented during the lecture course were leading. The attitude towards the images in the learning process of the studied groups is due on the one hand to the understanding that histology is largely morphological science and, on the other hand, that the histology itself deals with many images - microscopic preparations, backgammon, paintings on the board, presentations , slides, electronic images on the Internet. The fact that for the acquisition of knowledge in histology as a requirement in the program the students

must present protocols with drawings of the observed microscopic preparations at the end of the semester as a condition for certification should be taken into consideration.

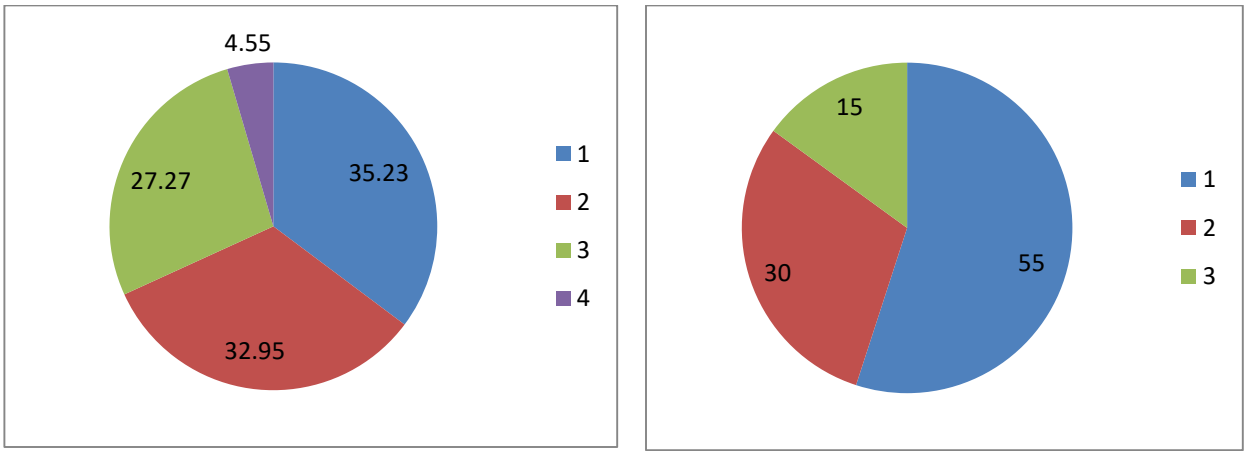

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Fig. 2.

When asking students about images outside the lectures and practical course, we mean images that are not present in the recommended textbooks, microscopic preparations and atlases displayed on the exercises as well as those presented in Moodle. Data (Fig. 3) shows that the most common response is "several times in the semester" in both groups. A higher rate of "almost every hour" response is seen in full-time students, as the training lasts for 15 weeks and the time spent outside the audience is much higher. It is natural for the part-time students, where the classes last about 20 days and their daily audience employment is an average of 8 hours, the time for additional learning to be shortened. They, of course, can use additional literature and resources outside of the classroom, so the percentage of respondents "several times in the semester" is larger. We also need to pay attention to the fact that students who have not used extra images or have responded "once in the semester" from the group of full-time students are a little more (approximately 17%) compared to the group of part-time students (15%). These differences can be explained in a different way. One of the possible explanations is the higher motivation of the extramural students expressed in the narrative interviews with representatives of the two groups. The result might be due to the irregularity in the group samples, too.

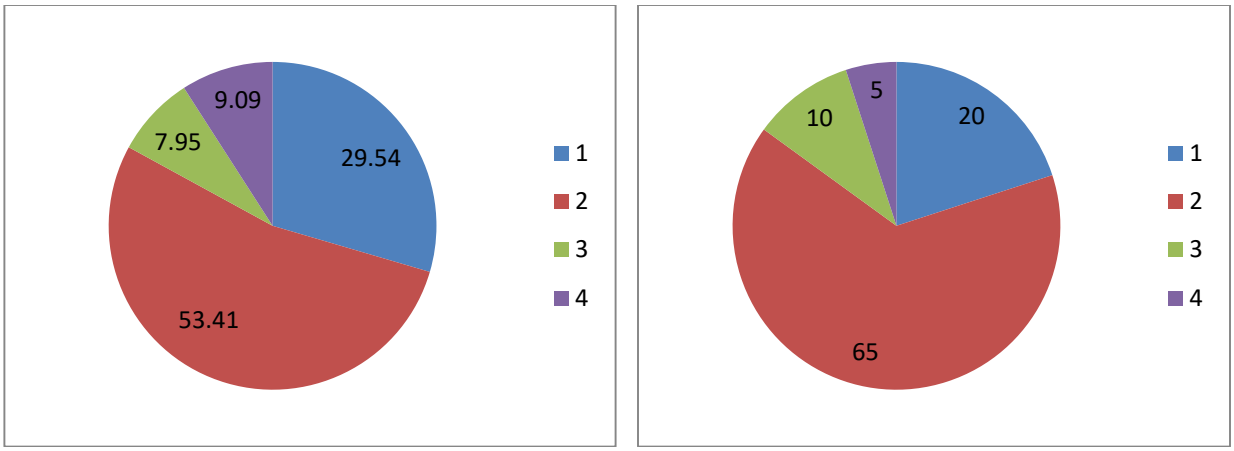

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Fig. 3

As Tytler & Hubber [16] state, building up images is a key element in literacy in science, and the production of own images enhances students' understanding of their actions and goals. Their own images in the science studies helps learners evaluate their work in explaining scientific phenomena and facts, as well as solving specific scientific tasks. Drawing makes student thinking clear and accurate.

Because of the ability to exchange and clarify meanings of concepts and ideas through images, it can serve as an assessment of diagnostics, formative and criterial assessment. According to Fiorella & Mayer [17], the effect of self-generated drawing is the strongest when learners receive instruction for the drawing, when learners work with partially designed illustrations intended to reduce the cognitive load, or when learners want to compare their drawing with a similar, provided by a teacher (instructor). From the point of view of practical application, a self-generated drawing can be an effective training strategy for adopting scientific knowledge presented in words provided that students receive appropriate guidance on what to draw, as well as support in the mechanics of painting. This is the approach to practical histology courses, where students receive verbal instructions on the structure of the observed object and its dimensions, observe a similar structure in histological atlases, and compare it to a plot of the teacher or a school board.

Comparing the responses of the respondents from the two groups (Figure 4) it is clear that for the students of the regular form of education their own drawings are the leading ones for 45.45% of the respondents, while the students from the part-time form the highest percentage (40.91%) have judged that their drawings play a subordinate role. This difference can be explained again by the form of education, since in regular students the time for observation and drawing is distributed evenly over time. This allows for greater calmness when drawing up own drawings, more time to compare with histological atlases and teaching drawings on the board, and the possibility of more detailed explanations of the dimensions and morphological details of the drawings. There is a small difference in the percentages for the "equivalent" response in the two groups studied - 31.82% in the regular form of study compared to 27.27% in the case of part-time students. From the narrative interviews with students, most of them say they feel insecure about the quality of their own drawings. Students say that "I cannot draw," "I draw ugly," or "I need a lot of drawing time." They look at the self-generated drawings of the microscopic objects on their aesthetic side or as a means to report activity during the semester and obtain the appropriate term endorsement. A much smaller number of them perceive the drawings as an element for deepening

understanding of the morphology of histological objects or as a way of memorizing a given microscopic structure. From our experience, we can share that those students who have adopted their own drawings as a means of more effective learning, regardless of the aesthetic quality of these images, have always had a better presentation of the practical and theoretical exam. This coincides with observation of other scientists who studied the role of visualization in acquiring biology knowledge [18].

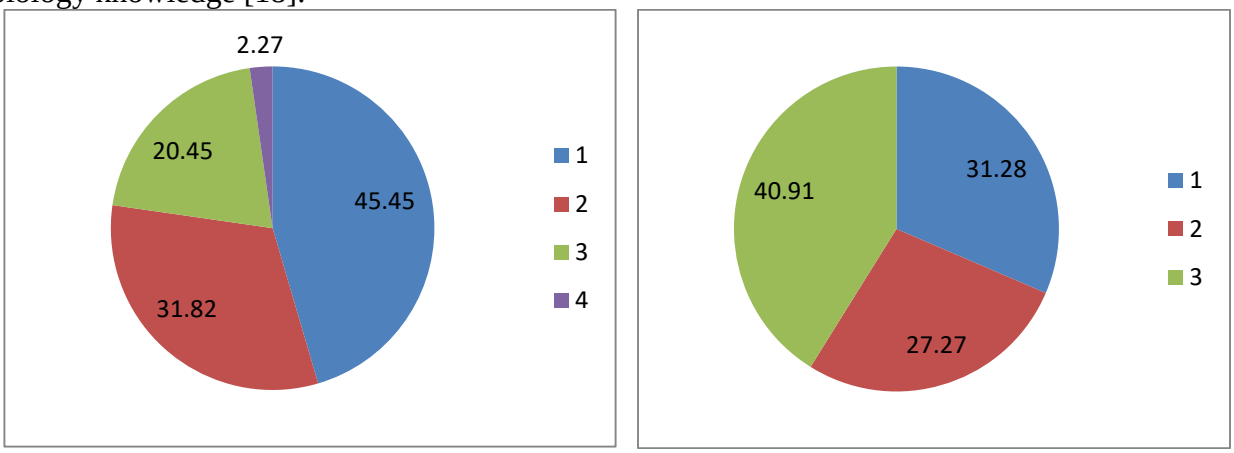

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Fig. 4.

To the question "Is there an image in histology training that you can remember best? "The results are presented on Fig. 5. The total number of respondents is 90, with predominant representation of the students in the regular form of education.

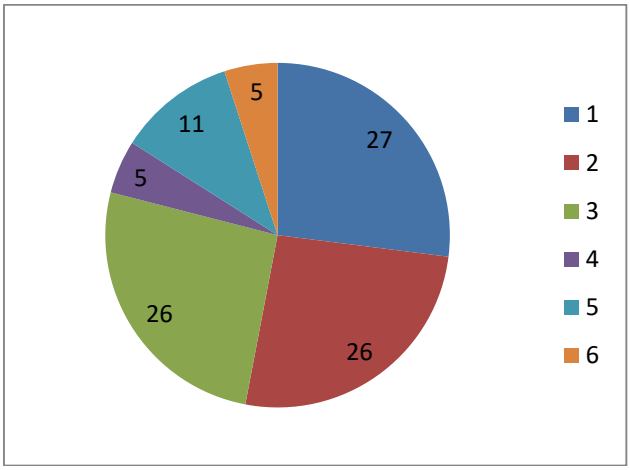

Fig. 5.

The microscope slide of spinal cord is not the easiest as a structure, but it is indicated by a large number of students as an image that remains in their minds. This is probably due to the fact that this structure is studied several times in the secondary education, and students have a prior knowledge of the structure. The quality of the microscope mounts is also important. Adipose tissue and simple squamous epithelium are also amongst those indicated by a large number of students as easy to remember. These microscopic objects are relatively simple as a structure, easily depicted by a drawing and easily understood by learners. This is the probable cause that they are the most

memorable among students. Interestingly, despite the above 30 preparations observed, the students have only indicated 6 of them as recognizable.

The analysis of the reasons for remembering these preparations was made on the basis of the answers that the students gave to the question from the questionnaire "What is the reason, in your opinion, to remember this image best?

As the main reason for commencing a preparation, most students indicate the quality of the preparations. Almost the same is the share of those that have pointed out the simplicity of the structure, interest or repetition of the observation (preliminary knowledge of the structure) as an opportunity to remember. A large percentage of the respondents did not indicate a specific reason for remembering a structure.

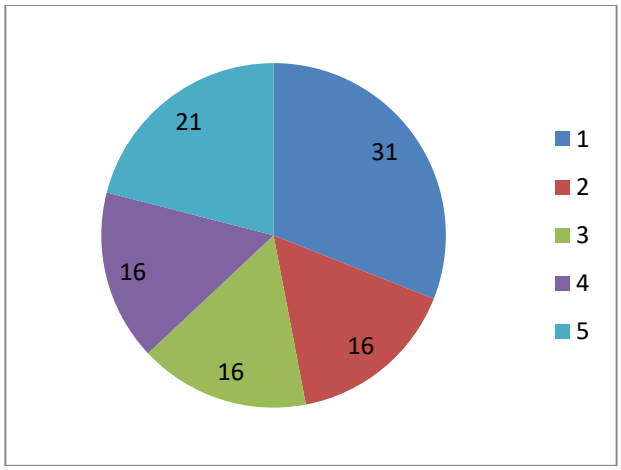

Fig. 6.

Conclusions

The image is the leading or equivalent to the text in learning histology from textbooks. Images less than those specified by lecturers are rarely used.

It is important to create your own images in learning histology. Depending on the learning strategies, it is likely to create a more permanent resemblance to the structure of certain objects. How creating own images in learning histology and other related disciplines affects the ability to memorize the learning content should be explored more thoroughly in different learning situations. It is also interesting to explore the possibility of deepening knowledge by constructing images and animations in an electronic environment. For the time being, research has found that, with the help of ICT and traditional training, relatively few preparations are remembered for a long time as they are either pre-studied or with a relatively simple morphology. There was a preference for students to visualize the material by electronic means, as it is more significant for students in the part-time form of study.

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Figure legends:

Fig. 1. What is the role of the textbook images you used for the practical histology exam?
A – full-time (regular) students ; B – part-time (extramural) students .
1- Leading; 2 – Equivalent;3 – Subordinate; 4 - Meaningless

Fig. 2. What was the role of the images you watched during your lecture course for your practice in histology?
A - full-time students; B - part-time students
1 - Leading; 2 – Equivalent;3 – Subordinate; 4 – Meaningless

Fig. 3. How often did you use images other than those given to you by the lecturers in the theoretical and practical course?
A – Full-time (regular) students ; B – Part-time (extramural) students .
1-Almost every lesson; 2-Several times in the semester; 3-Once per semester; 4-I have not used

Fig. 4. What was the role of your own drawing of microscopic preparations for your preparation for the practical histology exam?

A – full-time (regular) students ; B – part-time (extramural) students .

Fig. 5. Percentage of answers to the question "Is there an image in histology training that you can remember best? The total number of respondents – 90 (both regular and extramural students are surveyed).
1 - Spinal cord; 2 - Adipose tissue; 3 - Simple squamous epithelium; 4 - Stratified cornified epithelium; 5 - Pachinian bodies; 6 - Leukocytes

Fig. 6. Percentage distribution of answers to the question: "In your opinion, what is the reason to remember this image best? The total number of respondents – 90 (both regular and extramural students are surveyed).
1- The quality of the slide; 2 - Interesting; 3 - Easy; 4 - Frequently observed; 5 - No reason.