

## EDUCATIONAL STUDY

# Short-term effect of the demonstration of human dissection and excursion on students' ideas about the human organ systems: a Slovak experience

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## ABSTRACT

**BACKGROUND:** Excursions in natural sciences education are justified in the current school system and within the scope of subject focus. The research aimed to observe the immediate impact of demonstration of the human dissection and excursion on the formation of ideas of students about the human body systems.

**METHODS:** The experiment involved the first Slovak demonstration of a real human autopsy for students of the Biology Teaching Department (PdF TU in Trnava). Concepts of the structure of the human body were analyzed before and after experimental impact by a projective technique. The evaluation included the representation, description, and abundance of organs in the view of various systems. The subject of the research were also the questions focused on the use of illustrative procedures and tools in the educational process.

**RESULTS:** Significant statistical differences were found in the group affected by human autopsy in understanding of the digestive, urinary, and locomotor systems. Conversely, the skin, endocrine glands, and lymphatic system were the least represented by the experimental groups.

**CONCLUSION:** Considering the presented results, using different organizational forms and aids (real and virtual) is essential for bringing a positive educational effect on the studied problem (*Tab. 1, Fig. 5, Ref. 20*). Text in PDF [www.elis.sk](http://www.elis.sk).

**KEY WORDS:** ideas, human body dissection, excursion, human body system, university students.

## Introduction

New trends in natural sciences teaching focus their attention on actively exploring the natural materials of the surrounding environment, based on their own experience and observation within natural sciences excursions realized by students in undergraduate programs (1). In the current education system, dissections of organisms (animals and humans) are perceived as a somewhat controversial part of practical teaching of biology (2), yet still illustrative and attractive in higher education. Some authors consider them unethical in the context of the student's practical activities and try to replace them with other methods of teaching (3, 4, 5). Subsequently, the aim of the presented research is to confirm the contribution of the used organizational forms (real human dissection and the human body excursion), which appear justified in the research of similar focus. Mentioned authors report significantly more effective teaching of the subject (6).

Biology and Human Development in the combination of virtual dissection and observation of plastic models of organs and the human skeleton, as if only one teaching method was used. An alternative to real dissections of organisms is the so-called virtual autopsy using a computer (7). Modeling of human anatomy from modularity also appears attractive to the students (8, 9) or the use of three-dimensional plastic models of the human organs and skeleton. The advantage of carrying out a human demonstrative dissection is the fact that it is real (10) and allows the student to directly observe and interfere with the model object and authentically recognize organs of the systems and their localization in the organism (11).

The research aimed to investigate the impact of the human body demonstration dissection and the human body excursion on the concept and imagination of the human systems in university students with a professional focus on Biology. Another goal is to compare the perception and ideas about the human body systems between the experimental and control group of students and to confirm the contribution of the organizational forms used (human body dissection, human excursion). Based on the goals mentioned above, we have set the following hypotheses:

**H1:** A human excursion and a demonstration of human dissection carried out in school conditions positively influences ideas and concepts of organ systems in university students.

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**H2:** Students of the experimental group will have a qualitatively higher level of ideas and concepts about human organs and systems than students of the control group who did not participate in human autopsies and excursions.

**H3:** The popularity of organizational forms (demonstration of dissection, audiovisual dissection, human excursion, human body model) will be at a higher quality level in the experimental group of students than students of the control group who did not participate in human autopsies and excursions.

### Methods (Figs 1 – 3)

Fifty university students from the Faculty of Education of Trnava University participated in the research carried out during the winter semester in October 2017. The research sample consisted of students of the experimental group ( $N_e = 25$ ) in the teaching program of biology within the subject of Biology and Human Development. The control group of respondents consisted of university students of non-biology teaching programs ( $N_k = 25$ ). The respondents of the control group completed the subject of Somatic Development of Children and Youth at the beginning of the study (in the years 2014 and 2015), in which the human organ systems were theoretically discussed. The respondents of both research groups were 20 – 22 years old. The number of students in the experimental group was limited by the number of students in



**Fig. 1.** An expert explanation of organs and organ systems was part of the human dissection.



**Fig. 2.** Audiovisual autopsy of a human supplemented with a teaching model of organ systems in the school environment.



**Fig. 3.** Evidence of taste chemoreceptors on the tongue and realization of practical activities in laboratory conditions.

the year with the studied approbation. The excursion and autopsy of human bodies were realized on the same day due to time and organizational reasons at the beginning of the semester, in order to limit the influence of the teaching process on the test before (pre-test) and after (post-test) the experimental impact. The subject of human dissection was an expert lecture on observed organ systems supplemented by a demonstration of individual organs and their localization within a fixed human body.

Similarly, an excursion about the structures of the human body (the Human Body Exhibition) was performed with a model depiction of individual organs and systems seen authentically on the human body. Thematically, the excursion was also anthropologically focused on human development, genital system and embryonic and postembryonic development of a human individual. Post-experimental effects (post-test) and data acquisition were followed by practical exercises concentrating on somatoscopy and anthropometry for the students of the experimental group. It included practical activities that were practiced on a group basis and systematically in laboratory and school conditions (12).

We used the projective technique to determine the effect of using organizational forms (autopsy and human excursion) on the formation of ideas about organs and organ systems. This technique analyzes and reveals students' ideas about the studied phenomena using their drawings (13). The research group of students portrayed organs and systems in their drawings (human body silhouette). The subject of the study was the drawing, description and correct localization of organs in the human body. We also assessed the completeness of student drawings, whereas the respondent was given a score of 1 for the correct representation and description of ten or more organs, on the contrary, incomplete drawings and drawings with a lower number of organs showed zero value. The resulting score of the system shown was arithmetically averaged within the research group. The subject of evaluation of the test sheet were also questions focusing on the use of organizational forms and tools (autopsy, excursion about the human body, virtual autopsy, model of organ systems and human skeleton) during teaching practice in the future. The questions were scored bipolar with the possibility of positive (1) and negative (0) answers.

**Tab. 1. Ideas of students about the organ systems in research groups before (pre-test) and after (post-test) implementation of experimental impact ( $\chi^2$ -test).**

Ideas	Group	Test	n	%	$\chi^2$ - test	d.f.	p
Drawing of organ systems	Experimental	Pre-test	25	68	9.5238	1	<b>0.0020</b> **
		Posttest	25	100			
	Control	Pre-test	25	64	,0849	1	0.7708 NS
		Posttest	25	60			
Description of organs	Experimental	Pre-test	25	68	6.6396	1	<b>0.0100</b> *
		Posttest	25	96			
	Control	Pre-test	25	60	0.3472	1	0.5557 NS
		Posttest	25	68			
Location of organs	Experimental	Pre-test	25	48	4.1596	1	<b>0.0414</b> *
		Posttest	25	76			
	Control	Pre-test	25	36	0.7389	1	0.3900 NS
		Posttest	25	68			
Number of organs	Experimental	Pre-test	25	48	5.5556	1	<b>0.0184</b> *
		Posttest	25	76			
	Control	Pre-test	25	36	0.0000	1	1.0000
		Posttest	25	48			

NS p &gt; 0,05, \* p &lt; 0,05

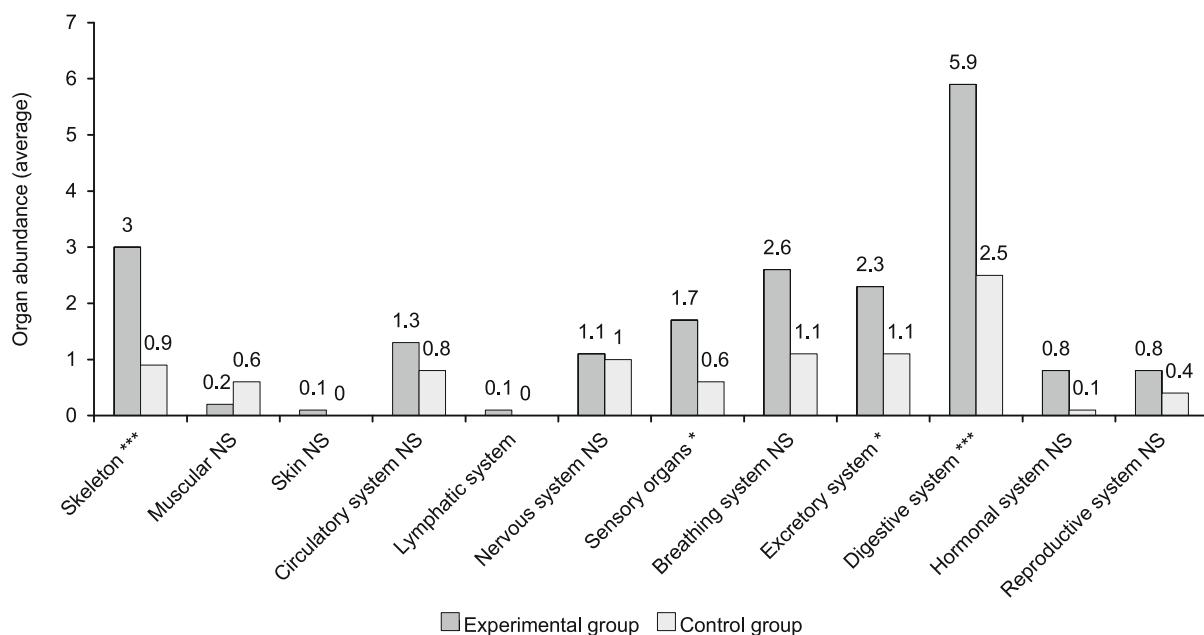
## Results

The obtained data were subjected to statistical analysis using a nonparametric  $\chi^2$  test (Chi-square 2x2), which we used to evaluate the results of individual groups of respondents before (pre-test) and after (post-test) the experimental influence. Before the realization of pedagogical research, we ensured a homogeneous composition of respondents of individual research groups as follows. Students of the experimental group did not differ from the control in the average mark on certificate from biology ( $e = 1.724 + 0.1$  vs  $k = 1.736 + 0.1$ ,  $\chi^2 = 0.017$ ,  $df = 1$ ,  $P = 0.894$ ), which is an important

indicator of the knowledge gap among students. Significant differences between research groups were not found in the number of students interested in nature (average:  $e = 0.846$  vs  $k = 0.307$ ,  $\chi^2 = 0.0117$ ,  $df = 1$ ,  $P = 0.913$ ). The difference between the groups was not evident even in students in the case of human autopsy before applying the research (average:  $e = 0.958$  vs  $k = 0.947$ ,  $\chi^2 = 0.133$ ,  $df = 1$ ,  $P = 0.732$ ).

### Ideas and concepts of organ systems

The subject of the research was to identify in the research groups the level of ideas about human organ systems before (pre-

**Fig. 4. Frequency of organs (mean) in organ systems (post-test) between the experimental and control group of respondents ( $\chi^2$  – test 2x2). NS p > 0,05, \* p < 0,05, \*\*\* p < 0,001.**

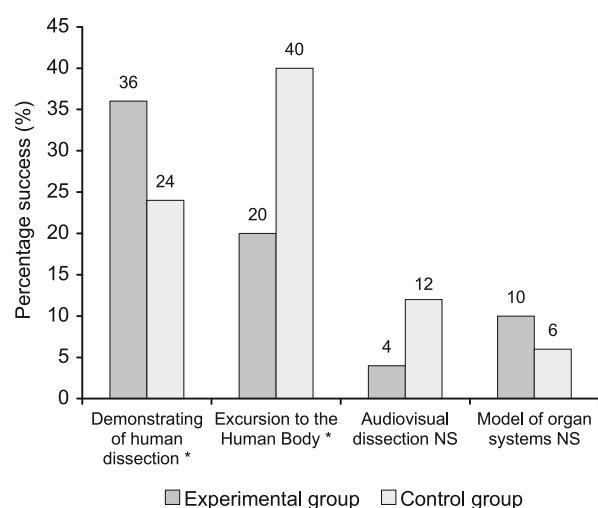
test) and after (post-test) the experimental influence (Tab. 1). Drawing, description, abundance, and localization of organs after the experimental impact (post-test) was at a higher quantitative level in both research groups of respondents. Significant effects ( $p < 0.05$ ) were found in the experimental group of students (pre-test = 68 %, post-test = 100 %) who, after completing demonstration autopsy and human excursion, depicted the organ systems with higher success rates than the respondents of the control group (pre-test = 64 %, post-test = 60 %). Similar findings are found in the description of the plotted organs, where the experimental group (pre-test = 68 %, post-test = 96 %) is in average more successful than the control group (pre-test = 60 %, post-test = 68 %). Statistically significant effects are recorded in favor of the experimental group of students also in the correct localization of organs and the abundance of organs shown in the human body ( $p < 0.05$ ). Differences in ideas and concepts were in the control group of respondents in all observed attributes between pre-test and post-test with no statistical significance ( $p > 0.05$ ).

#### *Representation of organs in the body systems (Fig. 4)*

The research aimed to identify the frequency of the representation (arithmetic mean) of the organs in the body systems after the experimental influence (post-test) (Fig. 1). We found statistically significant differences ( $p < 0.05$ ) in the experimental group of respondents. After attending the dissection and excursion of the human body, there are significant effects in the representation of the sensory organs ( $e = 1.7$ ;  $k = 0.6$ ) and the urinary system ( $e = 2.3$ ;  $k = 1.1$ ) of the human ( $p < 0.05$ ). Similarly, the representation of the locomotor system ( $e = 3.0$ ,  $k = 0.9$ ) and digestive system ( $e = 5.9$ ,  $k = 2.5$ ) were quantitatively higher in the experimental group than the control group. The differences found in the research groups were highly significant ( $p < 0.001$ ). An interesting finding in the experimental group is the absence of representation of the lymphatic system ( $e = 0.1$ ) and integumentary system ( $e = 0.1$ ) in human, which were not identified at all in the control group ( $k = 0$ ). Other organs of the body systems were depicted in lower-frequency in the student drawings, with differences among research groups without statistical significance ( $p > 0.05$ ).

#### *Popularity of organizational forms and tools (Fig. 5)*

The subject of the research was to compare the popularity of the use of organizational forms and tools (demonstration dissection, human body excursion, virtual dissection, models of skeleton and body systems) in the research groups of respondents during the teaching process (Fig. 2). We registered significant differences in the use of human autopsy, where the experimental group ( $e = 36\%$ ) showed on average a higher percentage of success than the control group of respondents ( $k = 24\%$ ). An interesting statistical finding ( $p < 0.001$ ) is the attribute of the popularity of the Human Body Exhibition. Here we have found a higher percentage score in the control group of respondents ( $k = 40\%$ ) against the experimental group of students ( $e = 20\%$ ) participating in the human body excursion. Audiovisual autopsy showed higher values ( $k = 12\%$ ) in the control group than in the experimental group ( $e = 4\%$ ). Consequently, the use of the organ system model and the



**Fig. 5. The popularity of organizational forms and utilities in research groups after (post-test) implementation of experimental impact ( $\chi^2$ -test). NS  $p > 0.05$ , \*  $p < 0.05$ .**

skeleton is more attractive in the experimental group of students ( $e = 10\%$ ), with the control group showing a comparatively lower score ( $k = 6\%$ ). The differences were found to be of no statistical significance in the research groups ( $p > 0.05$ ).

#### **Discussion**

In the presented research, we found that even a short-term impact of the use of illustrative organizational forms (demonstration dissection of the human body, human body excursion) in the university environment brings the desired educational effect within the framework of forming ideas about the human body systems. Students who attended the human autopsy and human body excursion showed positive attitudes towards autopsy and human excursions, as opposed to those who did not attend the autopsy. This fact is related to real observation and recognition of body systems and organs, making real autopsies attractive for students (10). Subsequently, they allow the student to develop fine motor skills in organ preparation directly in the organism (11). Similar findings of positive attitudes towards autopsy of organisms (mostly invertebrates and vertebrates) are recorded in secondary school students at a selected Moravian school in the Czech Republic (14). Authors of the survey found that more than 80 % of students had at least one autopsy exercise in primary and secondary schools in the past. Most students evaluated autopsies as attractive and interesting, while 10 % of respondents stated a negativistic attitude up to resistance to the realization of the autopsy. It is proven that the student's emotion of disgust is also influenced by the manipulation of the biological object itself and its appearance, whereas, on average, students with observing a model organism have a higher level of knowledge than students who did not participate in the observation. The degree of acquired knowledge is also related to the attractiveness of the observed zoological object, which, in the case of observation of,

for example, an attractive African slug species (genus *Achatina*) shows less resistance and a higher score of acquired knowledge (15). Subsequently, the researchers state that the positive formation of attitudes towards autopsy of the model organism (earthworm, fish, chicken, and rat) and their knowledge of the internal structure is closely related to its breeding in domestic conditions (16). Positive findings within the attractiveness of autopsy and human excursion were also found in our results, where students attending autopsy exhibit on average higher interest in its completion, as students of the control group who did not participate in autopsies. The results of the autopsy of animals in the past are similarly recorded for university students who report their experience with autopsy at primary and secondary schools. Subsequently, the positive findings are recorded in the case of students with experience with autopsy conducted in lower years of university study. Representative invertebrates (insect preparation, earthworm dissection) and vertebrate species (trout, chicken, and rat) were used as model organisms. These experiences have also probably influenced the current positive assessment of human demonstration dissection and implementation in future teaching. Positive findings in the framework of forming attitudes towards insect preparation are also recorded in higher education conditions in previous research (17). The university students of biology were influenced by a short-term course of entomology, which included the collection of insects, its observation in the natural environment and their subsequent preparation in school conditions. Common species of beetles and butterflies were used as model representatives (e.g., seven-spot ladybird, peacock butterfly). We found that the students who participated in the entomological course showed more positive attitudes towards insects on average than the group not involved in the preparation. From the previous findings, it is clear that the university education of an individual that can positively influence the attitude to insect (18). Conversely, insects are perceived somewhat negatively by the public and arouse among ordinary people rather fear and resistance (19). We also encounter similar negative perceptions of the autopsy of organisms (2, 5), where real dissections of animals are replaced by virtual computer dissections in school conditions (7, 20). As part of our findings, there is an increased interest in the use of virtual human autopsies in a group of students who did not attend autopsies. The use of virtual dissections seems to be less justified for respondents involved in real human dissection. When eliminating resistance to the real autopsy, the use of illustrative three-dimensional plastic models of human organs and the human skeleton is a suitable alternative for studying human organs and organ systems (6). These models showed a higher percentage of use rate among students involved in human autopsies compared to those who did not participate in the autopsy. An alternative option to illustrate is the use of Human Body Exhibition, where human organs in body systems are exposed directly as part of the human body. As part of our findings, we have higher popularity among the students not participating in the excursion. The main aim of the research was to confirm the benefits of using organizational forms (real human dissection and human body excursion). These appear after the gradual completion justified.

Positive results of acquired knowledge are also known in the use of virtual dissections in combination with the human body models of systems and skeleton (6). This is also evidenced by our findings where, following experimental influence, the group showed organs in body systems with a higher frequency than the group that did not participate in human autopsies and excursions. Similar differences are found between the research groups in the description of the organs and the correct localization within the body system. An interesting finding in the representation of organs in human organ systems is the lack of understanding of the lymphatic system as part of the human circulatory system in the group, which participated in the human body autopsy. In the research groups of respondents, the representation of the dermal system was often absent, which as a surface layer separating the organism from the surrounding environment was not shown on the surface of the human body. Based on the confirmed hypotheses and analysis of the results on the organs of the human body, we can state the positive impact of forming attitudes and ideas through the gradual use of the presented organizational forms (real autopsy and human excursion), suitably applicable also in the conditions of higher education of biology.

## Conclusion

In the presented research, we compared the level of notions and ideas about organs and body systems acquired after the experimental influence of human body dissection and excursion about the human body. Students who completed human body demonstration and human excursion showed on average a higher level of acquired knowledge than students who did not attend autopsies and excursions. Research has shown significant differences in both groups of respondents. Differences manifested themselves at the level of ideas and concepts aimed at drawing and describing organs, their localization in the human body, and their overall abundance in organ systems. We found statistically significant differences in the representation of the locomotor and digestive systems, the sensory organs and the urinary system. An interesting finding is the absence of a representation of the skin and lymphatic system, which was not shown as part of the circulatory system. Changes in attitudes in the interest of nature and the use of organizational forms and tools (real autopsy, virtual autopsy, a model of organs and human skeleton) were also investigated. When comparing the results, we found statistically significant effects in the interest and popularity of human dissection in the experimental group of respondents. On the contrary, we also record a significant impact on the item with interest in Human Body Exhibition, specifically for students, who did not attend autopsy and excursions. Similarly, the virtual autopsy showed a higher percentage score in the control group. On the contrary, the models of body systems were evaluated more positively from the students of the experimental group compared to the control group of respondents. Based on the obtained data we can state the positive formation of attitudes and ideas using the presented teaching forms and aids. Teaching a subject with a focus on a human in this way gives an ideal space for a more effective transfer of knowl-

edge within organs and body systems and their comprehensive understanding in the context of the human organism. Considering the presented research results, we recommend using the following organizational forms (human excursion, real autopsy, audiovisual autopsy, the models of body systems and human skeleton), which are presently unpretentious in use and bring a positive educational effect in the studied problem.

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