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## The modified Peyton's approach and students' learning style

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**Abstract:** **B a c k g r o u n d:** The aim of the study was to determine the predominant learning style and type of intelligence based on the VARK questionnaire and Multiple Intelligences Questionnaire respectively in second year medical students. Determining the relationship between individual preferences of students, based on their learning style and predominant type of intelligence and the perception of the modified Peyton's four-step approach used to teach cardiac auscultation.

**M e t h o d s:** The opinion of participants 236 of the modified four-step approach was attained through the use of anonymous questionnaires. Using the VARK questionnaire, the participants' learning style was defined. The predominant type of intelligence was determined by the Multiple Intelligences Questionnaire.

**R e s u l t s:** The kinesthetic style was the predominant unimodal learning style in second year medical students (in Polish and international students). The most predominant type of intelligence in Polish students was visual-spatial and mathematical and logical, while in international students the predominant types were visual-spatial and mixed type of intelligence. Quantitative analysis indicated that the modified Peyton's approach is a valuable learning and teaching method for most students, independent of their predominant learning style or intelligence type. The exception was a small group of students with linguistic intelligence predominance according to the Multiple Intelligence Questionnaire, for which the Peyton method was more difficult.

**C o n c l u s i o n s:** This study proves that the modified Peyton's approach is useful and effective didactic tool and can be successfully applied to most students. This is a new learning strategy for teaching cardiac auscultation in laboratory conditions in classes for a significant majority. Due to the fact that a group of students with a predominance of linguistic intelligence more often perceived the Peyton method to be difficult, it is worth combining traditional methods with new ones in class so that all students, regardless of unimodal learning style or prevailing type of intelligence, are taught satisfactorily.

**Keywords:** cardiac auscultation, the modified Peyton's four-step method, educational practices, learning strategies, learning preferences.

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## Background

Based on scientific research in the field of medical education carried out in many different countries over the past few years, it has been unambiguously concluded that the modified Peyton's method is a proven effective tool that can be used in teaching various clinical skills to medical students.

Literature describes various modifications of instructional approach, as mentioned in previous publications [1]. Initially Peyton's method was designed for a 1:1 teacher : student ratio [2–5]. The modified Peyton's method was used for small group teaching in 2014 [5]. The use of the four-steps method in bladder catheterization teaching, and newborn life support training has also been described [6]. The instructional method is a valuable didactic tool particularly in the context of medical simulation [5].

In addition, Peyton's method seemed to be superior for teaching laparoscopic skills to obstetrics and gynecology residents in the skills-lab setting [7].

However, no study has yet been carried out to answer the question of whether students' learning preferences affected the perception of the modified Peyton's four-step method. The curriculum at the Department of Medical Education is reviewed every year. Students' satisfaction with the organisation of courses is important for coordinators of said courses.

The modified Peyton's method has been used since 2017 in teaching cardiac auscultation by the medical faculty. The authors of this publication attempt to answer the question as to whether the implementation of the modified Peyton's four-step method to teach selected clinical skills will satisfy all students, taking into account their individual preferences and learning styles.

Every effort has been made in this publication to determine whether individual learning preferences, generally referred to as learning styles, affect the perception of the Peyton method in the teaching of auscultation of the heart.

Nationality or gender did not influence the perception of the modified Peyton's four-step approach [1].

Preferences related to the way students learn best, or the learning style, were determined based on the VARK questionnaire.

The VARK model categorizes learners by preference for four modalities: visual, aural, read/write, and kinesthetic. Ojeh *et al.* concluded that the VARK tool was useful in gathering information about the different learning styles of medical students [8]. The VARK questionnaire "might assist educators in designing blended teaching strategies to cater to the students' needs as well as help the students in becoming aware of

their learning style preferences to enhance learning" [8]. Thanks to this publication we know that teachers can use the modified Peyton's method in the teaching of auscultation of the heart, to facilitate students' understanding and memorization, independent of their individual learning preferences.

### **Aims of the study**

1. Determining the dominant individual learning preferences based on the Multiple Intelligences Questionnaire and the VARK questionnaire for medical students in the second year of study.
2. Determining the relationship between individual preferences of students based on their learning style and the perception of the Peyton's four-step approach used to teach cardiac auscultation.

### **Methods**

The study included second-year Polish students from the faculty of medicine and international students from the School of Medicine in English participating in the Laboratory Training of Clinical Skills (LTCS) course. As was described in previous publications, classes were held in groups of approximately 16 people in equipped rooms, enabling instruction under laboratory conditions. Students learned how to auscultate on each other. Each class lasted 90 minutes [1].

Teaching the physical examination of each organ system is performed using a traditional method: in the beginning of class, the teacher first demonstrates examination techniques on one of the students and then all students practice the examination on each other in pairs.

The modified Peyton's four-step approach was used to teach students cardiac auscultation. The students were exposed to Peyton's approach for the first time in these classes.

Table 1 presents each step of the modified four-step approach.

Table 2 presents the pattern of auscultation of heart valves. The students listened to supine examinees using the diaphragm of the stethoscope. Then the subject was asked to lie down in the left lateral decubitus position. Students repeatedly auscultated the mitral valve with the bell of the stethoscope. They were then auscultated in a seated position, with the patient leaning forward, at maximal exhalation.

The student, who was the first instructor, repeated the auscultation with commentary, and in the third step another student commented on the examination performed by the previous student. In this way, four student-instructors were prepared. They taught the subsequent steps in groups of 4 people (or 3- or 5-people, depending on the size of the group). Each student had to practice cardiac auscultation during class a few times due to this method.

**Table 1.** Steps of the modified Peyton's approach

<b>Steps of modified Peyton's approach</b>	<b>Description of the step</b>
The first step	watching the examination being performed by the academic teacher, without commentary, in real time
The second step	the teacher repeats the examination at a slower pace, describing the location of every point of application of the stethoscope to the chest wall and naming the cardiac valve being auscultated, also discussing additional maneuvers used in auscultation of the heart
The third step	a volunteer from the students is asked to describe the examination as it was carried out by the teacher
The fourth step	the student who commented previously on the auscultation of the heart in the third step is asked to independently perform the examination without any commentary in the fourth step; this student becomes an instructor for another group of 4 students

**Table 2.** The pattern of auscultation of heart valves.

<b>Site of the auscultation</b>	<b>Auscultated valve or pathology</b>
II intercostal space, on the right sternal border	aortic valve
II intercostal space, on the left sternal border	the pulmonary valve
IV intercostal space, parasternally on the right side	tricuspid valve
IV intercostal space, parasternally on the left side — Erb's point	the site of auscultation of the tricuspid and mitral valve
V intercostal space, in the left midclavicular line or more parasternally (the point can be verified by the placement of the examiner's hand, which allows one to feel the apical stroke)	the site of auscultation of the mitral valve
in the left lateral decubitus position: V intercostal space, in the left midclavicular line, with the bell of the stethoscope	mitral stenosis or other abnormalities
a seated position, with the patient leaning forward, at maximal exhalation, the diaphragm is used again to auscultate intercostal spaces III and IV at the left border of the sternum and in the region of the aortic valve	pathologies, for example: aortic regurgitation

After the classes, students were asked to complete an anonymous questionnaire composed of:

1. VARK questionnaire — free access to the questionnaire online
2. Multiple Intelligences Questionnaire — free access to the questionnaire online
3. Questionnaire prepared by the author — in which students had the opportunity to express their opinion on the usefulness of the modified Peyton approach.

Completion of the questionnaire was not mandatory; thus some students did not return completed questionnaires. As we described in a previous publication, the questionnaire was composed of closed and open-ended questions [1].

For the questionnaires, in which students expressed their opinions on the previously unknown modified Peyton's approach, the Multiple Intelligences Questionnaire and the VARK intelligence questionnaire were attached, which made it possible to determine whether the individual characteristics of students related to their preferences and learning styles influenced their evaluation of the Peyton approach. Data was entered into a Microsoft Excel spreadsheet, and then analyzed using STATISTICA 13.0.

The Mann–Whitney U test was used to compare the age between groups and the Pearson chi-square test to investigate the relationship between two nominal variables. The significance level  $\alpha = 0.05$  was assumed. The study was approved by the Bioethical Commission of the Medical College (nr 1072.6120.164.2017).

## Results

255 Polish students and 107 international students took part in the teaching of cardiac auscultation using the modified 4 step Peyton's approach. 236 students, with an average age of 21 years (19 to 28 years old) completed anonymous questionnaires (195 Polish students; 82.6%), women — 57.6%.

Using the VARK questionnaire, students were divided into the following groups based on their learning preferences:

V (the visual style) — 14.8%, A (the aural style) — 12.6%, R (the reading/writing style) — 14.8%, K (the kinesthetic style) — 40.4%, mixed type (e.g. V-R, A-K) — 17.0%. The kinesthetic (K) style was the most preferred unimodal style. There was no significant difference between the Polish and international groups of students ( $p = 0.414$  using Pearson's chi-square test).

Table 3 presents the results of the VARK questionnaire.

**Table 3.** Type of intelligence according to the VARK questionnaire.

VAR K — Type of intelligence	General [%]	Polish students [%]	International students [%]	<b>p = 0.414</b>
V (visual style)	14.8	17.4	7.9	
A (aural style)	12.6	12.8	13.2	
R (reading/writing style)	14.8	16.1	10.5	
K (kinesthetic style)	40.4	38.3	52.6	
mixed type (e.g. V-R, A-K)	17	15.4	15.8	

Table 4 presents the results of the Multiple Intelligences Questionnaire.

**Table 4.** Type of intelligence according to the Multiple Intelligences Questionnaire.

The Multiple Intelligences Questionnaire — Type of intelligence	General [%]	Polish students [%]	International students [%]	<b>p = 0.085</b>
Linguistic	11	8.1	13.2	
Mathematical and logical	28.4	34.2	15.8	
Visual-spatial	31.4	31.5	31.6	
Musical	10.2	10.1	7.9	
Mixed	19.1	16.1	31.6	

There was no significant difference also in the Multiple Intelligences Questionnaire between Polish and international students (0.085 using Pearson's chi-square test).

We analyzed students' answers to each question from the questionnaire prepared by the author, in which students expressed their opinion on the modified Peyton approach taking into account their type of intelligence. It appeared that most students considered that the modified Peyton's approach was effective, was easily understood, and allowed for good organization of classes independent of the type of intelligence and learning style. Most students claimed that the modified Peyton's approach facilitated understanding and believed that the method facilitated memorization through multiple repetitions, along with focused attention and concentration, as described in a previous publication [1].

Based on the analysis of the VARK questionnaire and student feedback on the modified Peyton's four-step method, no statistically significant differences were found

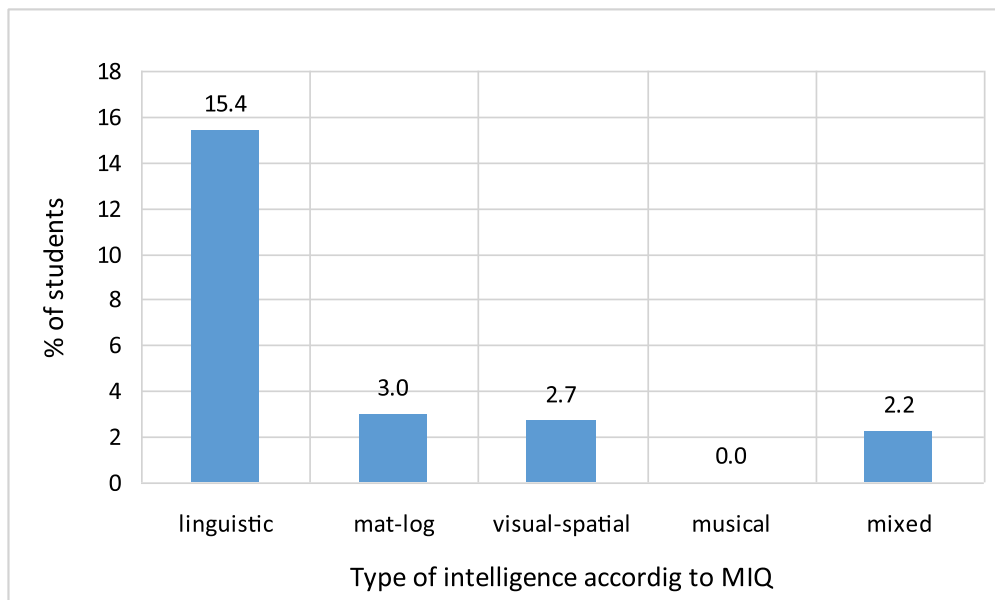


Fig. 1. Students who consider Peyton's method as difficult ( $p = 0.025$  using Pearson's chi-square test).

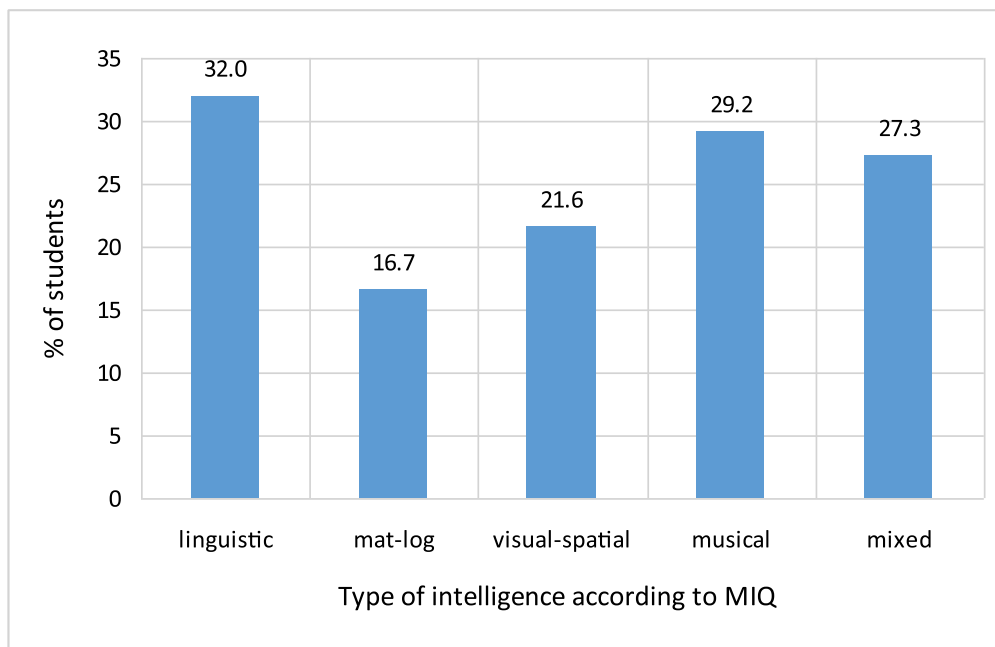


Fig. 2. Students who consider the traditional method to be more favourable for teaching cardiac auscultation ( $p = 0.037$  using Pearson's chi-square test).

between the dominant learning styles and the perception of the Peyton's four-step method ( $p > 0.05$ , Chi square test).

There were no significant differences between the answers of students representing different types of intelligence (according to the Multiple Intelligences Questionnaire) to most questions related to the perception of the modified Peyton's four-step approach in teaching auscultation of the heart ( $p > 0.05$ , Chi square test), except for the answers to two questions described below.

We noticed that students who have predominantly linguistic type of intelligence considered Peyton's approach as a difficult significantly method more often than other groups ( $p = 0.025$ ) and more often claimed that traditional method is more favourable for teaching cardiac auscultation ( $p = 0.037$ ).

It can be concluded that the modified Peyton's approach is beneficial for significantly more students, regardless of their individual preferences and style of learning. However, it is worth remembering that it can be more difficult for some students.

## Discussion

There is a plethora of information in the available literature on individual learning preferences and particularly developed types of intelligence, hence the authors of the study decided not to duplicate such information on this topic [9–21]. Both the VARK questionnaire and the Multiple Intelligence Test are easy to apply.

Despite doubts surrounding the existence of learning styles, scientific reports objectively confirm their existence, as exemplified by the Anderson study [22]. Literature outlines the quality and location of activation in the prefrontal cortex during working memory tasks. Anderson's study shows that learning style and task performance can influence prefrontal cortex activation, with applications toward neurological implications of learning style and populations with deficits in auditory or visual processing [22]. Kim RH determined the learning preferences of surgery residents in his multi-institutional study and proved that the distribution of preferences among residents was different than that of the general population. He concluded that the VARK model may have the potential to improve learning efficiency among residents [23]. Aldosari examined learning style preferences among dental students. The quadmodal VARK style was the preferred learning method chosen by dental students in his study, followed by unimodal aural and kinesthetic styles. Gender was also found to influence learning style preferences. According to Aldosari, the VARK questionnaire is a relatively quick and simple tool to reveal the learning style preferences at an individual or a group level. He proved that dental educators should adjust their delivery methods to approximate the learning preferences of their students. Dental students are encouraged to adapt a multimodal style of learning to improve their academic results [24]. However, Aldosari did not unequivocally suggest



a method that can be dedicated to all students. Retrosi examined the correlation between trainees' VARK-learning style and their ability to acquire laparoscopic skills [25]. His pilot study suggested that trainees' learning style may affect the ability to acquire laparoscopic skill proficiency. Papanagnou's observations were different, however; results of his study suggested that providing procedural instruction that is congruent with a student's self-perceived learning style does not appear to improve outcomes when instructing students on intravenous catheter placement [26].

Medical literature describes the use of the modified Peyton four-step approach in teaching various difficult medical procedures [5, 27–32]. The literature does not yet specify whether students' VARK-learning styles affect their perception of the modified Peyton's four-step approach. Based on the analysis of VARK questionnaires, it was found that the students' learning style does not affect the assessment of the suitability of the modified Peyton four-step approach used in the teaching of cardiac auscultation.

The Multiple Intelligence Questionnaire was used much less frequently in scientific research [33–35]. An example of this is the Sheahan study, which aimed to test the effectiveness of teaching clinical skills using a multiple intelligences teaching approach compared with the conventional teaching approach [33]. The study findings supported the use of the Multiple Intelligences Questionnaire for clinical skills teaching and showed an advanced understanding of how multiple intelligences teaching approaches may be used in nursing education [33].

The purpose of this study was to show whether learning preferences and intelligence type determined on the basis of VARK and Multiple Intelligences Questionnaire affected the perception of the modified Peyton's four-step method. The study showed that despite the prevailing group of students demonstrated a preference for the kinesthetic learning style according to VARK and visual-spatial and mathematical-logical according to Multiple Intelligences Questionnaire, individual groups did not differ significantly in terms of perception of the modified Peyton method. The style of learning and type of intelligence did not significantly affect the respondents' answers. The exception was a small group of students with the dominant type of linguistic intelligence according to the Multiple Intelligence Questionnaire, for which the Peyton method was more often difficult to teach the auscultation of the heart. Based on the opinions of most students, the new method facilitates memorization and allows for better organization of classes.

### **Limitations of the study**

The questionnaire was prepared by the authors and used only in the study.

A small number of students participating in the study. One skill was evaluated and in one medical college. The evaluation of the approach is limited to student feedback.

## Conclusions

The kinesthetic style was the most preferred unimodal learning style in second year medical students. There was no significant difference between the Polish and international groups of students. The most predominant type of intelligence in Polish students was visual-spatial and mathematical and logical, and in international students visual-spatial and mixed type of intelligence predominated. Quantitative analysis of the anonymous questionnaires of students who participated in the classes of cardiac auscultation indicated that the modified Peyton's approach is a valuable learning and teaching method independent of predominant learning style or intelligence type. There was a small group of students with a predominant linguistic type of intelligence according to the Multiple Intelligence Questionnaire, who more often than the others considered the modified Peyton's method as difficult. The conclusion is that it is worth combining traditional methods with new ones in class so that all students, regardless of their unimodal learning style or prevailing type of intelligence, are taught and satisfied.

This study proves that the modified Peyton's approach can be successfully applied to more students, regardless of nationality or learning style and supports the modified Peyton's four-step method as a useful and effective didactic tool.

The modified Peyton's four-step approach was positively perceived by students as a new learning strategy for teaching cardiac auscultation in laboratory conditions in further classes.

## Declarations

### *Ethics*

The study was approved by the Bioethical Commission of the Medical College.

### *Consent for publication*

Verbal consent was obtained from all participants. Questionnaires were anonymous. The ethics committee approved this procedure.

### *Availability of data and material*

A fully anonymous data set is available from the authors (agnieszka.skrzypek@gmail.com) on request.

### *Conflict of interest*

None declared.

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Not applicable.

## Abbreviations

FATE — Focus-Assessed Transthoracic Echo protocol  
LTCS — Laboratory Training of Clinical Skills  
MIQ — Multiple Intelligence Questionnaire  
OSCE — Objective Structured Clinical Examination  
VARK — the visual style, the aural style, the reading/writing style, the kinesthetic style of learning

## References

1. Skrzypek A., Szeliga M., Jagielski P., Perera I., Dębicka-Dąbrowska D., Wilczyńska-Golonka M., Górecki T., Cebula G.: The modified Peyton approach in the teaching of cardiac auscultation. *Folia Med Crac.* 2019; 59 (4): 21–32. doi: 10.24425/fmc.2019.131377.
2. Krautter M., Weyrich P., Schultz J.H., Buss S., Maatouk I., et al.: Effects of Peyton's Four Step Approach on objective performance measures in technical skills training — a controlled trial. *Teach Learn Med.* 2011; 23: 244–250.
3. Abusrewil F., Cameron M., Wallace D.: Advanced trauma life support skills training: a controlled trial. *Sixth Ottawa Conference on Medical Education: 1994.* 1994, Ottawa: University of Toronto Bookstores; 715.
4. *American College of Surgeons Committee on Trauma: Advanced trauma life support program for doctors: ATLS.* 1997, Chicago: American College of Surgeons.
5. Nikendei Ch., Huber J., Stiepak J., Huhn D., Lauter J., Krautter M.: Modification of Peyton's four-step approach for small group teaching — a descriptive study. *BMC Medical Education.* 2014. <https://doi.org/10.1186/1472-6920-14-68>.
6. Nourkami-Tutdibi N., Hilleke A.B., Zemlin M., Wagenpfeil G., Tutdibi E.: Novel modified Peyton's approach for knowledge retention on newborn life support training in medical students. *Acta Paediatr.* 2020 Jan 28. doi: 10.1111/apa.15198. [Epub ahead of print] PMID: 31991017.
7. Balafoutas D., Joukhadar R., Kiesel M., Häusler S., Loeb S., Woeckel A., Herr D.: The Role of Deconstructive Teaching in the Training of Laparoscopy. *JLS.* 2019 Apr–Jun; 23 (2). pii: e2019.00020. doi: 10.4293/JLS.2019.00020.
8. Ojeh N., Sobers-Grannum N., Guar U., Udupa A., Majumder M.A.A.: Learning style preferences: A study of pre-clinical medical students in Barbados. *J Adv Med Educ Prof.* 2017 Oct; 5 (4): 185–194.

9. Mozaffari H.R., Janatolmakan M., Sharifi R., Ghandinejad F., Andayeshgar B., Khatony A.: The Relationship Between the VARK Learning Styles and Academic Achievement in Dental Students. *Adv Med Educ Pract.* 2020 Jan 8; 11: 15–19. doi: 10.2147/AMEP.S235002. eCollection 2020. PMID: 32021538.
10. Auguste B.L., Girsberger M., Kennedy C., Srithongkul T., McGrath-Chong M., Bargman J., Chan C.T.: Are adverse events in newly trained home dialysis patients related to learning styles? A single-centre retrospective study from Toronto, Canada. *BMJ Open.* 2020 Jan 20; 10 (1): e033315. doi: 10.1136/bmjopen-2019-033315. PMID:31964671.
11. Hassanzadeh S., Karimi Moonaghi H., Derakhshan A., Masoud Hosseini S., Taghipour A.: Preferred Learning Styles among Ophthalmology Residents: An Iranian Sample. *J Ophthalmic Vis Res.* 2019 Oct 24; 14 (4): 483–490. doi: 10.18502/jovr.v14i4.5457. eCollection 2019 Oct–Dec. Review. PMID: 31875104.
12. Hoh J.M., Kumar H., Shaun L.Q., Sellapan M., Tay C.C.: A Cross-sectional Study on Learning Preferences for Research Methodology among Medical Students. *J Assoc Physicians India.* 2019 Dec; 67 (12): 18–21. PMID: 31801324.
13. Rezigalla A.A., Ahmed O.Y.: Learning style preferences among medical students in the College of Medicine, University of Bisha, Saudi Arabia (2018). *Adv Med Educ Pract.* 2019 Sep 6; 10: 795–801. doi: 10.2147/AMEP.S219176. eCollection 2019. PMID: 31565016.
14. Parashar R., Hulke S., Pakhare A.: Learning styles for medical students: role of VARK modality [Response to Letter]. *Adv Med Educ Pract.* 2019 Jun 5; 10: 401–402. doi: 10.2147/AMEP.S205980. eCollection 2019. No abstract available. PMID: 31289448.
15. Mozaffari H.R., Janatolmakan M., Sharifi R., Ghandinejad F., Andayeshgar B., Khatony A.: Influence of learning-style preferences in academic performance in the subject of human anatomy: an institution-based study among preclinical medical students. The Relationship Between the VARK Learning Styles and Academic Achievement in Dental Students. *Adv Med Educ Pract.* 2020 Jan 8; 11: 15–19. doi: 10.2147/AMEP.S235002. eCollection 2020. PMID: 32021538.
16. Auguste B.L., Girsberger M., Kennedy C., Srithongkul T., McGrath-Chong M., Bargman J., Chan C.T.: Are adverse events in newly trained home dialysis patients related to learning styles? A single-centre retrospective study from Toronto, Canada. *BMJ Open.* 2020 Jan 20; 10 (1): e033315. doi: 10.1136/bmjopen-2019-033315. PMID: 31964671.
17. Hassanzadeh S., Karimi Moonaghi H., Derakhshan A., Masoud Hosseini S., Taghipour A.: Preferred Learning Styles among Ophthalmology Residents: An Iranian Sample. *J Ophthalmic Vis Res.* 2019 Oct 24; 14 (4): 483–490. doi: 10.18502/jovr.v14i4.5457. eCollection 2019 Oct–Dec. Review. PMID: 31875104.
18. Hoh J.M., Kumar H., Shaun L.Q., Sellapan M., Tay C.C.: A Cross-sectional Study on Learning Preferences for Research Methodology among Medical Students. *J Assoc Physicians India.* 2019 Dec; 67 (12): 18–21. PMID: 31801324.

19. Rezigalla A.A., Ahmed O.Y.: Learning style preferences among medical students in the College of Medicine, University of Bisha, Saudi Arabia (2018). *Adv Med Educ Pract.* 2019 Sep 6; 10: 795–801. doi: 10.2147/AMEP.S219176. eCollection 2019. PMID: 31565016.
20. Parashar R., Hulke S., Pakhare A.: Learning styles for medical students: role of VARK modality [Response to Letter]. *Adv Med Educ Pract.* 2019 Jun 5; 10: 401–402. doi: 10.2147/AMEP.S205980. eCollection 2019. No abstract available. PMID: 31289448.
21. Khanal L., Giri J., Shah S., Koirala S., Rimal J.: Influence of learning-style preferences in academic performance in the subject of human anatomy: an institution-based study among preclinical medical students. *Adv Med Educ Pract.* 2019 May 24; 10: 343–355. doi: 10.2147/AMEP.S198878. eCollection 2019. PMID: 31239799.
22. Anderson A.A., Parsa K., Geiger S., Zaragoza R., Kermanian R., Miguel H., Dashtestani H., Chowdhry F.A., Smith E., Aram S., Gandjbakhche A.H.: Exploring the role of task performance and learning style on prefrontal hemodynamics during a working memory task. *PLoSOne.* 2018 Jun 5; 13 (6): e0198257. doi: 10.1371/journal.pone.0198257. eCollection 2018.
23. Kim R.H., Viscusi R.K., Collier A.N., Hunsinger M.A., Shabahang M.M., Fuhrman G.M., Korndorffer J.R.: Learning preferences of surgery residents: a multi-institutional study. *Surgery.* 2018 Apr; 163 (4): 901–905. doi: 10.1016/j.surg.2017.10.031. Epub 2018 Feb 13.
24. Aldosari M.A., Aliabaa A.H., Al-Sehaibany F.S., Albarakati S.F.: Learning style preferences of dental students at a single institution in Riyadh, Saudi Arabia, evaluated using the VARK questionnaire. *Adv Med Educ Pract.* 2018 Mar 19; 9: 179–186. doi: 10.2147/AMEP.S157686. eCollection 2018.
25. Retrosi G., Morris M., McGavock J.: Does Personal Learning Style Predict the Ability to Learn Laparoscopic Surgery? A Pilot Study. *J Laparoendosc Adv Surg Tech A.* 2018 Jul 27. doi: 10.1089/lap.2018.0196.
26. Papanagnou D., Serrano A., Barkley K., Chandra S., Governatori N., Piela N., Wanner G.K., Shin R.: Does tailoring instructional style to a medical student's self-perceived learning style improve performance when teaching intravenous catheter placement? A randomized controlled study. *BMC Med Educ.* 2016 Aug 12; 16 (1): 205. doi: 10.1186/s12909-016-0720-3.
27. Peters M., ten Cate O.: Bedside teaching in medical education: a literature review. *Perspect Med Educ.* 2014 Apr; 3 (2): 76–88. doi: 10.1007/s40037-013-0083-y.
28. Lund F., Schultz J.-H., Maatouk J., Krautter M., Moltner A., Werner A., Weyrich P., Junger J., Nikendei Ch.: Effectiveness of IV Cannulation Skills Laboratory Training and Its Transfer into Clinical Practice: A Randomized, Controlled Trial. *PLoSOne.* 2012; 7 (3): e32831. doi: 10.1371/journal.pone.0032831.
29. Walker M., Peyton J.W.R.: Teaching in the theatre. In: Teaching and learning in medical practice. Ed. J.W.R. Peyton. Rickmansworth: Manticore Publishers Europe Ltd 1998; 171–180.
30. Wu E.H., Elnicki D.M., Alper E.J., Bost J.E., Corbett E.C. Jr., Fagan M.J., Mechaber A., Ogden P.E., Sebastian J.L., Torre D.M.: Procedural and interpretive skills of medical

- students: experiences and attitudes of third-year students. *Acad Med.* 2006; 81 (10 Suppl): S48–S51.
31. Wu E.H., Elnicki D.M., Alper E.J., Bost J.E., Corbett E.C. Jr., Fagan M.J., Mechaber A.J., Ogden P.E., Sebastian J.L., Torre D.M.: Procedural and interpretive skills of medical students: experiences and attitudes of fourth-year students. *Acad Med.* 2008 Oct; 83 (10 Suppl): S63–67. doi: 10.1097/ACM.0b013e318183c5a7.
  32. Skrzypek A., Górecki T., Krawczyk P., Podolec M., Cebula G., Jabłoński K., Szeliga M., Nowakowski M.: Implementation of the modified 4- step approach method for teaching echocardiography using the FATE protocol — a pilot study. *Echocardiography.* 2018 Aug 26. doi: 10.1111/echo.14128.
  33. Sheahan L., While A., Bloomfield J.: An exploratory trial exploring the use of a multiple intelligences teaching approach (MITA) for teaching clinical skills to first year undergraduate nursing students. *Nurse Educ Today.* 2015 Dec; 35 (12): 1148–1154. doi: 10.1016/j.nedt.2015.05.002. Epub 2015 May 14. PMID: 26031787.
  34. Nwagu E.N., Ezedum C.E., Nwagu E.K.: The impact of a multiple intelligences teaching approach drug education programme on drug refusal skills of Nigerian pupils. *Glob Health Promot.* 2015 Sep; 22 (3): 35–44. doi: 10.1177/1757975914547203. Epub 2014 Oct 6. PMID: 25288586.
  35. Szymanowicz A., Furnham A.: Gender and gender role differences in self- and other-estimates of multiple intelligences. *J Soc Psychol.* 2013 Jul–Aug; 153 (4): 399–423. PMID: 23951949.