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Nataša M. Milić[1]
Andrija R. Pavlović
University of Belgrade, Faculty of Medicine, Belgrade, Serbia

Valerija B. Janićijević
University of Belgrade, Teacher Education Faculty, Belgrade, Serbia

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How Can We Teach Our Students if We Do Not Know How they Learn?
- Medical students' learning styles and academic performance -

Extended summary

Learning styles refer to the idea that people learn in different ways. Learning ability is the natural or instinctive ability to acquire and process information. Students learn in different ways – by listening and observing; by imitating and reflecting upon something; by interpreting information intuitively and logically. How much a student will learn in class also depends on the compatibility of his/her learning style with the teacher's way of working, i.e., on the adaptation of teaching methods and tools to the student's dominant learning style.

The concept of learning styles has continuously expanded its influence in recent decades. Learning style is defined as a developmentally and biologically determined set of characteristics that make the same teaching method excellent for some and unpleasant for others. Today, there is a growing understanding that teachers should pay special attention to students' preferences so that teaching methods comprehensively support learning styles.

In the field of medicine, the need for individualized education is clearly recognized. The introduction of an innovative way of educating medical students in an online environment should contribute to reaching the standard of the collective knowledge of doctors necessary for improving the health of individuals and the population as a whole, in the usual way of working, and especially in extraordinary circumstances such as the Corona virus pandemic. In recent years, the Department of Medical Statistics and Informatics has initiated the imple-

1 matasa.milic@med.bg.ac.rs

mentation of different learning environments at the Faculty of Medicine of the University of Belgrade in order to enable students to choose the way they study and to encourage a more efficient acquisition of knowledge. This reform was triggered by a growing awareness that an insufficient knowledge of statistics contributes to erroneous conclusions in medical literature. In this research, the goal was to determine the dominant learning styles among medical students and analyze the connection between learning styles and students' academic performance in the course Medical Statistics and Informatics. This research then served as the basis for improving a distance learning platform for medical statistics to improve the academic performance of the students attending medical schools.

A prospective cohort study was conducted among the students of the Faculty of Medicine of the University of Belgrade who were enrolled at the compulsory course Medical Statistics and Informatics during the academic year 2017/18. The Learning Styles Index questionnaire was used to measure the dimensions of learning styles: sensory/intuitive, visual/verbal, active/reflective and sequential/global. Additional data included demographic data and a formal evaluation of student achievement. The existing approach to online teaching supported by the distance learning platform Moodle was upgraded for the academic year 2020/2021 in order to cover all ways in which students learn.

The research included 462 medical students. Most respondents were female (64.5%), while their average age was 21.4±1.1 years. The average results of the problem solving and the final grade in the subject were 16.8±2.6 and 82.8±12.4. The dominant learning styles on the active/reflective and sensing/intuitive scales were active (74.9%) and sensory (50%). On the visual/verbal scales and the sequential/global scales, the main learning characteristics were neutral toward visual (48.5% vs. 41.3%) and neutral toward sequential (72.3% vs. 18.4%). Sensory learning style and age were significant predictors in multivariate regression models, with problem solving and final course grade as dependent variables. Based on these findings, the existing learning platform was upgraded to cover all learning idiosyncrasies and to personalize learning for students with non-sensory learning styles.

The students with a strong preference for the sensory learning style have better academic results in Medical Statistics and Informatics. A better knowledge and understanding of learning styles can help teachers and staff design curriculum and adapt teaching methods to help students reach their full academic potential.

Keywords: learning styles, medical students, academic performance

References

- Alghasham, A. A. (2012). Effect of students' learning styles on classroom performance in problem-based learning. *Medical teacher*. 34, S14–S19. https://doi.org/10.3109/0142159x.2012.656744
- Alvin, M. D., George, E., Deng, F., Warhadpande, S. and Lee, S. I. (2020). The Impact of COVID-19 on Radiology Trainees. *Radiology*. 201222. https://doi.org/10.1148/radiol.2020201222

- Arthurs, J. B. (2007). A juggling act in the classroom: Managing different learning styles. *Teaching and learning in nursing*. 2 (1), 2–7. https://doi.org/10.1016/j.teln.2006.10.002
- Arsenijević, J. i Andevski, M. (2022). Univerzitetska onlajn-nastava tokom pandemije virusa korona u odnosu na oblast obrazovanja. *Inovacije u nastavi*. 35 (3), 106–119. http://www.doi.org/10.5937/inovacije2203106A
- Brown, T., Zoghi, M., Williams, B., Jaberzadeh, S., Roller, L., Palermo, C., McKenna, L., Wright, C., Baird, M., Schneider-Kolsky, M. and Hewitt, L. (2009). Are learning style preferences of health science students predictive of their attitudes towards e-learning? *Australian Journal of Educational Technology*. 25 (4), 524–543. https://doi.org/10.14742/ajet.1127
- Carver, C. A., Howard, R. A. and Lane, W. D. (1999). Enhancing student learning through hypermedia courseware and incorporation of student learning styles. *IEEE Transactions on Education*. 42 (1), 33–38.
- Coffield, F., Moseley, D., Hall, E., and Ecclestone, K. (2004). *Learning styles and pedagogy in post-16 learning: A systematic and critical review*. London: Learning and Skills Research Centre.
- DeLuca, G. C., Ovseiko, P. V. and Buchan, A. M. (2016). Personalized medical education: Reappraising clinician-scientist training. *Sci Transl Med*. 8 (321), 321fs2. https://doi.org/10.1126/scitranslmed.aad0689
- Dobson, J. L. (2010). A comparison between learning style preferences and sex, status, and course performance. *Advances in physiology education*. 34 (4), 197–204. https://doi.org/10.1152/advan.00078.2010
- Dunn, R. and Griggs, S. A. (1989). Learning styles: Quiet revolution in American secondary schools. *Clearing House*. 63 (1), 40–42.
- Felder, R. M. and Silverman, L. K. (1988). Learning and teaching styles in engineering education. *Engineering education*. 78 (7), 674–681.
- Felder, R. M. (1996). Matters of style. *ASEE prism*. 6 (4), 18–23.
- Felder, R. M. and Spurlin, J. (2005). Applications, reliability, and validity of the index of learning styles. *International journal of engineering education*. 21 (1), 103–112.
- Graf, S., Viola, S. R. & Leo, T. (2007). In-Depth Analysis of the Felder-Silverman Learning Style Dimensions. *Journal of Research on Technology in Education*. 40 (1), 79–93. https://doi.org/10.1080/15391523.2007.10782498
- Hernández-Torrano, D., Ali, S. and Chan, C. K. (2017). First year medical students' learning style preferences and their correlation with performance in different subjects within the medical course. *BMC Medical Education*. 17 (1), 131. https://doi.org/10.1186/s12909-017-0965-5
- İlçin, N., Tomruk, M., Yeşilyaprak, S. S., Karadibak, D. and Savcı, S. (2018). The relationship between learning styles and academic performance in TURKISH physiotherapy students. *BMC Med Educ*, 18 (1), 291. https://doi.org/10.1186/s12909-018-1400-2
- Kolb, A. D. (1984). *Experiential learning: Experience as the Source of Learning and Development*. Englewood Cliffs, New Jersey: Prentice Hal.

- Kuljis, J. and Liu, F. (2005). A Comparison of Learning Style Theories on the Suitability for elearning. *Web Technologies, Applications, and Services*. 191–197.
- Kuri, N. P. and Truzzi, O. M. (2002). Learning styles of freshmen engineering students. In: *Proceedings of the 2002 International Conference on Engineering Education*. Arlington, VA: International Network for Engineering Education and Research.
- Lawson, S. C. (2011). *An examination of the relationship among student learning style, instructor learning style, and student performance in a Georgia technical college* (doctoral dissertation). Athens: University of Georgia. Retrieved November 13, 2021. from https://getd.libs.uga.edu/pdfs/lawson_stanley_c_201105_edd.pdf
- Liew, S. C., Sidhu, J., and Barua, A. (2015). The relationship between learning preferences (styles and approaches) and learning outcomes among pre-clinical undergraduate medical students. *BMC Med Educ*. 15 (1), 1–7.
- Manojlović, M., Gvozden, M. i Milojičić, J. (2023). Construction and validation of learning style assessment instrument SU-19. *Inovacije u nastavi*. 36 (1), 1–20. http://www.doi.org/10.5937/inovacije2301001M
- Miller, D. G., Pierson, L. and Doernberg, S. (2020). The Role of Medical Students During the COVID-19 Pandemic. *Ann Intern Med*. M20-1281. https://doi.org/10.7326/m20-1281
- Milic, N. M., Masic, S., Milin-Lazovic, J., Trajkovic, G., Bukumiric, Z., Savic, M., et al. (2016). The importance of medical students' attitudes regarding cognitive competence for teaching applied statistics: multi-site study and meta-analysis. *PLoS ONE*. 11 (10), e0164439. https://doi.org/10.1371/journal.pone.0164439
- Milic, N. M., Trajkovic, G. Z., Bukumiric, Z. M., Cirkovic, A., Nikolic, I. M., Milin, J. S., et al. (2016). Improving education in medical statistics: implementing a Blended Learning Model in the existing curriculum. *PloS ONE*, 11 (2), e0148882. https://doi.org/10.1371/journal.pone.0148882
- Milic, N., Masic, S., Bjegovic-Mikanovic, V., Trajkovic, G., Marinkovic, J., Milin-Lazovic, J., et al. (2018). Blended learning is an effective strategy for acquiring competence in public health biostatistics. *International journal of public health*. 63 (3), 421–428. https://doi.org/10.1007/s00038-017-1039-5
- Mohammadi, S., Mobarhan, M. G., Mohammadi, M., and Ferns, G. A. (2015). Age and gender as determinants of learning style among medical students. *Journal of Advances in Medicine and Medical Research*. 7 (4), 292–298. https://doi.org/10.9734/BJMMR/2015/15741
- Mumford, A. and Honey, P. (1992). Questions and answers on learning styles questionnaire. *Industrial and Commercial Training*. 24 (7), 10–13. https://doi.org/10.1108/00197859210015426
- O'Doherty, D., Dromey, M., Lougheed, J., Hannigan, A., Last, J. and McGrath, D. (2018). Barriers and solutions to online learning in medical education – an integrative review. *BMC Med Educ*. 18 (1), 130. https://doi.org/10.1186/s12909-018-1240-0
- Quinn, M. M., Smith, T., Kalmar, E. L. and Burgoon, J. M. (2018). What type of learner are your students? Preferred learning styles of undergraduate gross anatomy students according

to the index of learning styles questionnaire. *Anatomical sciences education*. 11 (4), 358–365. https://doi.org/10.1002/ase.1748

- Rose, S. (2020). Medical Student Education in the Time of COVID-19. *JAMA*. 323 (21), 2131–2132. doi:10.1001/jama.2020.5227
- Sklar, D. P. (2020). COVID-19: Lessons from the Disaster That Can Improve Health Professions Education. *Acad Med*. 95 (11), 1631–1633. https://doi.org/10.1097/acm.0000000000003547
- Tariq, S., Khan, M. A., Afzal, S., Shahzad, S. R, Hamza, M., Khan, H. A., et al. (2016). Association between academic learning strategies and annual examination results among medical students of King Edward Medical University. *Annuals of King Edward Medical University*. 22 (2), 124–134. http://dx.doi.org/10.21649/akemu.v22i2.1290
- Weissgerber, T. L, Milic, N. M., Winham, S. J. and Garovic, V. D. (2015). Beyond bar and Line graphs: time for a new data presentation paradigm. *PLoS Biol*. 13 (4), e1002128. https://doi.org/10.1371/journal.pbio.1002128
- Weissgerber, T. L., Garovic, V. D., Milin-Lazovic, J. S., Winham, S. J., Obradovic, Z., Trzeciakowski, J. P. and Milic, N. M. (2016). Reinventing biostatistics education for basic scientists. *PLoS Biol*. 14 (4), e1002430. https://doi.org/10.1371/journal.pbio.1002430
- Weissgerber, T. L., Winham, S. J., Heinzen, E. P., et al. (2019). Reveal, don't Conceal: Transforming Data Visualization to Improve Transparency. *Circulation*. 140 (18), 1506–1518. https://doi.org/10.1161/CIRCULATIONAHA.118.037777
- Young, T. (2010). How valid and useful is the notion of learning style? A multicultural investigation. *Procedia-Social and Behavioral Sciences*. 2 (2), 427–433. https://doi.org/10.1016/j.sbspro.2010.03.037