

Teaching and learning considerations during the COVID-19 pandemic: Supporting multimodal student learning preferences

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Background. The advent of COVID-19 and the subsequent national lockdown has catapulted higher education institutions into emergency remote teaching (ERT). A principal challenge in this shift is the ability to stimulate student interest towards engagement with, and retention of, course content. The creation of teaching and learning (T&L) resources and activities using a combination of the visual, aural, read/write and kinaesthetic (VARK) modes is fundamental in ensuring student engagement.

Objectives. To determine the learning profiles of undergraduate students and to explore how student learning profiles may be incorporated in T&L approaches during ERT.

Methods. This descriptive study profiles the learning preferences of undergraduate students in a health science faculty using the VARK questionnaire. The study further outlines modifications in T&L implemented to support the varied learning preferences during the COVID-19 ERT response.

Results. Our findings demonstrate that the majority of our students have a multimodal learning preference, with the kinaesthetic modality being the most preferred. Voice-over PowerPoint presentations with transitioning images, and audio files, supported the visual and aural learners through asynchronous engagement. Additionally, online discussion forums and applied projects (such as theme park designs) enhanced asynchronous learning by stimulating the visual, read/write and kinaesthetic preferences, respectively. Microsoft Team sessions with PowerPoint presentations supported visual and aural learning preferences through synchronous engagement.

Conclusions. Rethinking traditional T&L approaches towards supporting the diverse student learning preferences is critical in student-centred T&L amidst the many challenges that ERT has precipitated. Academics need to be dynamic in their T&L approaches and intuitive in their awareness of how subject content may be modified/enhanced in the ERT environment.

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The advent of COVID-19 and the subsequent lockdown, both nationally and internationally, has catapulted higher education institutions into emergency remote teaching and learning (ERT) and the hitherto uncharted realm of digitisation, for many.^[1-4] The agility with which this move was achieved, in terms of making all modules available online, is notable; however, most academics and students were not ready for this paradigm shift.^[1,3] Online teaching and learning (T&L) represents a reciprocal relationship between students, academics and the course curriculum, through the use of technology and the internet.^[5] Thus, successful online T&L involves the integration of content (what needs to be taught), pedagogy (what is the best method to teach it) and technology (what is the most appropriate form used to promote content and pedagogy).^[6]

A principal challenge facing online T&L is the ability to nurture and maintain student motivation during the process and to improve understanding and retention of course content.^[7] Students may differ widely in their learning preferences, i.e. the preferred way in which they interact with academic content, and so this consideration, particularly in the context of COVID-19 and ERT, requires academics to critically reflect on their curriculum and pedagogy.^[7,8] The visual, aural, read/write and kinaesthetic (VARK) model presents a means to determine students' learning preferences but also highlights the necessity and benefits of carefully planned multimedia presentations to encompass the varying preferences.^[7] The creation of multimodal learning environments allows the curriculum to be offered using a combination of the VARK sensory

modes, thus grasping student attention and improving student motivation to learn.^[9]

Although built primarily on theoretical knowledge, the evolution of the basic medical sciences towards an integrated theoretical and practical approach in T&L has largely been adopted.^[10] The practical/hands-on component enhances active learning through visual and kinaesthetic engagement. It is, however, important that the move towards integrated T&L approaches, warranted by the evolution of discipline-specific trends, complements the type of students typically accessing health sciences qualifications. Furthermore, ERT, which has caused a gap in supporting this integrated approach to T&L, requires careful consideration to continue supporting and enhancing ongoing student engagement against the backdrop of student learning preferences.

While ERT encompasses an unexpected interventional shift of T&L delivery to an online platform, it differs from pre-arranged online courses designed for virtual delivery.^[11-13] Hence, most universities and their staff were unprepared and therefore required immediate academic development (in terms of technological skills) and curriculum transformation to meet the demands of online teaching and delivery.^[11-13] Academics were required to adapt their subject content as well as create and implement varying types of T&L strategies.^[14]

The present study used the learning preference profile of undergraduate students in a health sciences faculty to provide an outline of simple modifications in T&L approaches that have been applied to support the

varied learning preferences of students. In response to ERT and equipped with awareness of the learning preferences of the current study cohort, availability of student data/connectivity, and heuristic knowledge of the research team,^[15] a number of multimodal teaching materials such as voice-over PowerPoint, audio podcasts and discussion forums were developed.

Methodology

Study design

This was a quantitative and descriptive study. It comprises two components: the first profiles the learning preferences of undergraduate students in the Department of Basic Medical Sciences, Faculty of Health Sciences, Durban University of Technology (DUT), and the second component provides an outline of T&L modifications that were implemented to support the multimodal learning preferences of the student cohort, during the COVID-19 ERT response.

Study population and recruitment

All registered 1st- and 2nd-year undergraduate students were informed of the study during selected T&L sessions of the different courses. Written informed consent was obtained from interested students ($n=495$), who completed the demographic and VARK questionnaires during their first week of lectures in 2020. Ethical approval was obtained from the Institutional Research Ethics Committee (REC 153/16).

VARK questionnaire

Learning style preferences data were collected using a downloaded copy of the VARK questionnaire version 8.01 (<http://www.vark-learn.com/the-vark-questionnaire/>). A subscription site specifically for use of the VARK questionnaire was purchased and the copyright permission was held by Fleming.^[16] The VARK questionnaire is a 16-item, self-reporting multiple-choice questionnaire based on four sensory modalities (visual, aural, read/write and kinaesthetic) which are used for learning and understanding information.^[17]

Data collection

Demographic data including age and gender were obtained using a self-administered questionnaire. The VARK questionnaire was administered to all students who provided informed consent. Students were informed that they could choose more than one option per question, a recommendation strongly suggested by Fleming and Mills, and were not compelled to answer all questions, if external to their experience.^[17] Completed questionnaires were received and results were captured on the VARK website (<http://site.vark-learn.com/subscription-administration/?access=dut>) to determine the overall learning preferences and learning modality status of each participant. All responses were scored and results were generated online for each of the VARK categories of the questionnaire.

Data analysis (VARK)

All data from the VARK subscription website were captured onto Excel and the scores were statistically analysed using STATA version 15, to determine the percentage of students in each category. Data were categorised as either a unimodal category (only one of the VARK preferences was dominant) or a multimodal category (dominance of more than one preference). The multimodal category was further categorised into bimodal (demonstrating two preferences); trimodal (demonstrating three preferences); and

quadrimodal (demonstrating four preferences). Data are presented as graphs, frequencies and percentages. Demographics (age, gender, race, etc.) were stratified by unimodal v. multimodal learning modality, to determine the student modality preference. Demographic variables were further stratified by each category of learning style (VARK) to determine the student's preferred unimodal learning style. A probability value of $p<0.05$ was considered statistically significant.

Modifications considered in T&L approaches

Using the VARK data collected from the current student cohort, modifications in T&L strategies and delivery during ERT were implemented. These modifications were tabulated and contrasted with conventional T&L practices (Table 1).

Findings and discussion

The impact of gender and age on learning preferences is a topic of active research, with previous studies yielding inconsistent results. A 100% response rate was recorded for the VARK questionnaire. While previous studies have yielded varied results in terms of gender and learning preferences, the majority (64%) of both the women and men surveyed in this study displayed a multimodal learning preference. This finding is consistent with the findings of previous studies.^[9,18] As expected, 95% ($n=470$) of the population represents generation Z. Generation Z (born between 1996 and 2010), is the generation following the millennials and is described as having a low attention span with great reliance on technology and a need to engage through multiple learning channels.^[19] Most of the students profiled displayed a multimodal learning preference (64%, $n=317$) in contrast to 36% ($n=178$) who displayed a unimodal learning preference (Fig. 1). In addition, unimodal preferences, namely kinaesthetic, was noted in 17% of this cohort ($n=84$), followed by 7% each for aural and read/write ($n=35$) and 5% for visual ($n=25$) (Fig. 1).

Moreover, of the 317 students who demonstrated a multimodal learning preference, 26% ($n=82$) also preferred two modes of presentation (bimodal), 20% ($n=63$) preferred three modes (trimodal) and the remaining 54% ($n=171$) preferred four modes of presentation (quadrimodal) (Fig. 2). The most prevalent bimodal combination identified was the aural and kinaesthetic (AK) modes (9%, $n=29$), followed by visual and kinaesthetic

Table 1. Traditional v. emergency remote teaching (ERT) and learning approaches

Traditional T&L approaches	Modifications during COVID-19 ERT
PowerPoint (V/A)	Audios via podcasts (A) Voice-over PowerPoint (V/A) Video PowerPoint via Zoom (V/A/R) Microsoft Teams sessions (V/A/R)
Tutorials with demonstrations/tutors (K/A)	Discussion forums via engagement with current COVID-19-related published articles (V/R) Applied projects (theme park designs; V/A/R/K)
Practical sessions (K/A/V)	Designing online activities (K/V/R)
Textbooks* (R)	Virtual sessions with PowerPoint on key concepts (V/A)
Hardcopy notes (R)	

Primary learning modes are indicated in parentheses. V = visual; A = aural; R = read/write; K = kinaesthetic.
*Textbook availability during ERT was limited for many students as a result of emergency evacuation from residence and bursary-related issues.

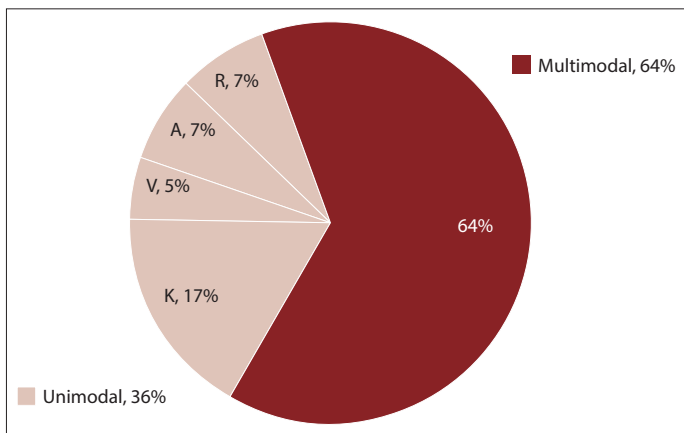


Fig. 1. Unimodal v. multimodal learning preferences of students.

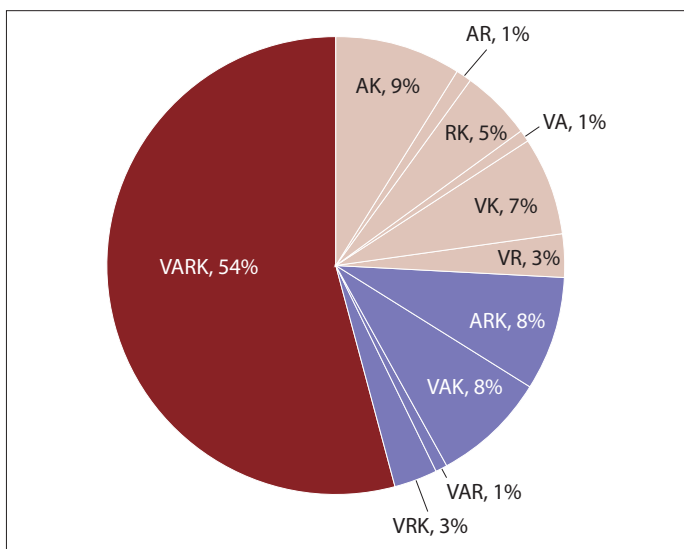


Fig. 2. Distribution of students' multimodal learning preferences.

(VK) modes (7%, $n=22$), read/write and kinaesthetic modes (RK) (5%, $n=16$), visual and read/write (VR) mode (3%, $n=9$), visual and aural (VA) modes (1%, $n=3$) and aural and read/write (AR) modes (1%, $n=3$) (Fig. 2). The most prevalent trimodal combination identified was the aural, read/write and kinaesthetic modes (ARK) (8%, $n=25$) and the visual, aural and kinaesthetic modes (VAK) (8%, $n=25$), followed by the visual, read/write and kinaesthetic modes (VRK) (3%, $n=9$) (Fig. 2). The least popular trimodal combination was the visual, aural and read/write (VAR) mode (1%, $n=3$).

We highlight the kinaesthetic learning preference as the most frequently used style, followed by read/write and aural (Table 1). An earlier report suggested that embracing T&L strategies that complement one's learning style may improve learning outcomes, in contrast to those that oppose one's preferences.^[16] Interestingly, 64% ($n=317$) of our total sample were multimodal learners, which is in agreement with various other studies.^[18,20-22] Multimodality was highlighted in our study as the most prominent learning preference in the GenZ subgroup as well as in male and female subgroups. This generation is known to require stimulation through

multiple learning channels, hence a more diverse array of T&L strategies in an ERT platform will augment successful learning outcomes.

Traditional T&L delivery incorporates face-to-face classroom lectures, with the use of resources such as textbooks, chalkboard, anatomical models, tutorials and practical manuals (atlases and dissection guides) as well as online repositories through learning managements systems such as Moodle. Furthermore, during the face-to-face lecture delivery, students deliberately used their smartphones to voice-record real-time lectures which appealed their aural and read/write preferences when accessing outside class time. Given that most students are multimodal learners, it is essential that our digitised delivery incorporates multimodal strategies, focussing on the use of auditory and kinaesthetic styles. Despite the limitations associated with online T&L, a recent study suggests that tactile stimuli achieved through touching and interacting with laptops and PCs may augment the learning experience of the kinaesthetic learner.^[23] It is presumed that auditory learners prefer aural resources to enhance the learning and understanding of content, following which they are empowered to interrogate their understanding and translate to read/write style.

Several studies recommend a multimodal delivery to improve student learning.^[20,24,25] For example, a study conducted by Peter *et al.*^[26] substantiates the integration of digitised learning with VARK learning preferences, advocating the use of online resources aligned with learning categories, to improve ongoing student engagement and increase the efficiency of online learning.^[26] Our observations suggest that traditional T&L strategies support visual and aural learners. During the COVID-19-induced ERT, it was evidently difficult to accommodate all learning preferences, as delivery of resources occurred predominantly through the virtual classroom which primarily supports the aural and read/write learning styles. Hence, the ability to adopt strategies that respond to the multimodal learner requires much reflection and consideration.

An outline of various strategies/modifications applied during 2020's ERT approach is demonstrated and contrasted with traditional T&L approaches (Table 1). The activities also highlight the primary modes of learning supported in each approach in an attempt towards demonstrating simple modifications to traditional T&L that can be made in ensuring that multimodal learning preferences are supported.

The implementation of various synchronous and asynchronous online activities during ERT shown in Table 1, was aimed at maintaining the ongoing engagement of multimodal learners. Asynchronous engagement was encouraged through the use of voice-over PowerPoint presentations with transitioning images, and audio files. This mode enables students to visualise and listen to the explanations of the content simultaneously, which supports both the visual and aural learners. Moreover, the use of voice-over PowerPoint, for example, had to be designed to ensure that the intensity and pitch of speech was adequate to support student engagement. Recorded PowerPoint videos and audio files further allowed students to move through lecture presentations at their own pace by pausing and moving forwards and backwards when necessary for self-reinforcement. In light of the lack of tutorial and practical sessions, the option of integrating relevant study outcomes (e.g. the cardiovascular system) with online discussion forums supported the visual and read/write preferences. Additionally, the use of applied projects (such as theme park designs) enhanced student engagement

by stimulating their VARK preferences. The use of weekly Microsoft Teams sessions with PowerPoint on key concepts encouraged synchronous engagement, which subsequently stimulated the visual and aural learning preferences. These sessions also encouraged student engagement by creating a virtual platform and forum questions and discussions in the virtual classroom.

Strengths of the study

The present study is among the first, to our knowledge, that highlights the need for academics to be dynamic in their T&L approaches and intuitive in their awareness of how students may perceive and interact with their subject content in the ERT climate.

Limitations and recommendations

This cross-sectional study was only conducted among first- and second-year students from the Faculty of Health Sciences, consequently restricting us in generalising the data to all students. Moreover, it is possible that as students progress into later years, their learning style preferences may change. Assessments have also not been highlighted in this study. It is possible that the use of virtual assessments such as MCQs/True/False questions, among kinaesthetic and aural learners, may compromise their overall assessment outcomes as the learning preferences of these learners may differ from these modes.

Conclusion

The shift to the use of the multimodal strategies such as audios via podcasts, voice over PowerPoint/Zoom videos, Microsoft Teams and discussion sessions enhanced the learning process. This finding is reflected in student feedback reports, emphasising general student satisfaction with resources provided and their flexibility for asynchronous use. Navigating through the uncharted territories of ERT therefore requires the academic to creatively improve the quality, delivery and diversity of online resources that promote ongoing student engagement. Learning style preferences is a critical consideration in the delivery of online T&L within this context. Rethinking traditional T&L approaches towards supporting the diverse student learning preferences is critical in student-centred T&L amidst the many challenges that ERT has precipitated. Considering modifications in traditional T&L approaches to ensure that multimodal learning preferences are supported, is therefore warranted.

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Conflicts of interest. None.

1. Bao W. COVID-19 and online teaching in higher education: A case study of Peking University. *Hum Behav Emerg Technol* 2020;2(2):113-115. <https://doi.org/10.1002%2Fhbe.2.191>
2. Goh P-S, Sandars J. A vision of the use of technology in medical education after the COVID-19 pandemic. *Med Ed Publish* 2020;9:1-8. <https://doi.org/10.3946%2Fpkjme.2021.197>
3. Toquero C. Challenges and opportunities for higher education amid the COVID-19 pandemic: The Philippine context. *Pedagogical Research* 2020;5(4):1-5. <https://doi.org/10.29333/pr/7947>
4. Shehata MH, Abouzeid E, Wasfy N, Abdelaziz A, Wells RL, Ahmed SA. Medical education adaptations post COVID-19 - an Egyptian reflection. *J Med Educ Curric Dev* 2020;7:1-9. <https://doi.org/10.1177/2382120520951819>
5. Barr BA, Miller SF. Higher Education: The Online Teaching and Learning Experience. Online submission. 2013:1-23. <https://files.eric.ed.gov/fulltext/ED543912.pdf> (accessed 30 November 2020).
6. Aguilar SJ. A research-based approach for evaluating resources for transitioning to teaching online. *Info Learn Sci* 2020:1-10. <https://doi.org/10.1108/ILS-04-2020-0072>
7. Zhang K, Bonk CJ. Addressing diverse learner preferences and intelligences with emerging technologies: Matching models to online opportunities. *Canadian Journal of Learning and Technology/La revue Canadienne de l'apprentissage et de la technologie*. 2009;34(2):1-14
8. Becker K, Kehoe J, Tennent B. Impact of personalised learning styles on online delivery and assessment. *Campus-Wide Info Syst* 2007;24(2):105-119. <https://doi.org/10.1108/10650740710742718>
9. Renuga M, Vijayalakshmi V. Applying Vark principles to impart interpersonal skills to the students with multimodal learning styles. *Life Sci J* 2013;10(2):55-60.
10. McMenamin PG. Body painting as a tool in clinical anatomy teaching. *Anat Sci Educ* 2008;1(4):139-144. <https://doi.org/10.1002/ase.32>
11. Mohammed AO, Khidhir BA, Nazeer A, Vijayan VJ. Emergency remote teaching during coronavirus pandemic: The current trend and future directive at Middle East College Oman. *Innov Infrastruct Solut* 2020;5(3):72-83. <https://doi.org/10.1007/s41062-020-00326-7>
12. Durak G, Çankaya S. Emergency distance education process from the perspectives of academicians. *Asian J Distance Educ* 2020;15(2):159-174.
13. Whittle C, Tiwari S, Yan S, Williams J. Emergency remote teaching environment: A conceptual framework for responsive online teaching in crises. *Info Learn Sci* 2020;(5/6):311-319. <https://doi.org/10.1108/ILS-04-2020-0099>
14. Ferri F, Grifoni P, Guzzo T. Online learning and emergency remote teaching: Opportunities and challenges in emergency situations. *Societies* 2020;10(4):1-18. <https://doi.org/10.3390/soc10040086>
15. Bailey DR, Lee AR. Learning from experience in the midst of COVID-19: Benefits, challenges, and strategies in online teaching. *Computer-assisted language learning*. *Electr J* 2020;21(2):178-198.
16. Fleming ND. The case against learning styles: "There is no evidence...". 1st ed. Christchurch: VARK Learn Limited; 2012;3:1-3.
17. Fleming ND, Mills C. Helping students understand how they learn. *The Teaching Professor* 1992;7(4):44-63.
18. Prithishkumar IJ, Michael S. Understanding your student: Using the VARK model. *J Postgrad Med* 2014;60(2):183-186. <https://doi.org/10.4103/0022-3859.132337>
19. Singh AP, Dangmei J. Understanding the generation Z: The future workforce. *South-Asian J Multidiscipl Stud* 2016;3(3):1-5.
20. Samarakoon L, Fernando T, Rodrigo C, Rajapakse S. Learning styles and approaches to learning among medical undergraduates and postgraduates. *BMC Med Educ* 2013;13(1):1-6. <https://doi.org/10.1186/1472-6920-13-42>
21. Farkas GJ, Mazurek E, Marone JR. Learning style versus time spent studying and career choice: Which is associated with success in a combined undergraduate anatomy and physiology course? *Anat Sci Educ* 2016;9(2):121-131. <https://doi.org/10.1002%2Fase.1563>
22. Martinez EG, Tucsca R. Learning styles and gross anatomy assessment outcomes at a Colombian school of medicine. *Educ Médica* 2019;20(2):79-83. <https://doi.org/10.1016/j.edumed.2017.12.012>
23. Seyal AH, Rahman MNA. Understanding learning styles, attitudes and intentions in using e-learning system: Evidence from Brunei. *World J Educ* 2015;5(3):61-72. <https://doi.org/10.5430/wje.v5n3p61>
24. Parashar R, Hulke S, Pakhare A. Learning styles among first professional northern and central India medical students during digitisation. *Adv Med Educ Pract* 2019;10:1-5. <https://doi.org/10.2147%2FAMEPS182790>
25. Choudhary R, Dullo P, Tandon R. Gender differences in learning style preferences of first year medical students. *Pak J Physiol* 2011;7(2):42-45.
26. Peter S, Bacon E, Dastbaz M. Learning styles, personalisation and adaptable e-learning. In: Uhomoihibi J, Ross M, Staples G, editors. 14th International Conference on Software Process Improvement Research, Education and Training, INSPIRE 2009. Swindon, UK: British Computer Society; 2009:77-87.

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