

Learning Styles in Pathology: A Comparative Analysis and Implications for Learner-Centered Education

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Abstract

Initiatives like “American Medical Association (AMA)-Reimagining Residency” and “Accreditation Council for Graduate Medical Education (ACGME)-Next Accreditation System” are examples of a paradigm shift toward learner-centered pedagogy in resident education. Such interventions require an understanding of the basics of the learning process itself. This study aimed to identify preferred learning styles in pathology with the intent to use specialty-specific pattern data, if any, to improve pathology training modalities. Kolb’s learning tool questionnaire was sent to pathology-inclined medical students, pathology residents, fellows, and faculty in 5 academic programs. Data from 84 respondents (6 students, 37 residents, 12 fellows, 29 attendings) were analyzed. There was remarkable similarity in learning styles of fellows and faculty, revealing a dominance of observational learning styles (“assimilating” and “diverging”) that was consistent with pathology being a visual field. In contrast, residents showed dominance of “learn by doing” styles (“converging” and “accommodating”). Residents’ stratification by training year showed a scattered distribution with an upward trend toward “learn by doing” behavior. While the difference in styles between residents and faculty/fellows may be due to a generational gap, transition from medical school, or acquisition of technical skills required for grossing specimens, this is an opportunity for adopting blended learning models and active learning processes to cater to residents’ different styles and to allow for flexibility to use all styles as and when needed. Based on these findings, we hypothesize that partnering juniors and seniors with similar styles has a potential for successful mentorship and exploration of other psychometrics is recommended for further understanding and improvement of pathology training.

Keywords

learning styles, pathology education, personalized training, learner-centered training, residency education, pathology residency

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Introduction

Initiatives such as “American Medical Association (AMA)-Reimagining Residency” and the “Accreditation Council for Graduate Medical Education (ACGME)-Next Accreditation System” are two of the many examples that highlight a paradigm shift toward learner-centered pedagogy to improve the learning process in resident education. Active involvement and accommodation of learners’ needs and preferences are key principles of successful learner-centered education.¹ These principles are derived from differences among individuals in acquiring and assimilating knowledge that define their own individual learning styles.

David A. Kolb categorized these differences and described 4 learning styles based on experiential learning theory.² This theory describes learning as a process whereby knowledge is formed

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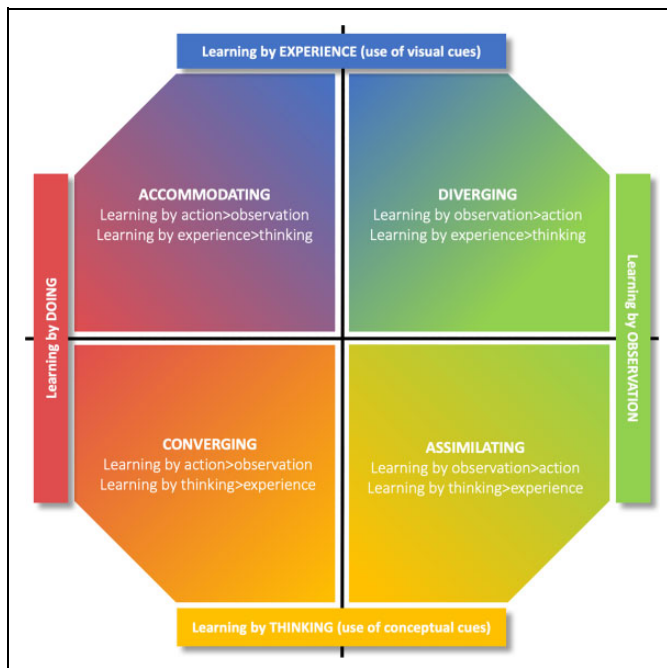


Figure 1. A simplified diagrammatic representation of Kolb's learning styles.

through comprehension and transformation of an *experience*. One can perceive things either as how they appear without considering any deep details based on their experience (*concrete experience*) or alternatively discern things as concepts or ideas (*abstract conceptualization*). Once the perception is built, it needs to be transformed for learning to occur. This is achieved either through practical application (*active experimentation*) or observation (*reflective observation*). These 2 dimensions (perception and transformation) serve as 2 axes of the graph forming 4 quadrants of the learning styles described by Kolb (Figure 1).

The most effective learning style is at the intersection of the 4 quadrants of this model, with equivalent utilization of all 4 styles in the form of a learning cycle using reflective observation, conceptualization, repetitive action, and hands-on experience. However, individuals' learning preferences in real life are skewed toward 1 or 2 quadrants based on their baseline knowledge, personal experiences, and what is required in their professional and personal life.^{3,4}

Kolb developed a 12-item questionnaire, commonly known as Kolb Learning Style Inventory (LSI) to identify individuals' learning preferences.⁴ Each of the learning styles has a correlation with specific learning activities, which may have implications in planning residency curricula. Previous research assessing trainees from different medical specialties has shown preference for different learning styles and the LSI tool has been used to assess and optimize the learning process.⁵⁻¹²

Pathology is a unique medical specialty wherein, at baseline, education is imparted in both visual and experiential forms. Gathering data on how the pathology trainee learns may provide interventional opportunities for improved delivery and acquisition of pathology-specific education. The purpose of

this study is to identify and compare learning styles among pathology faculty, fellows, residents, and medical students and discuss the usefulness of these data in improvement of learning process in the field of pathology.

Methods

After review and approval from our institutional review board, the Kolb's LSI v3.1 was obtained from the proprietor (Korn-Ferry Hay Group) through a research scholarship grant. The LSI questionnaire was sent electronically via Google Forms to pathology faculty, residents, fellows, and medical students (interested in pursuing pathology) at Loyola University Stritch School of Medicine (LUMC). The survey was also sent to a faculty member at Ohio State Wexner Medical Center, Duke University Medical Center, and University of Chicago Medical Center to forward the survey to their respective programs for voluntary participation. A brief introduction to the Kolb LSI and instructions to complete the survey were included in the e-mail. Responses were collected between August 2017 and December 2017. Participants were offered their results at no cost with a brief explanation of their results. Participants' learning styles were determined based on the calculations and graphical templates provided by Korn Ferry Hay Group. Demographic information including age, gender, matriculation from an international or American medical school, level of training, years of experience, and primary specialty was also collected. All statistical analyses were performed on Stata 10.0 (StataCorp LLC, College Station, Texas).

Results

A total of 84 participants responded to the questionnaire. This included 6 medical students, 37 residents, 12 fellows, and 29 faculty members. Since the total number of recipients at other institutions is not known, an overall response rate could not be calculated. The response rate at LUMC was 98% with 48 participants (4 medical students, 16 residents, 5 fellows, and 23 faculty members). To reduce variance and bias during analysis, data were stratified into 4 groups, as shown in Table 1.

Figure 2 shows the distribution of learning styles among 4 study groups with faculty and fellows showing similar distribution of learning styles. Both of these groups showed a dominance of assimilating, 39% and 41%, respectively, followed by diverging learning styles at 29% for faculty and 25% for fellows. No statistically significant differences were noted between the 2 groups using Fisher exact test ($P = 0.31$).

Pathology residents were noted to favor converging (40%) followed by diverging (22%) learning styles. The other learning style preferences of residents were equally distributed between accommodating and assimilating styles, both at 19%. No similarity was noted between residents' and faculty/fellows' distribution of learning styles ($P = .31$). Analysis of residents' learning styles by postgraduate year (PGY) did not show any significant differences ($P = .22$) and was randomly scattered throughout 4 styles as seen in Figure 3. Finally, there were only 2 styles noted among medical students, with 67% of

Table 1. Demographics of Survey Respondents.

Faculty (n = 29)					
Age	Sex	Medical School	Credentials	Subspecialty	Experience
31-40 years (31%)	F (52%)	AMG (48%)	MD/DO (59%)	AP (79%)	>10 years (52%)
41-50 years (21%)	M (48%)	IMG (52%)	MD, PhD (24%)	CP (14%)	6-10 (14%)
51-60 years (31%)			PhD (17%)	AP, CP (7%)	1-5 (34%)
>61 years (13%)					
Fellows (n = 12)					
Age	Sex	Medical School	Credentials	Subspecialty	
25-30 (25%)	F (50%)	AMG (67%)	MD (83%)	AP (92%)	
31-35 (33%)	M (50%)	IMG (33%)	MD, PhD (17%)	CP (8%)	
36-40 (25%)					
>40 (17%)					
Residents (n = 37)					
Age	Sex	Medical School	Credentials	Postgraduate Level	
25-30 (65%)	F (54%)	AMG (54%)	MD/DO (95%)	PGY1 (35%)	
31-35 (30%)	M (46%)	IMG (46%)	MD, PhD (5%)	PGY2 (11%)	
41-45 (5%)				PGY3 (32%)	
				PGY4 (22%)	
Medical Students (n = 6)					
Age	Sex	Degree Enrollment	MS Level		
21-25 (17%)	F (50%)	MD (67%)	MS2 (17%)		
26-30 (50%)	M (50%)	MD, PhD (33%)	MS3 (17%)		
>30 (33%)			MS4 (67%)		

Abbreviations: AMG, American medical graduate; IMG, International medical graduate; AP, anatomic pathology; CP, clinical pathology; MS, medical student; F, female; M, male; PGY, postgraduate year.

students using assimilating followed by converging (33%) learning styles. All 4 Loyola medical students who participated demonstrated an assimilating learning style. Regression analysis did not show any correlation of learning styles with demographic variables of participants in each group.

Discussion

The pedagogical model of the first residency program at Johns Hopkins (1899) was based on “apprenticeship” training.^{13,14} While thousands of successful physicians have been trained using this model to date, the current US workforce comprises 5 generational learners and workers (traditionalists/silent, boomers, and millennials).¹⁵ Millennials account for the majority of resident physicians at this cross section in time.¹⁵ The most significant gap emerges between baby boomers and millennials, the 2 groups that constitute the majority of the current education providers and stakeholders in graduate medical education. While baby boomers are touted to be the “hard working” generation, millennials have been regarded as “entitled,” highlighting the gravity of contrast in social and possibly learning aptitudes. Millennials and forthcoming generations are, generally

speaking, more technology-savvy, reject hierarchical models, and advocate for greater work–life balance than their teachers.^{16,17} Not surprisingly, the need to respond to these behavioral differences was first encountered in elementary and college education.¹⁸ The result was a significant shift from a teacher-focused approach to a learner-focused one. Implementation of a learner-centered model of education as described by Weimer includes needs/baseline assessment, learners’ engagement, and autonomy and is supplemented by objective evaluation and feedback from teachers whose roles are changed to guides, coach, and mentors, diffusing the hierarchical models.¹ These principles of educational reform are being tested and implemented in some medical specialties with success.¹⁹⁻²²

David A. Kolb described 4 learning styles (accommodating, diverging, converging, and assimilating) that indicate how people perceive and assimilate learning experiences.²⁻⁴ While the most balanced style is at the point of intersection of these learning styles, where one would use all 4 styles equally, real-life situations vary. Studies have shown that one’s learning style changes as a learner develops and matures.^{3,10} Learners may skew toward one or more styles based on the requirements of their profession. For example, otolaryngology residents

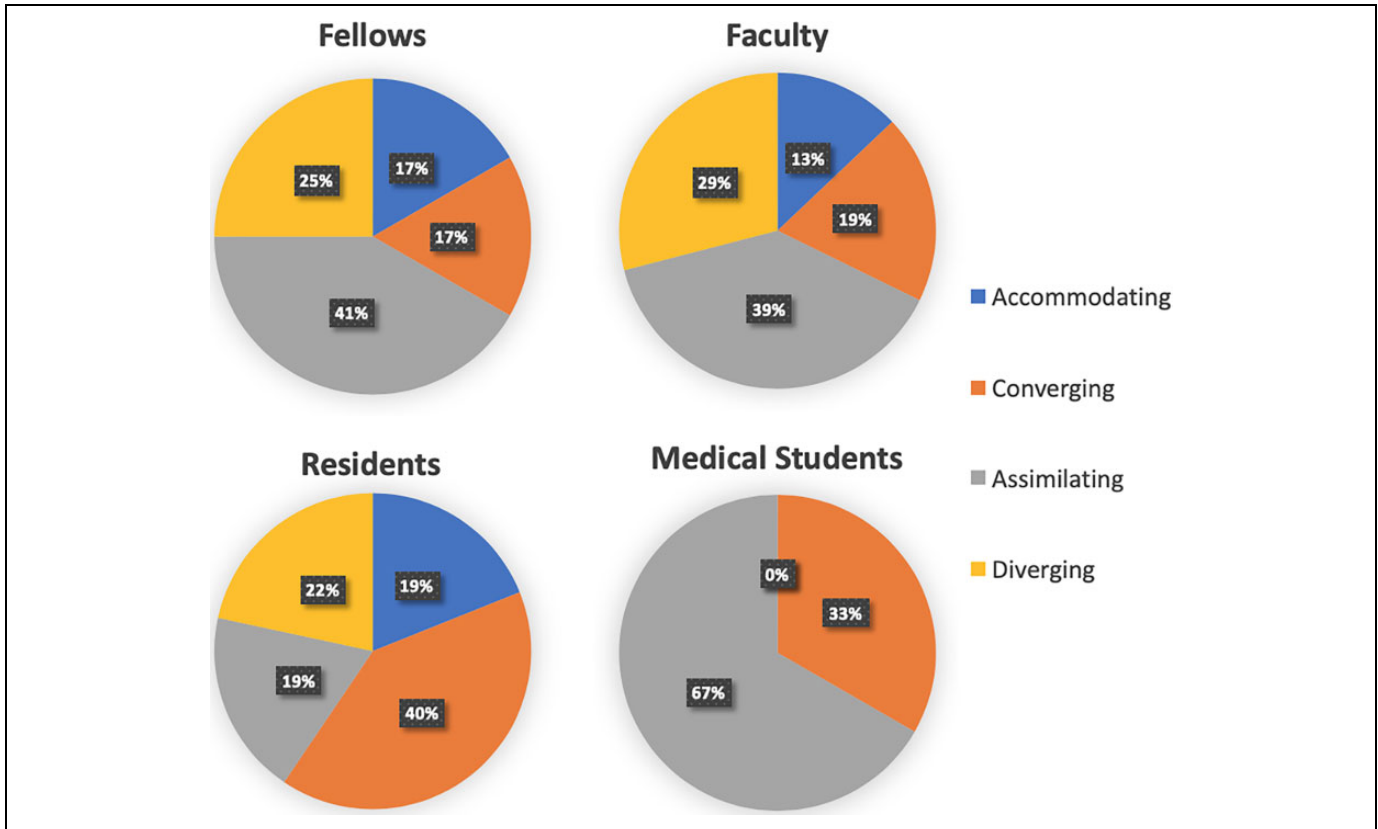


Figure 2. Distribution of learning styles among 4 groups of survey participants.

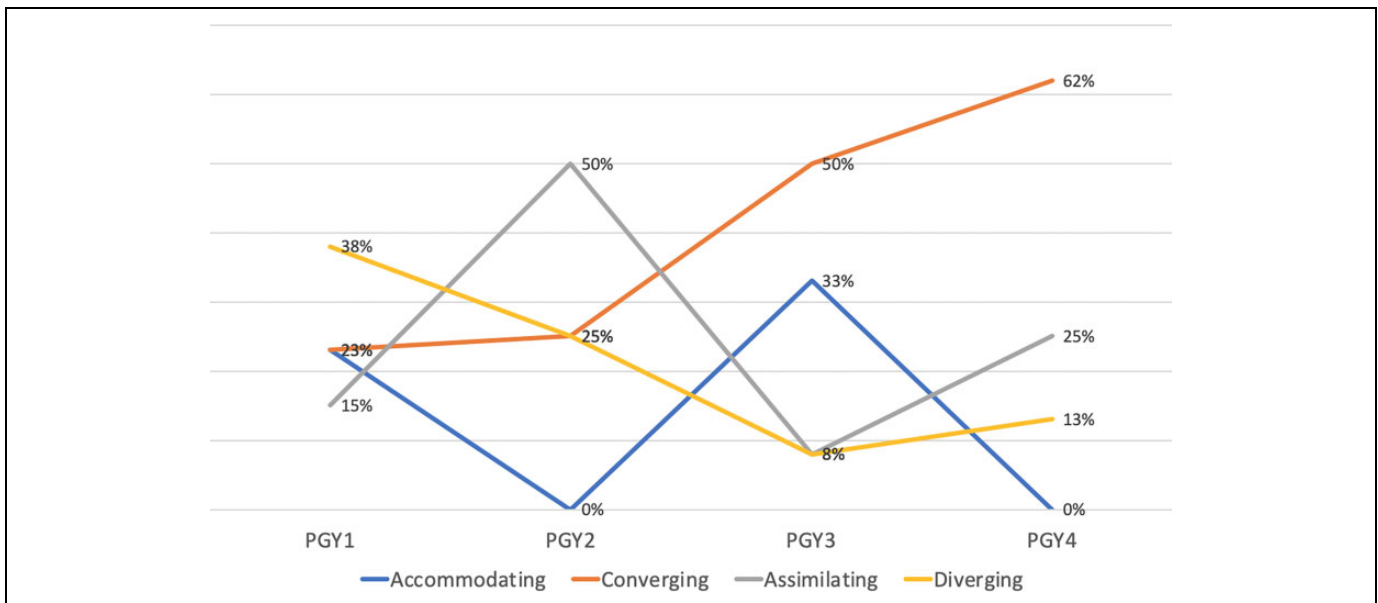


Figure 3. Learning styles distribution and trends among pathology residents, by each postgraduate year level.

are reported to have a preference for converging and accommodating learning styles while most of the otolaryngology fellows are at the center of the graph, with preference for a balanced style.^{8,10} Analysis of such learning curves allows opportunities for improved delivery of education to expedite

delivery and produce trainees that learn and train well above their PGY level thresholds.

One of the purposes of this study was to identify patterns of learning in pathology trainees before, during, and after residency. The results show that fellows and faculty learning styles

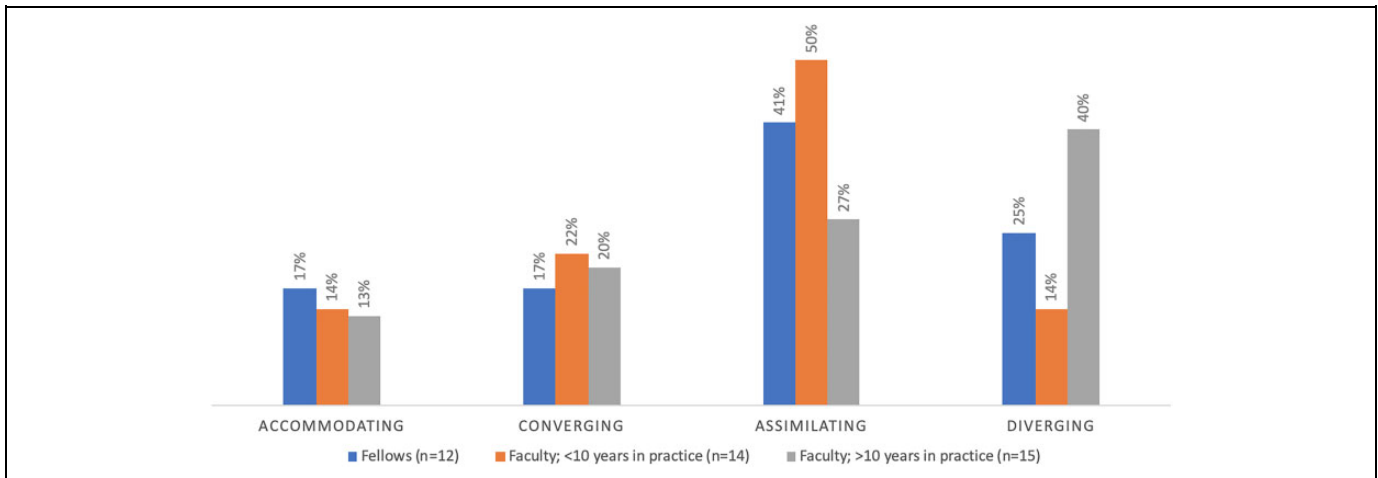


Figure 4. Comparison of learning style trends by years in practice.

were similar, both showing a preference for assimilating and diverging styles. It is fascinating to see this similarity, as when grouped together as “post residency,” both fellows and faculty having gained a baseline knowledge and maturity choose to experience pathology similarly to each other, with assimilating and diverging styles. Both these styles are on the right side of Kolb’s learning diagram (Figure 1) and indicate “learn by observation” behavior. The dominance of these styles is not surprising and results are consistent with pathology being a visual field, requiring meticulous observational skills. When faculty were stratified based on experience as shown in Figure 4, then those with over 10 years of experience showed a predominance of the *diverging* learning style. While previous studies have shown preference for “learning by observing” (assimilating and diverging) with increasing age and experience, the majority of these experienced learners adopted an *assimilating* style with increased conceptual thinking.^{4,23} However, our results show that as pathologists mature and gain experience, the application of prior experience to problem-solve (ie, diverging learning style) supercedes conceptual thinking (ie, assimilating learning style). This explains the instinctive and swift diagnostic acumen of senior and expert pathologists; one can observe in daily sign-out practice. This also underscores the fact that learning styles are not mutually exclusive and a considerable overlap of characteristics of adjacent learning styles exists on Kolb’s diagram.

In contrast to the faculty and the fellows, the residents in training showed a diametrically opposite learning style. The dominant style of residents was *converging* with more than half of the residents plotted on the left side of Kolb’s diagram (Figure 1), showing a “learn by doing” preference of learning style. This variance of learning styles between residents and fellows/faculty could be attributed to several factors. The difference could be purely generational, with the younger resident learners preferring the “learn by doing” mode versus the assimilating and diverging methods. However, the similarity between the fellow results and faculty results argues against this being the main reason for the difference, as there are generational differences between these 2

groups as well. In day-to-day clinical service, pathology residents are responsible for measuring, weighing, and cutting organs (ie, grossing specimens) and performing autopsies—these require manual and technical skill learning sets. In contrast, faculty and fellows are more likely to be involved in “nonlaborious” tasks such as slide previewing, data gathering, and case sign out. There might also be a component of selection bias in our cohort, as fellows at the LUMC program (and presumably most programs) function closer to faculty members rather than residents. Thus, pedagogical styles that require learners to “perform” rather than just “observe” are predominant in the resident cohort.

Another factor that influences residents’ styles is the transition from medical school to residency. In keeping with prior published reports from other specialties, the dominant learning styles of medical students in our study were *assimilating* and *converging*.^{9,11} This highlights that medical students interested in pathology did not differ from students interested in other specialties. Also, majority of pathology residents have little or no exposure to the practice of pathology as a subspecialty, and thus, a transition to residency from medical school can be a contributing factor of variance in learning styles while they are being acclimatized to pathology training. However, majority of PGY1 residents in this study were seen to have dominance of *diverging* style (38%), as seen in Figure 4. While the sample size of medical students in this study is small and results may not be generalizable, the abrupt transition of learning style could be due to several factors. Eight (61%) out of 13 of PGY1 residents in the current study were international medical graduates whose baseline learning style may be different than US medical students. Additionally, all of these international medical graduates showed a gap of more than 2 years since medical school graduation during which specific experiences may have also contributed to their learning style. Finally, the survey was conducted in the fall and time since start of residency may be another confounding variable.

This study also indicated a prevalence of the *converging* style of learning among senior pathology residents, highlighting a wide gap during the transition from residency into fellowship. Stratifying residents based on PGY level shows an

uneven, random distribution of learning styles. However, with increasing PGY levels, there is an overall upward trend toward adopting a *converging* style with a concurrent downslope of *diverging* style. This dominance of the *converging* style among residents is not specific to the field of pathology with similar results seen in general surgery, orthopedics, otolaryngology, and pediatric residents.^{5,6,8,9,11} These data are consistent with earlier reports showing an initial increase in preference for “learning by doing” up to middle age with subsequent decline in this type of learning preference.⁴ This change highlights the gap between senior faculty and trainees. A high prevalence of *diverging* style among faculty is in keeping with their role in disseminating large amounts of information based on their experience, while residents are accustomed to learning by conceptualization. As a result, the involvement of junior faculty in teaching can be greatly beneficial in creating a holistic learning environment, bridging the gap in learning (and possibly teaching) styles between learner and teacher.

While one published report in medicine has showed variability of learning styles based on few demographic features, our study did not show such correlation.⁶ A wide range of demographic variables in our study population created a relatively small sample size within each group that may have caused a failure to detect any such differences if they do exist in the field of pathology.

Data from this study indicate that there is a mixture of the 4 learning styles among pathology residents. Such a mixture of learning styles among residents provides opportunities for adopting a blended learning model, using strategies and approaches that address all 4 groups of learning styles. As most of the pathology trainees are on the left side of the Kolb’s diagram, they require active experimentation or involvement in the learning process. While curriculum development based solely to cater specific learning styles has shown variable results,^{24,25} active engagement of learners (one of the key principles of Weimer’s learner-centered model) has consistently shown improved outcomes.¹⁹⁻²² Therefore, the authors recommend a curriculum with a subset of senior-resident-led didactics, which would provide opportunities for active involvement of trainees, learner-centered educational process, and possibly bridge learning style gaps. A hybrid model involving case-based teaching, didactics, quiz, and slide sessions, which are a mixture of “faculty teaching residents” and “residents teaching residents,” would produce a collaborative learning environment, cater to all groups, and theoretically offer both learners and faculty an opportunity to adapt to different teaching methods. The aim is not to make everyone unidirectional or to conform to the same learning style, but to produce individuals who are able to develop skills to use all 4 learning styles as and when required.

Published reports show that similarity in personality traits is a contributing factor in success of a relationship.²⁶ People with similar learning styles also tend to communicate better.²⁷ These studies indicate that partnering trainees and faculty with similar learning styles has a potential for a successful mentorship program. A similarity in learning styles would help both sides have

a deeper understanding of one another, which could increase success of the mentor–mentee relationship and reduce failures based on possible mismatch.

It should be noted that learning style is only one of the metrics of one’s personality and other factors such as emotional intelligence, work and leadership style, and learning environment need to be explored as well. While the knowledge of intrinsic traits helps in assessment of learners’ profiles, modifying the learning environment accordingly has the most impact on one’s learning and assimilation of knowledge. This will also require the program to be dynamic and continually improve and adapt to new lots of residents entering the program every year and make changes accordingly. The change in the faculty’s role to facilitative educators can be fostered by continued faculty development. Additionally, developing tools to objectively evaluate diagnostic skills will help in formative feedback and provide assessment “for” learning, rather assessment “of” learning. To foster this change in educational approach, small and gradual steps towards a competency-based system are recommended. While the qualitative nature of the study and relatively small sample size with the majority of the participants from a single institution (participant bias) are the limitations associated with this work, this study attempts to provide insights into learning styles of pathology trainees and to initiate discussion on the topic and to provide future directions for improved learning experience.

Authors’ Note

This study was presented as a poster at the United States and Canadian Academy of Pathology Annual Meeting at Vancouver, British Columbia in March 2018. A.A. is a millennial, E.M.W. is a baby boomer, V.A. is a Gen-Xer, L.M. is a millennial, and K.M.M. is a Xennial.

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Declaration of Conflicting Interests

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