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Enhancing ophthalmology education using virtual reality: an experiential simulation lab curated for medical students by medical students

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Abstract

Purpose: Ophthalmology, though fundamental, is often sidelined in modern medical curricula—despite its complex anatomy and the looming shortage of ophthalmologists. To reimagine how students engage with this vital field, we developed and evaluated an immersive, peer-led virtual reality (VR) simulation lab designed to enhance first-year medical students' understanding, confidence, and enthusiasm for ophthalmology at Loyola University Chicago Stritch School of Medicine.
Methods: Forty-two first-year students participated in a 1-hour session combining foundational didactics with experiential learning at 3 interactive VR stations. These featured the OcuSim app via Oculus headsets, stereoscopic EyeSim modules, and the iBench 3D ZSpace platform. Guided by senior students and residents, participants explored ocular anatomy, pathology, and neurovisual pathways in an immersive format. Pre- and post-session surveys and assessments captured changes in confidence, knowledge, and clinical reasoning. Statistical analysis utilized Wilcoxon signed-rank and McNemar chi-square tests.

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Results: The intervention yielded marked improvements across cognitive and affective domains. Confidence in labeling ocular anatomy rose from a mean of 2.7 to 3.5 ($p < 0.01$), and visual pathway comprehension improved from 2.3 to 3.3 ($p < 0.01$). Objective assessments confirmed gains in anatomical labeling and interpretation of neuro-ophthalmic deficits, including cranial nerve III palsies and Meyer's loop lesions. Notably, 100% of students answered cranial nerve III-related questions correctly post-intervention, up from 78.6%. Feedback highlighted the lab's novelty, relevance, and its capacity to make complex content intuitive and engaging.
Conclusion: This student-led VR simulation lab transcends traditional teaching by blending clinical relevance with cutting-edge interactivity. It significantly boosts anatomical comprehension, clinical reasoning, and learner confidence—while igniting interest in an underserved specialty. As immersive technology becomes more accessible, this model offers a scalable blueprint for transforming medical education with impact and innovation.

Keywords: anatomy education, medical student curriculum, ophthalmology education, virtual reality

Introduction

Virtual reality (VR) technology has increasingly gained acceptance as a training tool across various medical specialties.[1,2] Although several systematic reviews have shown the utility of VR in ophthalmic education in surgical residency training, the technology has yet to be appropriately integrated into the medical school curriculum.[3–8] Ophthalmology education at the medical school level is particularly well-suited for VR technology due to the intricate nature of ocular anatomy and pathologies that are best visualized with specialized and costly equipment typically inaccessible to students.[9,10] Our study proposes integrating a VR simulation lab into the first-year medical student anatomy curriculum to offer a novel platform for students to actively engage with and better comprehend the intricacies of ocular anatomy more effectively. In the past several decades, ophthalmology education and exposure has been exceedingly low,[1,11,12] having only a marginal obligatory role after the 1910 Flexner report.[13] As numerous educational institutions adopt abbreviated preclinical periods, ophthalmology education finds itself marginalized within mandatory curricula, often relegated to extracurricular pursuits such as interest groups and student advising.[1] Even outside of the preclinical years, an Association of the University Professors in Ophthalmology (AUPO) survey reported a 38% decrease in schools that required a formal ophthalmology rotation from 2000 to 2004.[14] Collectively, this is concerning considering the Health Resources and Services Administration's (HSRA) Health Workforce

Simulation Model predicts a considerable shortage of ophthalmologists by 2035.[15] Several studies have shown that early exposure to specialized fields, such as radiology and neurosurgery, led to an increase in the desire to pursue these fields.[16,17] With this in mind, the aim of our simulation lab was not only to impart knowledge to medical students, but also to offer them exposure that may foster an interest in the field of ophthalmology.

Furthermore, prior research has emphasized the necessity of targeted educational interventions to enhance confidence levels, particularly in mastering physical examination skills.[18] Notably, studies have indicated that medical students' performance is not solely dependent on their knowledge base but also on their level of confidence.[19] VR learning modalities have emerged as promising tools in this regard, with evidence suggesting their efficacy in bolstering confidence levels, particularly in anatomical understanding.[20] As such, the integration of VR technologies into medical education holds promise for addressing the multi-faceted aspects of student learning and performance, especially in fields where students have limited exposure, such as ophthalmology.

Our innovative curriculum endeavors to enrich student comprehension and engagement by providing a vivid and interactive learning experience that aligns with technological advancements in medical education. Centered around a peer-led VR ocular anatomy simulation lab, the curriculum aims not only to deepen students' understanding of ocular anatomy and pathologies, but also to revolutionize conventional medical education practices.

To our knowledge, this is the first study of its kind to explore the unique capabilities of VR technology administered to medical students by medical students in an academic ophthalmology anatomy course setting. In this study, we aim to demonstrate the possibility for a lasting curricular change for our university and others.

Methods

Problem identification

Our study identifies a deficiency in practical and immersive education for first-year medical students, following the Kern 6-step approach for curriculum development.[21] Traditional methods frequently fail to adequately convey the intricacies of ocular anatomy and pathology. Recognizing the necessity for a more thorough exploration of the eye, encompassing both its anatomical structure and associated pathologies, we have developed an approach aimed at providing students with a more comprehensive understanding. By leveraging VR technology, we offer an opportunity to visualize and interact with complex eye structures and pathologies, facilitating a deeper and more intuitive comprehension.

Table 1. Responses to the 2022 assessment

Measured outcome	Pre-assessment ($N = 48$)	Post-assessment ($N = 22$)
Median anatomy confidence (IQR)	3 (3–4)	3 (2–4)
Median pathway confidence (IQR)	3 (3–4)	3 (2–4)
CN3 correct	38 (79.2%)	21 (95.5%)
Median anatomy labeling (IQR)	6 (3 – 9)	9 (7–9)
Median visual pathway labeling (IQR)	5 (4 – 7)	7 (6–7)

IQR = Interquartile range
CN3= Cranial Nerve 3
Binary responses are summarized as count with proportions.
Participants' pre-and-post responses could not be linked. For this reason, no null hypothesis tests were conducted.

Needs assessment of targeted learners: pilot study

The data analysis from our pilot program at the Loyola University Chicago Stritch School of Medicine in November 2022 yielded promising results. A total of 48 students completed a pre-session survey, while 22 students completed a post-session survey. Although we were unable to link the participants' pre- and post-survey responses and therefore could not conduct null hypothesis testing, our summary statistics indicated improvement in all 3 assessment questions (Table 1). Additionally, students perceived the 2022 session as a valuable use of their time, as evidenced by their comments in the survey's dedicated section. The majority of participants reported that the program enhanced their ophthalmic knowledge and expressed a desire for VR to be incorporated into more educational sessions across various disciplines in addition to ophthalmology. This observation underscored the need for further investigation, thereby providing a strong foundation for the rationale behind our study.

Goals and measurable objectives

This study aimed to investigate the efficacy of a VR based ophthalmic simulation in enhancing the knowledge, skills, and confidence of first-year medical students. Objectives included improving engagement and enhancing understanding of ocular anatomy and pathology as well as the visual pathway through VR simulation, with 4 specific aims:

1. Increase learner engagement through an immersive and interactive teaching method.
2. Improve students' spatial understanding of complex anatomical structures.
3. Provide clinical relevance through virtual patients with pupil and cranial nerve pathologies.

4. Increase exposure to the field of ophthalmology early in medical students' preclinical years

Educational strategies

The VR curriculum integrates traditional lectures with immersive virtual reality modules to offer a comprehensive and interactive learning experience in ophthalmology. The program begins with a lecture delivered by an attending ophthalmologist, covering essential knowledge of ocular anatomy and visual pathways. This foundational learning is brought to life in the stereo classroom, where students use 3D glasses to interact with EyeSim software (A Nu Reality Inc., Oakbrook, IL, USA) navigating through detailed images of the eye's anatomy. This setup allows students to explore complex structures dynamically, simulating a virtual dissection.

Students further engage with the iBench 3D ZSpace Monitor (zSpaceInc., San Jose, CA, USA), a large, mobile holographic display in the skills transfer lab. This advanced virtual patient simulator enables students to perform virtual dissections, explore eye pathology, and practice eye exam skills in a clinically relevant setting. Equipped with motion-sensing 3D glasses, students can rotate and zoom images through head movements, deepening their understanding of ocular anatomy and visual pathways. This hands-on experience bridges the gap between theoretical knowledge and practical application, particularly in diagnosing conditions such as cranial nerve III palsy and Horner syndrome.

The curriculum is further enriched with Oculus headset (Reality Labs, Menlo Park, CA, USA) modules designed to create an immersive virtual study room. Here, students can virtually teleport themselves to different parts of the room and examine the eye from various angles. This approach allows for a detailed and interactive exploration of ocular structures, integrating visual, tactile, and auditory elements to enhance the learning experience. The Oculus-based modules focus on glaucoma and retinal anatomy, enabling students to identify angle anatomy, analyze optic nerve pathology, and visualize the mechanisms of glaucoma and retinal function in a 3D environment.

This innovative approach ensures that students gain a deep, practical understanding of ocular anatomy and pathology, consistent with the proficiency level expected of first-year medical students.3-5 The active participation of medical student leaders, residents, and faculty members fosters an engaging and sustainable learning environment, ensuring the program's continuity and adaptability for future cohorts.

Implementation of VR

Participants engaged in a dynamic, 3-station rotation led by residents, second-, third-, and fourth-year medical students. Stations included:

1. Teaching session conducted by an ophthalmologist using 3D models.

2. The OcuSim app installed on an Oculus headset with demonstrations of trabecular meshwork anatomy and the causes of glaucoma.
3. Interaction with a virtual patient on stereoscopic computer screens.

Activities encompassed exploring and interacting with stereoscopic virtual models of the eye, as well as practicing eye exam skills on a virtual patient. The Oculus headsets incorporated the OcuSim app's Retina module, offering a 3D perspective on retinal anatomy, including the structure and function of the retina and choroid, while the Glaucoma module provided insights into trabecular meshwork anatomy and the pathology causing glaucoma.

Evaluation and feedback for the VR curriculum

We used pre- and post-session surveys (Appendix A and B) and objective testing to assess changes in students' understanding, followed by statistical analysis via 2-tailed paired t-tests. The surveys aimed to:

1. Assess the practicality and effectiveness of the VR curriculum.
2. Identify areas for improvement.
3. Evaluate the potential long-term role of VR in the ophthalmology component of the anatomy curriculum.

The survey questions were aligned with our curricular educational objectives. Self-reported measures included Likert scale questions where students rated their confidence in understanding ocular anatomy and visual pathways before and after the sessions, providing insight into their perceived learning. The objective assessments were based on multiple-choice questions that tested students' ability to identify anatomical structures and interpret clinical scenarios related to cranial nerve lesions and visual field defects.

Forty-two students were enrolled in the study. Participation was voluntary and anonymous, with assurances that responses would not affect the grade students received in the anatomy course. This study received exemption status from the Institutional Review Board.

Results

Significant advancements were evident across multiple domains after the VR anatomy sessions (Table 2). Our results combined both self-reported measures and objective grading to evaluate the impact of the VR-based ophthalmology education program.

Figure 1 delineates a significant improvement in the students' confidence to accurately label ocular anatomy, with mean confidence level increasing from 2.7/5 (SD = 1.1, median = 3) pre-workshop to 3.5/5 (SD = 0.802, median = 4) post-workshop ($p < 0.01$). Similarly, Figure 2 demonstrates a substantial elevation in the participants' self-reported confidence levels regarding the understanding of the

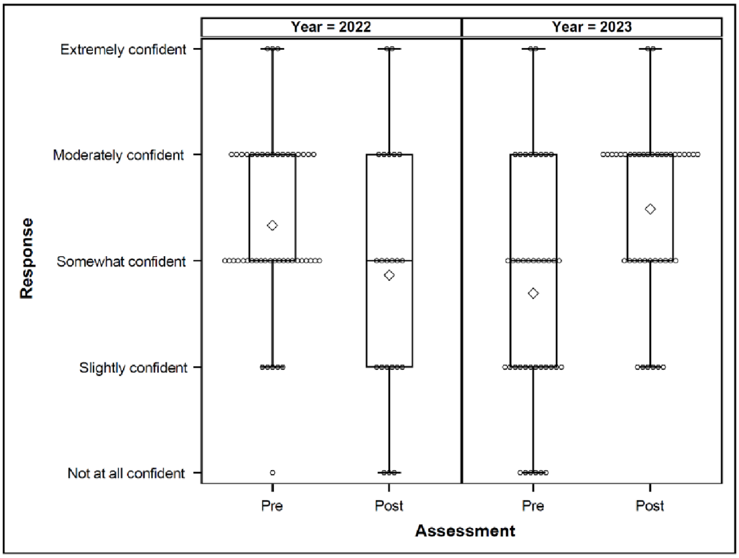

Fig. 1. Self-reported confidence levels in ocular anatomy labeling before and after a virtual reality simulation workshop (2022 and 2023 cohorts).

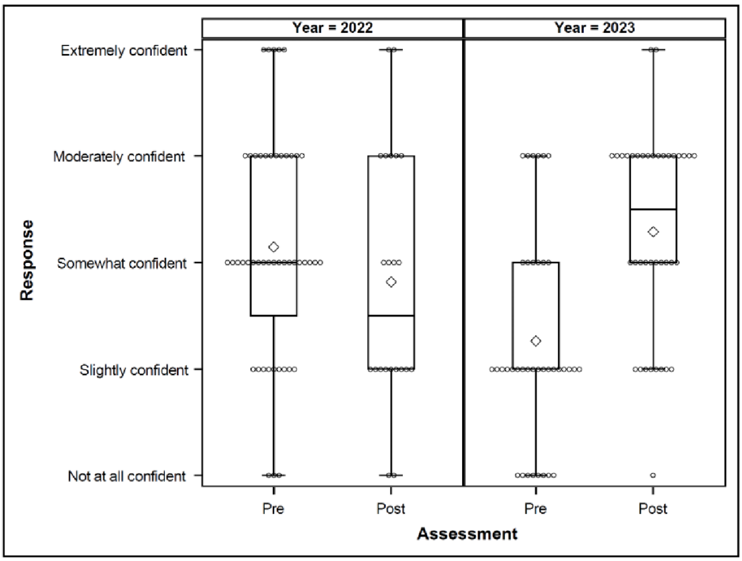

Fig. 2. Self-reported confidence levels in labeling the visual pathway before and after a virtual reality workshop (2022 and 2023 cohorts).

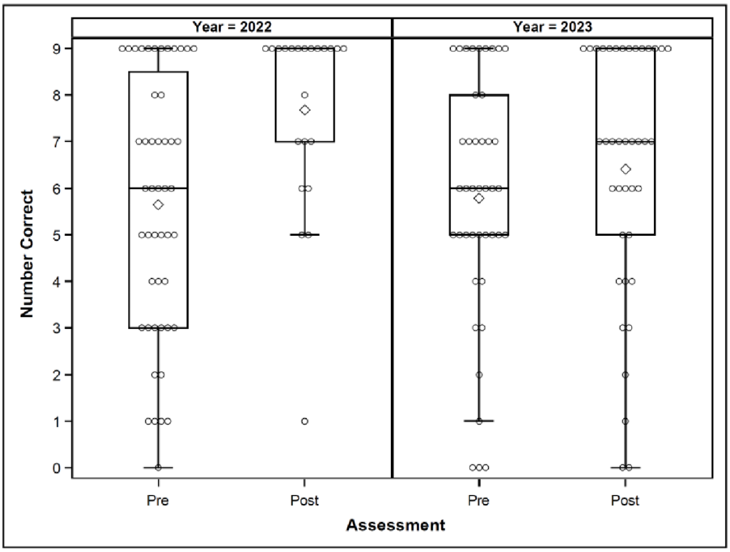

Fig. 3. Pre- and post-workshop accuracy in labeling ocular anatomical structures (out of 9), including the retina, choroid, cornea, sclera, ciliary body, iris, optic nerve, lens, and pupil (2022 and 2023 cohorts).

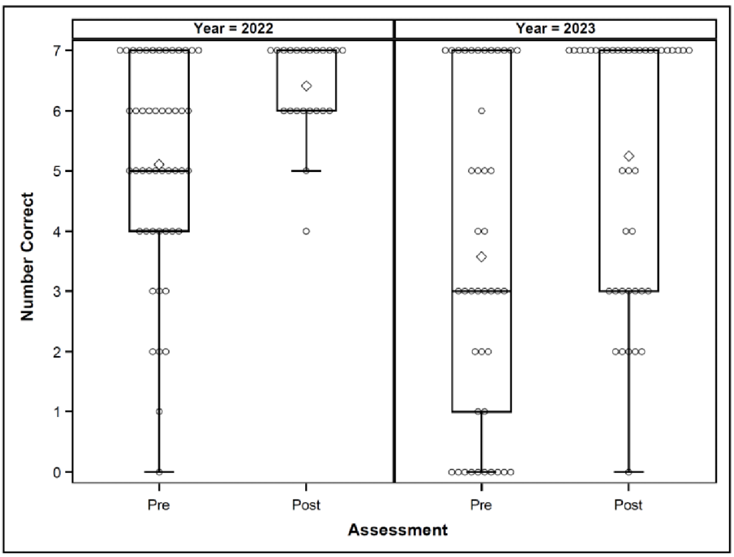

Fig. 4. Pre- and post-workshop accuracy in labeling visual pathway structures (out of 7), including the optic radiation, optic chiasm, optic nerve, visual cortex, retina, lateral geniculate nucleus, and optic tract (2022 and 2023 cohorts).

visual pathway, with an increase of 2.3/5 (SD = 0.96, median = 2) pre-workshop to 3.3/5 (SD = 0.92, median = 3) post-workshop ($p < 0.01$). Furthermore, the students demonstrated enhanced accuracy in labeling both ocular anatomy and the visual pathway (Figs. 3 and 4, respectively). Ocular anatomy labeling increased from a mean of 6.5/9 (SD = 2.3, median = 6) to 6.9/9 (SD = 2.3, median = 7), while visual pathway labeling increased from a mean of 4.6/7 (SD = 2.7, median = 3) to a mean of 6.2/7 (SD = 2.2, median = 7) post-workshop ($p < 0.05$). Additionally, students scored significantly higher on 3/5 multiple-choice questions on physiology and pathology related to ocular anatomy, including questions about cranial nerve III defects, Meyer's loop, and bones of the orbit ($p < 0.05$) (Table 2).

Table 2. Responses to the 2023 assessment

Measured outcome	Valid *N*	Pre-assessment	Post-assessment	*p*
Median anatomy confidence (IQR)	38	3 (2 – 3)	4 (3–4)	< 0.001
Median pathway confidence (IQR)	34	2 (2 – 3)	3 (3–4)	< 0.001
CN3 correct	42	33 (78.6%)	42 (100.0%)	0.004
Optic chiasm correct	41	23 (56.1%)	27 (65.9%)	0.39
Meyer's loop correct	42	14 (33.3%)	33 (78.6%)	< 0.001
Orbit correct	42	32 (76.2%)	39 (92.9%)	0.02
Horner correct	42	41 (97.6%)	41 (97.6%)	NA
Median anatomy labeling (IQR)	39	6 (5–7)	7 (5–9)	.02
Median visual pathway labeling (IQR)	41	3 (1–7)	7 (3–7)	< 0.001

Valid *N*: The number of participants used for the estimates; IQR: Interquartile range; NA; Significance value is not available, because there are no discordant responses
Wilcoxon signed-rank test was used to compare pre- and post-quantitative responses.
Exact McNemar chi-square test was used to compare pre-and post binary responses.

Discussion

The implementation and evaluation of VR simulation in medical education at Loyola University Chicago Stritch School of Medicine represents a thorough investigation into the pedagogical benefits of incorporating VR technology into the ophthalmology education curriculum for first-year medical students.

Our statistical analysis revealed a substantial improvement in multiple-choice questions related to ocular anatomy, indicating enhanced spatial conceptualization among participants. Moreover, the observed increase in confidence levels in labeling ocular anatomy and the visual pathway suggests that the immersive VR workshop holds promise for augmenting both knowledge acquisition and its practical application.[22–24]

Given the limited exposure of medical students to ophthalmology education, the implementation of effective methodologies to bolster confidence in their knowledge becomes imperative, thus heightening the likelihood of applying these skills in practice. Consequently, the integration of clinical workshops such as the one detailed in this study into medical education curricula assumes paramount importance in bridging the gap between theoretical knowledge and clinical proficiency, thereby better equipping students for real-world practice.

Beyond its educational merits, incorporating VR simulation in the ophthalmology curriculum has significant implications for the future of medical training. While VR offers the potential to enhance the quality and accessibility of medical education, it’s important to acknowledge that its implementation could widen the gap between institutions with varying resources. Schools with the means to invest in VR technology may provide more advanced learning experiences, potentially increasing educational disparities. However, as VR becomes more widespread and affordable, its adoption could reduce costs and make it accessible to a broader range of institutions. By expanding access and continuing to innovate, VR can become a valuable investment in medical education, ensuring students across diverse settings benefit from high-fidelity simulations.

However, it is essential to acknowledge certain limitations in this study. The single-session format may limit the extrapolation of findings to sustained educational impacts over an extended duration. Additionally, the generalizability of outcomes is constrained by the specific cohort of first-year medical students and may necessitate broader sampling for comprehensive applicability. Future research efforts could consider longitudinal assessments to delineate the longevity of observed improvements.

Nonetheless, the positive influence on participants’ comprehension of ocular pathophysiology, coupled with the evident boost in confidence levels, highlights the potential of VR technology to transform traditional educational approaches in ophthalmic training.[25,26] By adding empirical evidence to the existing literature, this study contributes to the growing body of research advocating for the efficacy of VR in enhancing medical training.[3-5]

In conclusion, this study presents compelling evidence supporting the efficacy of VR technology within ophthalmology education for first-year medical students. This research contributes to the ongoing discourse on the transformative impact of VR technology in medical education and its ability to enhance anatomical education through innovative and immersive modalities.

Declarations

Ethics approval and informed consent

This study received exemption status from the Institutional Review Board.

Competing interests

The authors declare that they have no competing interests.

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References

1. Haowen J, Vimalesvaran S, Myint Kyaw B, Tudor Car L. Virtual reality in medical students' education: a scoping review protocol. BMJ Open. 2021 May 26;11(5):e046986. https://doi.org/10.1136/bmjopen-2020-046986
2. Oh YB, Kim GW, Han KS, et al. Efficacy of Virtual Reality Combined With Real Instrument Training for Patients With Stroke: A Randomized Controlled Trial. Arch Phys Med Rehabil. 2019;100(8):1400-1408. https://doi.org/10.1016/j.apmr.2019.03.013
3. Ong CW, Tan MCJ, Lam M, Koh VTC. Applications of Extended Reality in Ophthalmology: Systematic Review. J Med Internet Res. 2021 Aug 19;23(8):e24152. https://doi.org/10.2196/24152
4. Karbasi Z, Niakan Kalhori SR. Application and evaluation of virtual technologies for anatomy education to medical students: A review. Med J Islam Repub Iran. 2020;34:163. Published 2020 Dec 3. https://doi.org/10.47176/mjiri.34.163
5. Uruthiralingam U, Rea PM. Augmented and Virtual Reality in Anatomical Education - A Systematic Review. Adv Exp Med Biol. 2020;1235:89-101. https://doi.org/10.1007/978-3-030-37639-0_5

6. Lee R, Raison N, Lau WY, et al. A systematic review of simulation-based training tools for technical and non-technical skills in ophthalmology. Eye. 2020 Oct 13;34(10):1737-59. https://doi.org/10.1038/s41433-020-0832-1
7. Ng DS, Yip BHK, Young AL, et al. Cost-effectiveness of virtual reality and wet laboratory cataract surgery simulation. Medicine. 2023 Oct 6;102(40):e35067. https://doi.org/10.1097/MD.0000000000035067
8. Mondal S, Kelkar AS, Singh R, Jayadev C, Saravanan VR, Kelkar JA. What do retina fellows-in-training think about the vitreoretinal surgical simulator: A multicenter survey. Indian J Ophthalmol. 2023 Aug;71(8):3064-8. https://doi.org/10.4103/IJO.IJO_381_23
9. Nguyen AAK, Tsui E, Smith JR. Social media and ophthalmology: A review. Clin Exp Ophthalmol. 2022 May 12;50(4):449-58. https://doi.org/10.1111/ceo.14091
10. Moxon NR, Goyal A, Giaconi JA, et al. The State of Ophthalmology Medical Student Education in the United States: An Update. Ophthalmology. 2020 Nov;127(11):1451-3. https://doi.org/10.1016/j.ophtha.2020.05.001
11. Kalina RE, Van Dyk HJ, Weinstein GW. Ophthalmology teaching in medical schools. Academic Medicine. 1981 Feb;56(2):143-5. https://doi.org/10.1097/00001888-198102000-00014
12. Shah M, Knoch D, Waxman E. The State of Ophthalmology Medical Student Education in the United States and Canada, 2012 through 2013. Ophthalmology. Jun 2014;121(6):1160-3. https://doi.org/10.1016/j.ophtha.2013.12.025
13. Higginbotham EJ. Assessing the Status of Ophthalmic Education 100 Years After the Flexner Report. Arch Ophthalmol. 2010 Dec 13;128(12):1600. https://doi.org/10.1001/archophthalmol.2010.280
14. Quillen DA, Harper RA, Haik BG. Medical Student Education in Ophthalmology: Crisis and Opportunity. Ophthalmology. 2005 Nov;112(11):1867-8. https://doi.org/10.1016/j.ophtha.2005.05.005
15. Berkowitz ST, Finn AP, Parikh R, Kuriyan AE, Patel S. Ophthalmology Workforce Projections in the United States, 2020 to 2035. Ophthalmology. 2024 Feb;131(2):133-9. https://doi.org/10.1016/j.ophtha.2023.09.018
16. Branstetter BF, Faix LE, Humphrey AL, Schumann JB. Preclinical Medical Student Training in Radiology: The Effect of Early Exposure. American Journal of Roentgenology. 2007 Jan;188(1):W9-14. https://doi.org/10.2214/AJR.05.2139
17. Zuckerman SL, Mistry AM, Hanif R, et al. Neurosurgery Elective for Preclinical Medical Students: Early Exposure and Changing Attitudes. World Neurosurg. 2016 Feb;86:120-6. https://doi.org/10.1016/j.wneu.2015.08.081
18. Wu EH, Fagan MJ, Reinert SE, Diaz JA. Self-Confidence in and Perceived Utility of the Physical Examination: A Comparison of Medical Students, Residents, and Faculty Internists. J Gen Intern Med. 2007 Nov 16;22(12):1725-30. https://doi.org/10.1007/s11606-007-0409-8
19. Mavis B. Self-efficacy and OSCE performance among second year medical students. Advances in Health Sciences Education. 2001;6(2):93-102. https://doi.org/10.1023/A:1011404132508
20. Brown KE, Heise N, Eitel CM, et al. A Large-Scale, Multiplayer Virtual Reality Deployment: A Novel Approach to Distance Education in Human Anatomy. Med Sci Educ. 2023 Feb 16;33(2):409-21. https://doi.org/10.1007/s40670-023-01751-w
21. Thomas PA, Kern DE, Hughes MT, Chen BY. Curriculum Development for Medical Education: A Six-Step Approach. Johns Hopkins University Press; 2016.

22. Vihos J, Chute A, Carlson S, Shah M, Buro K, Velupillai N. Virtual Reality Simulation in a Health Assessment Laboratory Course: A Mixed-methods Explanatory Study Examining Student Satisfaction and Self-confidence. Nurse Educ. 2024;49(6):E315-E320. https://doi.org/10.1097/NNE.0000000000001635
23. Taysi AE, Taysi NM, Sismanoglu S. Evaluation of the efficacy of a simulation model used in oral and maxillofacial surgery education. BMC Med Educ. 2024 Mar 19;24(1):310. https://doi.org/10.1186/s12909-024-05307-3
24. Yu JH, Chang HJ, Kim SS, et al. Effects of high-fidelity simulation education on medical students' anxiety and confidence. PloS One. 2021 May 13;16(5):e0251078. https://doi.org/10.1371/journal.pone.0251078
25. Deuchler S, Dail YA, Koch F, et al. Efficacy of Simulator-Based Slit Lamp Training for Medical Students: A Prospective, Randomized Trial. Ophthalmol Ther. 2023 Aug 9;12(4):2171-86. https://doi.org/10.1007/s40123-023-00733-w
26. Tso HL, Young J, Yung CW. Comparing Eyesi Virtual Reality Simulator and Traditional Teaching Methods for Direct Ophthalmoscopy: Students' Perspectives at Indiana University School of Medicine. Journal of Academic Ophthalmology. 2021 Jan 27;13(01):e66-72. https://doi.org/10.1055/s-0041-1726349

Appendix

A. M1 VR Lab PRE-test 2023

1. Rate your understanding of the visual pathways (1 being the lowest understanding, 5 being the best understanding)

1 2 3 4 5

2. Rate your understanding of the anatomy of the eye (1 being the lowest understanding, 5 being the best understanding)

1 2 3 4 5

3. If cranial nerve III is lesioned, what happens to the eye?
   a. Down and in
   b. Down and out
   c. Up and in
   d. Up and out

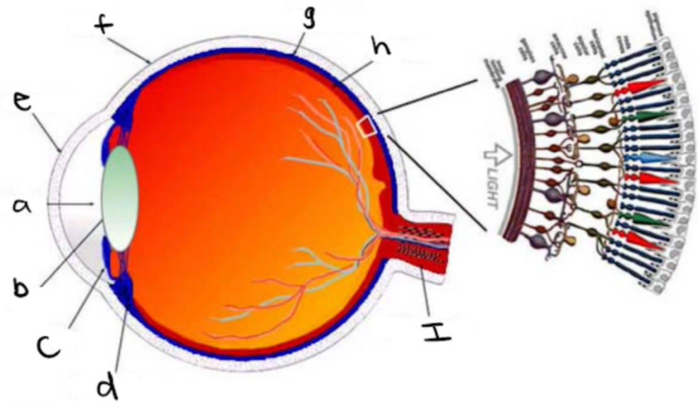
4. A lesion to the optic chiasm would cause which of the following visual field defects?
   a. Monocular vision loss
   b. Contralateral homonymous hemianopia
   c. Contralateral superior quadrantopia (“pie in the sky”)
   d. Bilateral hemianopia

5. A lesion to the inferior optic radiations (Meyer’s loop) results in which of the following visual field defects?
   a. Monocular vision loss
   b. Contralateral homonymous hemianopia
   c. Contralateral superior quadrantopia (“pie in the sky”)
   d. Bilateral hemianopia

6. Which correctly identifies the bones of the medial wall of the orbit?
   a. Ethmoid, Lacrimal, maxillary, sphenoid
   b. Zygomatic, sphenoid
   c. Frontal, sphenoid
   d. Maxillary, palatine, zygomatic

7. Which correctly identifies the triad seen in Horner's syndrome?
    a. Ptosis, mydriasis, anhidrosis
    b. Ptosis, miosis, anhidrosis
    c. Exophthalmos, miosis, anhidrosis
    d. Nystagmus, mydriasis, strabismus

8. Please label the following:



Retina	Choroid	Cornea	Sclera	Ciliary Body	Iris	Optic Nerve	Lens	Pupil
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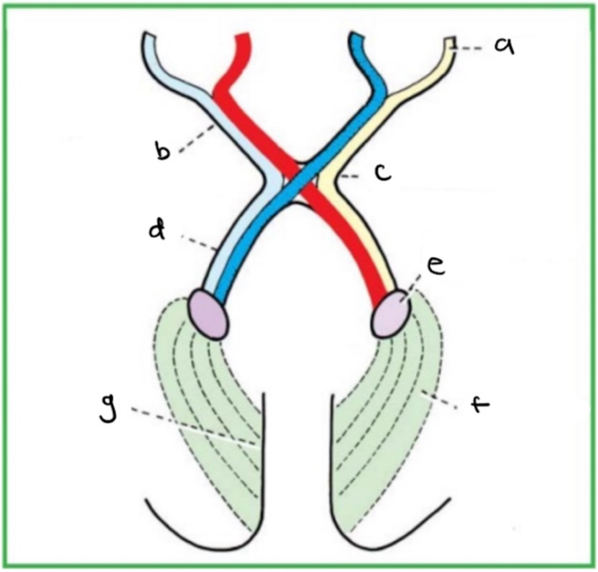
9. Please label the following



Optic Radiation	Optic Chiasm	Optic Nerve	Visual Cortex	Retina	Lateral Geniculate Nucleus	Optic Tract
___	___	___	___	___	___	___

B. M1 VR Lab POST-test 2023

1. Rate your understanding of the visual pathways (1 being the lowest understanding, 5 being the best understanding)

1 2 3 4 5

2. Rate your understanding of the anatomy of the eye (1 being the lowest understanding, 5 being the best understanding)

1 2 3 4 5

3. Would you recommend this opportunity for next year's class
   a. yes
   b. no

4. If cranial nerve III is lesioned, what happens to the eye?
   a. Down and in
   b. Down and out
   c. Up and in
   d. Up and out

5. A lesion to the optic chiasm would cause which of the following visual field defects?
   a. Monocular vision loss
   b. Contralateral homonymous hemianopia
   c. Contralateral superior quadrantopia ("pie in the sky")
   d. Bilateral hemianopia

6. A lesion to the inferior optic radiations (Meyer's loop) results in which of the following visual field defects?
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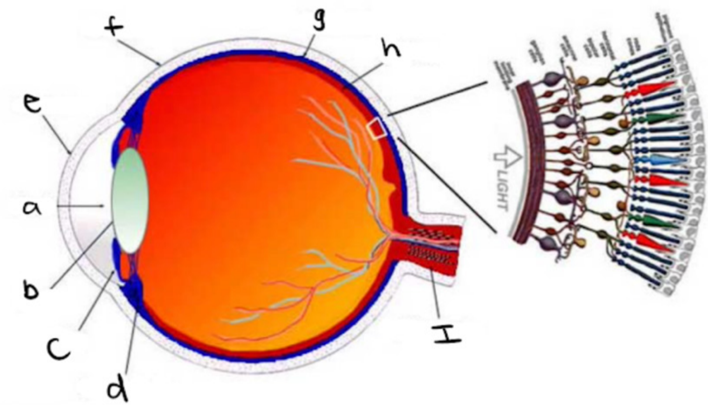
   c. Frontal, sphenoid
   d. Maxillary, palatine, zygomatic

8. Which correctly identifies the triad seen in Horner syndrome?
    a. Ptosis, mydriasis, anhidrosis
    b. Ptosis, miosis, anhidrosis
    c. Exophthalmos, miosis, anhidrosis
    d. Nystagmus, mydriasis, strabismus

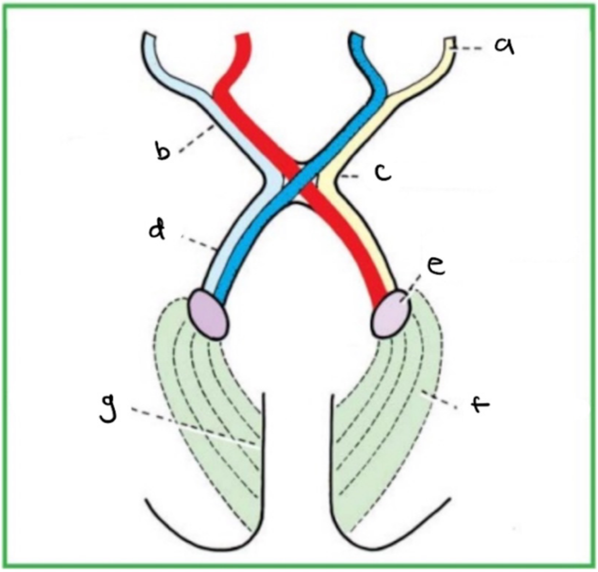
9. Please label the following:



Retina	Choroid	Cornea	Sclera	Ciliary Body	Iris	Optic Nerve	Lens	Pupil

____ ____ ____ ____ ____ ____ ____ ____ ____

10. Please label the following



Optic Radiation	Optic Chiasm	Optic Nerve	Visual Cortex	Retina	Lateral Geniculate Nucleus	Optic Tract
___	___	___	___	___	___	___

C. Video overview of the ophthalmology virtual reality workshop for first-year medical students

This video provides a comprehensive overview of the innovative VR workshop for first-year medical students, designed to enhance comprehension of ocular anatomy and ophthalmologic physiology. Through interviews with participating medical students and session organizers, the video underscores the effectiveness of immersive VR technology in facilitating the visualization of intricate anatomical structures and physiological processes. Accompanied by live footage from the workshop sessions, the video demonstrates the transformative potential of VR in medical education, highlighting its capacity to improve student engagement and learning outcomes in the field of ophthalmology.