COMMENTARY ARTICLE

Precision Education-The Future of Medical Education

Senthil Kumar Rajasekaran

Vice Dean for Academic and Clinical Affairs and Professor of Medicine Department of Medical Sciences Khalifa University College of Medicine and Health Sciences, Abu Dhabi, UAE. Adjunct Faculty, Wayne State University School of Medicine, Detroit, MI. Affiliate Faculty, Harvard T.H. Chan School of Public Health, Harvard University.

Correspondence to *Senthil Kumar Rajasekaran MD., MMHPE., FCP., FAcadMed, ice Dean for Academic and Clinical Affairs and Professor of Medicine Department of Medical Sciences Khalifa University College of Medicine and Health Sciences, Abu Dhabi, UAE.*
E-mail: ....

Abstract

The rapid integration of artificial intelligence (AI) in education presents a transformative opportunity to reevaluate traditional models, particularly in the realm of physician training. Despite advancements in active learning techniques, medical education largely adheres to a standardized approach, overlooking individual variations in baseline knowledge and learning preferences. As competency-based medical education gains prominence, addressing the unique needs of individual learners becomes imperative. This commentary advocates for the implementation of Precision Education (PE) in medical schools—a paradigm shift that tailors content and assessments to individual learners. PE leverages longitudinal data and learner analytics to drive personalized interventions, enhancing educational, clinical, and system outcomes. The commentary explores the impact of PE on learning outcomes, emphasizing its role in optimizing learning paths, fostering learner engagement, and promoting efficient use of time both for the faculty and the learners. Notably, PE aligns with the principles of evidence-based medicine and requires effective use of data analytics for predictive insights and actionable interventions. The equitable application of PE is crucial in addressing disparities in medical education outcomes, necessitating careful consideration of potential biases and the co-creation of interventions with and or by a diverse set of learners. The commentary also delves into practical strategies and tools, including adaptive learning platforms, learner analytics dashboards, and integration with electronic health records. However, it acknowledges barriers such as suboptimal learner engagement and the need for faculty involvement in tailoring interventions. While presenting promising evidence, the field of precision education is still evolving, requiring further research to comprehensively understand its impact, especially in the specific context of medical education. As AI continues to advance, the integration of PE in medical education stands to benefit from refined instructional design, and continuous assessment and improvement of personalized approaches.

Journal of Medical Education and Practice.
??:??–??

COMMENTARY

AI's rapid emergence and adaptation bring a massive opportunity for us to rethink the educational delivery models. While medical education has come a long way in embracing multiple active learning techniques such as problem-based learning, team-based learning and case-based learning, it remains traditional in terms of using a "one size fits all" approach. The baseline knowledge with which the learners enter medical school and/or individual courses is not considered while designing educational experiences. This means the learner may either have a larger

learning gap compared to their peers or be comfortable with the material compared to their peers in the cohort. This is particularly important as we increasingly emphasize fairness and equity in medical education. Addressing this issue is also timely as medical schools and residency programs increasingly embrace competency-based medical education (CBME)[1]. This challenge calls for designing and implementing an individualized approach to educational delivery and assessments for medical learners. The concept of a personalized approach to interventions is not foreign to medical education, as healthcare is adopting precision medicine as a management modality for multiple complex medical conditions[2].

While future physicians are expected to acquire lifelong learning skills[3], for the most part, the current medical education system does not require learners to use lifelong learning skills to demonstrate mastery and/or self-identify gaps and address those. This commentary explores the role and importance of precision education interventions in medical schools to improve learner performance and outcomes.

Precision education (PE), also known as adaptive learning, refers to an educational approach that tailors educational content and assessment to the individual needs and abilities of each learner. Triola M and Burk-Rafel B define PE as a systematic approach that integrates longitudinal data and analytics to drive precise educational interventions that address each learner's needs and goals in a continuous, timely and cyclical fashion, ultimately improving meaningful educational, clinical, or system outcomes[1].

This can be accomplished by effectively utilizing learner performance analytics to create customized learning experiences and assessments that are aimed at enhancing further learning. This approach considers factors such as prior knowledge and personal strengths and weaknesses.

The impact of precision education interventions on learning outcomes has been studied in medicine and other disciplines. PE can help optimize the learning paths and experience by focusing on areas where a learner needs more support while allowing them to make faster progress on others[4]. Precision education encourages learners to take an active role in their learning. By focusing on the specific needs of each learner, precision education can help optimize the use of time. Learners may spend more time on challenging topics while progressing more quickly through areas where they excel, leading to a more efficient learning process. For example, The Anesthesia Research Group for Educational Technology (TARGET) is developing an automated tool to deliver individualized education to anesthesia residents based on a longitudinal digital representation of the learner[5]. Several studies cite the value of PE as it is grounded in Self Determination theory[6]. Tailoring the educational experience to individual learners can increase their motivation to learn

and foster increased engagement in the learning process. PE mirrors the concept of evidence-based medicine, where care providers use data and evidence to inform the management plan. Implementation of PE relies on data analytics and assessment tools to identify individual learning needs. Effective use of data analytics can help predict underperformance and dropout risk. Analytics also helps inform actionable interventions. This data-driven approach can help faculty make informed decisions about curriculum design and overall program effectiveness[7]. PE may contribute to reducing educational disparities among learners, especially, if implementation is co-created by a diverse set of learners[8]. Equity is particularly important for the application of PE in medical education. Harmful bias in assessment can perpetuate inequities in outcomes[9]. Addressing inequities through PE must be coupled with appropriate coaching, providing actionable feedback and making relevant resources accessible and affordable to learners[10]. Hasty use of PE interventions aimed at addressing inequities may have unintended consequences and perpetuate inequities instead of ameliorating them[8].

There are several strategies and tools that can guide implementation of PE in medical education programs. Adaptive learning platforms are commonly used by learners for study purposes and for exam preparation. These platforms are excellent examples of using technology to PE initiatives. Controlled studies have demonstrated superior outcomes with use of adaptive learning platforms. Yakin M and Linden K reported significant improvement in dental learner performance in the group that used adaptive learning platform compared to the ones that did not[11]. A systematic review of efficacy of adaptive e-learning reported improvements in skills among learners and health professionals[12]. Effective implementation of PE also requires use of learner analytics (LA). Several medical schools are using web-based dashboards that learners can access to learn where they stand and identify opportunities for improvements. Such expectations closely align with the expectations for medical learners to be Master Adaptive Learners[13]. An electronic learner performance dashboard displays quantitative and qualitative data from learner performance in various formative and summative assessments[14]. In an ideal model, the dashboard must display learner performance data drawn from various sources of assessments along with expected standards. This can help learners to appreciate the attainment or gaps in attainment of expectations. Such dashboards can also be helpful in implementing coaching programs for learners. The coaches can use the real-time data to assess learner progress and tailor their coaching strategies. Such well-constructed dashboards can also foster a sense of responsibility on the learners to create SMART learning goals and discuss those with their coaches[15]. This data-driven approach is a key component of precision education. However, there are several barriers that can hinder expected

outcomes. These include suboptimal learner engagement with the dashboard, coaches not tailoring the interventions based upon the LA data. Data from electronic health records (EHR) can be mined for designing targeted interventions for residents and learners who are in their clinical phase of training. This would require effective integration of the process into the clinical workflow of clinical faculty who are often burdened with patient care obligations not finding adequate time to engage in tailoring educational experiences for residents and medical learners.

CONCLUSION

It's important to note that while there is promising evidence, the field of precision education is still evolving and more research is needed to understand its full impact, especially in the specific context of medical education. As adoption of AI becomes more ubiquitous, medical educators can expect computers to guide them with PE interventions. The effectiveness of precision education may also depend on the implementation of appropriate technologies, the quality of instructional design and the ongoing assessment and refinement of personalized approaches.

CONFLICTS OF INTEREST

There are no conflicts of interest.

REFERENCE

1. Triola MM, Burk-Rafel J. Precision Medical Education. Acad Med. 2023;10-1097.
2. Elemento O. The future of precision medicine: towards a more predictive personalized medicine. Emerging Topics in Life Sciences. 2020;4(2):175-177.
3. Hojat M, Veloski J, Nasca TJ, Erdmann JB, Gonnella JS. Assessing physicians' orientation toward lifelong learning. J Gen Intern Med. 2006;21:931-936.
4. Cutrer WB, Miller B, Pusic MV, Mejicano G, Mangrulkar RS, Gruppen LD, *et al*. Fostering the development of master adaptive learners: a conceptual model to guide skill acquisition in medical education. Acad Med. 2017;92(1):70-75.
5. Garibaldi BT, Hollon MM, Woodworth GE, Winkel AF, Desai SV. Navigating the Landscape of Precision Education: Insights from On-the-Ground Initiatives. Acad Med. 2023;10-1097.
6. Drake CB, Heery LM, Burk-Rafel J, Triola MM, Sartori DJ. A Theoretical Foundation to Inform the Implementation of Precision Education and Assessment. Acad Med. 2023;10-1097.
7. Tempelaar D, Rienties B, Nguyen Q. The contribution of dispositional learning analytics to precision education. Educ Technol Soc. 2021;24(1):109-122.
8. Sukhera J. Precision Education and Equity: A Participatory Framework to Advance Equitable Assessment. Acad Med. 2023;10-1097.
9. Conference Participants. Josiah Macy Jr. Foundation Conference on Ensuring Fairness in Medical Education Assessment: Conference Recommendations Report. Acad Med. 2023 Apr 18. doi: 10.1097/ACM.0000000000005243.
10. Boatright D, Edje L, Gruppen LD, Hauer KE, Humphrey HJ, Marcotte K. Ensuring Fairness in Medical Education Assessment. Acad Med. 2023;98(8 Suppl):S1-S2.
11. Yakin M, Linden K. Adaptive e-learning platforms can improve student performance and engagement in dental education. J Dent Educ. 2021;85(7):1309-1315.
12. Fontaine G, Cossette S, Maheu-Cadotte MA, Mailhot T, Deschênes MF, Mathieu-Dupuis G, *et al*. Efficacy of adaptive e-learning for health professionals and students: a systematic review and meta-analysis. BMJ Open. 2019;9(8):e025252.
13. Cutrer W, Pusic M, Gruppen LD, Hammoud MM, Santen SA (Eds.). The master adaptive learner. Elsevier Health Sciences. 2019.
14. Boscardin C, Fergus KB, Hellevig B, Hauer KE. Twelve tips to promote successful development of a learner performance dashboard within a medical education program. Med Teach. 2018;40(8):855-861.
15. Hauer KE, Iverson N, Quach A, Yuan P, Kaner S, Boscardin C. Fostering medical students' lifelong learning skills with a dashboard, coaching and learning planning. Perspect Med Educ. 2018;7:311-317.