

Trends in Pharmacological Sciences



Scientific Life

Mentoring future science leaders to thrive

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Mentoring is a well-known subject, but we know little about it as a science. We need to learn more about how to evolve mentorship. In this article, we propose some new directions for mentorship in the present and the future.

Introduction

As the field of science, technology, engineering, mathematics, and medicine (**STEMM**) (see [Glossary](#)) advances, mentorship must also change. In a classical mentoring relationship, the mentor creates an environment in which there is mutual respect, trust, shared values, and open communication. Mentoring in reverse allows mentees to express their concerns to mentors [1]. Unfortunately, mentorships often go wrong because of the dark side of mentoring, such as mentees being assigned mentors who have demonstrated their lack of concern for the mentee's career and mentors who did not have adequate resources for an additional mentee and therefore the mentee was not adequately trained [2]. Academic mentoring is designed to influence future STEMM professionals, resulting in mentoring styles that can sometimes inadvertently pass on biases. The result is a breakdown in **cultural competency** and **cultural humility**, which may adversely affect the mentoring relationship and process [1]. In the end, negative mentoring can break bridges rather than strengthen relationships between trainees and mentors [3]. The result can be bitter

relationships instead of mutually beneficial successes in mentoring.

There are certain concepts that are now becoming more common in mentoring, such as intentional and **casual mentoring** [3,4]. **Intentional mentoring** is the process of mentoring more effectively through ensuring one is making informed decisions to meet the mutual and established goals of the mentorship [3]. Casual mentoring deformatizes aspects of mentoring to allow a more open and honest mentor–mentee relationship [4]. These modern forms of mentoring are important and have positive outcomes, especially regarding mentoring underrepresented minorities (**URMs**) [4,5].

In many cases, URMs also have the greatest need for **effective mentoring** [2–4]. However, although there exist many concepts for mentorship overall and tools to be used to carry out mentorship, often there is a lack of critical understanding of what the mentees need and a mentor's capacity to understand what is needed. In this article, we establish new roles for mentors and discuss practices mentors should have in their **toolkit** to enable them to become effective and empowering mentors.

Effective mentoring through holistic mentoring

In **holistic mentoring**, the individual mentee's needs are identified and supported with collaborative efforts designed to strengthen the mentee's capacity to thrive. Mentorship must go beyond simple monthly surface-level meetings or one-type-fits-all approaches. Mentees are individuals who require different approaches to mentoring, and they ask different questions as they navigate the academic maze ([Figure 1](#)). Furthermore, mentorship styles must be readily aligned to adapt and aid mentees in a format that is beneficial to them and will increase their learning experiences [5]. For URMs, who typically face distinct challenges such as **microaggressions** in STEMM, mentors

Glossary

Acculturation: integrating or taking on behaviors from a different culture, also referred to as 'assimilation.'

AI: artificial intelligence refers to a machine's capacity to think or perform tasks that are usually performed by humans.

Ally: an individual who is committed to your upward mobility and thus provides support, encouragement, and assistance while keeping your confidence.

Casual mentoring: a spontaneous and unrequested mentoring style that deformatizes the usual constraints of mentorship, allowing a more open and honest mentor–mentee relationship. Additionally, this style of mentoring functions in ways that privilege those with unknown, unwritten rules in the academy, occult information that one cannot glean without extensive networking, or it provides meaningful information that may change the outcome of a vital task, grant, or award.

Cross-cultural communication: the communication style that takes into consideration the similarities and differences between cultural groups.

Cultural awareness: an individual's understanding and acceptance of differences between themselves and those from other backgrounds.

Cultural competency: the capacity to comprehend, value, and appreciate individuals from cultures other than your own.

Cultural humility: understanding and appreciating others from different cultures and nurturing positive relationships with individuals from differing backgrounds.

Diversity: the inclusion of individuals who hail from different social and ethnic groups, including those with different genders and sexual self-identifications.

Effective mentoring: a successful mentoring style in which the mentor can challenge, support, advise, encourage, listen, and instill confidence without being judgmental.

Equity: the practice of being unbiased when dealing with diverse groups of individuals.

Holistic mentoring: a coaching style in which mentors engage in promoting overall personal growth for their mentees, which takes into consideration the mental, cultural, and social well-being of the mentee.

IDP: an individual development plan is a directional blueprint for planning your future, identifying your strengths, weaknesses, and goals, that allows mentees to interact with their mentors.

Inclusion: the intentional practice of ensuring equal access and opportunities for individuals who have traditionally been excluded, marginalized, or oppressed.

Intentional mentoring: the process of making informed determination and following best practices to meet the mutual and established goals of the mentorship relationship.

Introspection: examining one's own beliefs, biases, mental state, and emotions.

Microaggressions: a terminology that defines adverse workplace communication or behavior

practices that convey harmful, hostile, offensive, and insensitive attitudes.

Peer review: the process whereby one's work is formally evaluated by members of one's professional community.

PI: a principal investigator is an individual who is responsible for preparing, applying, conducting, and administering a research grant or sponsored agreement.

Reverse mentoring: a management style in which the mentee provides instructions to the mentor.

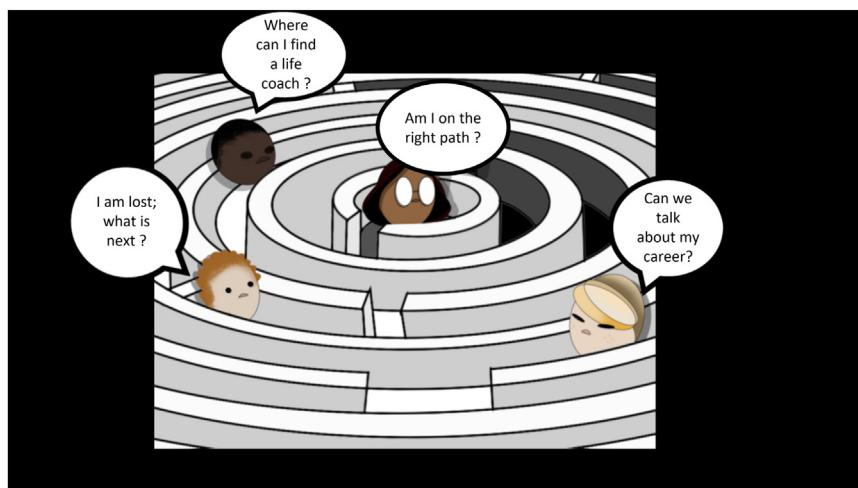
Self-inflection: being conscious of your own identity, priorities, insecurities, and biases.

STEMM: an abbreviation for science, technology, engineering, mathematics, and medicine, it refers to fields of study that concentrate on problem solving, critical thinking, and evidence-based resolutions to various phenomena.

Toolkit: a set of skills that enables the mentor to be effective and empowering.

URMs: underrepresented minorities are defined as US citizens who hail from specific groups and self-identify as Black Americans/AfricanAmerican/Afro-Americans, Hispanic/Latino/a/x, Pacific Islander or Asian Pacific Americans, Native Hawai'ians, Inuit and Alaskan Native, or Native Americans, also known as American Indians, First Americans, or Indigenous Americans. It is also important to note individuals with disabilities, who are defined as those with a physical or mental impairment that limits one or more major life activities are associated with the term underrepresented. Students from low socioeconomic status backgrounds or disadvantaged backgrounds are associated with the term underrepresented. Women, Veterans, or sexual and gender minorities are also considered an underrepresented population in the scientific workforce.

need to be cognizant of these challenges and provide support, such as by becoming an **ally**, which involves taking a stand against microaggressions, helping the student understand the underlying issues, and making the perpetrator aware of their behavior. More important, mentors need to be aware not to contribute to microaggressions themselves by engaging in **self-inflection** and fine-tuning their **cultural awareness** as a means of personal growth and **introspection** [1]. Furthermore, academia in the past has played a large role in breeding **acculturation** and conformity of other cultures through the withholding of approval or 'affirmation,' especially during the **peer review** process or awarding of grants and funds [6]. Therefore, it is important to engage in **reverse mentoring**,



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Figure 1. Searching for a mentor in the academic maze of uncertainty. The mentees can be seen navigating the maze of uncertainty while carrying signs with their questioning in search of a mentor who could provide help.

building cultural humility as a mentor, to avoid causing mentees to conform to better fit into a mold of communal acceptance resulting in a loss of identity and culture [1–3].

Mentorship that focuses only on career or academic development may neglect the important personal well-being of the mentee [5]. We believe mentorship now has to create a more holistic model that recognizes the importance of a mentee's physical and mental health. Universities should be encouraged to provide resources to support the mentee's and mentor's overall well-being. Although mentees can use multiple mentors to satisfy these various roles, mentors should be aware of available support services, which includes mental health services and life coaches (Figure 1). The holistic mentoring process identifies the individual mentee's needs and supports them with collaborative actions to strengthen their potential to flourish.

New approaches and effective strategies regarding technology

Given the pandemic, mentorship will likely be based on technology for the foreseeable future. This can be valuable for mentees

because **cross-cultural communication** has never been easier due to virtual technologies being used more often [7]. For example, before the pandemic, it was the norm to have in-person lab meetings, but now many lab meetings are held virtually. Furthermore, as many companies move toward creating virtual work environments, known as the 'metaverse,' further opportunities for virtual mentoring may be facilitated [8]. Beyond this, technology is offering new ways to train mentors. Virtual mentor training, or technology-enhanced mentor training, may reduce the monetary amount necessary to impart critical skills to mentors, and studies have shown it to have positive effects [9]. For institutions with less funding, such as historically Black college and universities, virtual programs allow them to ensure that more mentors are well trained [7,9].

Artificial intelligence (**AI**) is further changing how mentoring will be done in the future [10,11]. For one, because mentoring can be performed virtually, mentoring will not be limited geographically. Ultimately, in the future, it may be possible for AI to take on some roles of mentoring. Already, there

are AI programs that can allow training in becoming more persuasive [10]. These programs are effective because they can automatically link to other software to monitor progress, set reminders, and work on the mentee's schedule [10]. Rather than replacing mentors, however, AI will serve to enhance mentoring, allowing mentors to dedicate more time and resources to address specific mentee needs. Future technologies will allow mentors to better connect to URM individuals and increase the time they spend with mentees. We believe that in the future, software will be used to glean mentee data that the mentor and mentee can use to prepare mentees for success. Much of this will be included in future, less time-consuming, and more comprehensive individual development plan (IDP) software, with which mentees can evaluate themselves with confidentiality. Although technologies are forever advancing, there will always be a need for in-person mentoring, which will allow consideration of body language, social cues, and the assessment of the mentee's capacity or other barriers for using the technologies [1–3].

Quantification of mentoring and mentorship as a science

The effects of mentorship on mentees is clear, and negative experiences can result in mentees failing to achieve their goals as they advance to the next stage of the pipeline [12]. However, there is no agreed way to evaluate mentorship and define if a mentorship has been a success. Some strategies propose using metrics such as hours of mentoring, number of signups, satisfaction score, and number of goals met [13]. Similarly, other strategies judge success based on the career or academic outcomes of the mentees [14]. However, these both lack a holistic view of the nonacademic assistance a mentor may offer. Conversely, other strategies have a more holistic view and rather focus on 'pulse checks,' which involve frequently checking with the mentor and mentee to ensure both are

satisfied with the current progress being made [15].

As mentoring evolves, it must be recognized and studied as a science, including quantifications and curricula to study and improve its effectiveness. There should be rubrics to mutually quantify mentorship at a high level. This can be measured by principal investigators (PIs), whereas, at a lower level, mentees can assess their PIs. For example, these rubrics can include scoring in how well mentors did in listening to mentee feedback, aiding in creation of individual development plans, and providing helpful and relevant career development training. This can provide important mutual feedback that can aid in future mentorship relationships. Equally, at an institutional level, there should be requirements for all facets of mentoring, including training in how to be culturally competent [1–3] and sensitivity training. Furthermore, there should be guidelines for how mentoring should be practiced across the institution. In this way, mentoring is both consistent and recognized as an aspect of attaining or maintaining faculty positions. Furthermore, institutions should maintain a certain standard for mentorship and offer training on a consistent basis. It is imperative for every mentor to be included in the evaluation process and in the core competences and leadership efforts at an institution.

Concluding remarks

Successful mentoring is crucial to keeping URMs in the pipeline and fostering greater **diversity** [12]. Notably, STEM individuals and institutions should recognize that successful mentorship drives careers, and mentors need to be more willing to be exposed to more types of mentor relationships. If there is a singular type of mentor, it will not satisfy all requirements and the due diligence of a mentor. As such, we need to create and seize opportunities and involve a wide variety of mentors. Furthermore, we must incorporate

diversity, **equity**, and **inclusion** strategies to create welcoming, effective mentoring environments that transcend current definitions of mentors and translate into new and positive experiences.

Data and materials

All data are available in the main text.

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Declaration of interests

The authors declare that they have no competing interests.

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