Report from the National Academy of Sciences: The Science on Effective Mentoring in STEMM

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Key Report Findings

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How was the Project Conducted?

The **Statement of Task** asked the Committee to "conduct a study of STEMM mentoring programs and practices at the undergraduate and graduate levels."

It provided 3 "guiding questions" for the study:

- What are **common definitions and differentiations** among the various models of mentoring in STEMM?
- What are the **most successful elements** of effective mentoring relationships in STEMM education at the various stages of career development?
- How can and should **mentees and mentors be trained** to be more effective in the mentor-mentee relationship?

In addition to a final report, the committee was also task with creating an online guide for institutions, departments, and individual faculty members.

Who is on the Committee?










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What is Mentorship?

Mentorship is a professional, working alliance in which individuals work together over time to support the personal and professional growth, development, and success of the relational partners through the provision of career and psychosocial support.

Mentorship includes **career support functions** (e.g., career guidance, skill development, sponsorship) and **psychosocial support functions** (e.g., emotional support or role modeling) aimed at mentee talent development.

It complements other developmental processes like teaching or coaching to support mentees in developing knowledge and skills, and is essential to holistic development of STEMM professionals, including STEMM identity development.

What is Mentorship? Elements

Trust

Trust develops when mentors and mentees work together to identify and respond to their mutual goals, needs, and priorities. These change over time and thus may require adjustment.

Self-reflection

Critical and honest self-reflection occurs at multiple stages of effective mentorship processes.

Expectations

Explicit declarations of the expectations of both mentors and mentees at the initiation of mentorship—revisited periodically and possibly recorded in writing—can help create an effective mentoring relationship.

Education

Mentorship is a learned skill, and mentorship education influences mentor and mentee attitudes, self-efficacy, and behaviors.

What is Mentorship? Stages

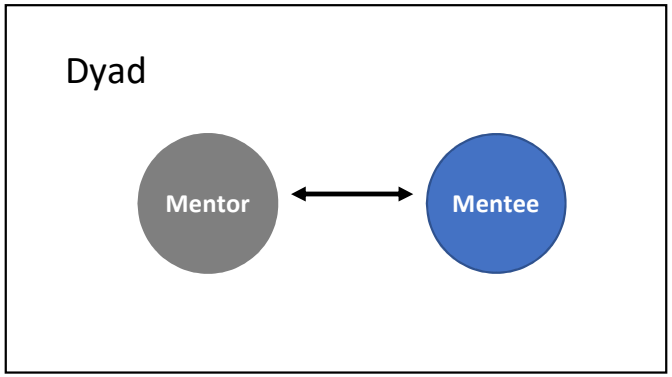
A **series of stages**:

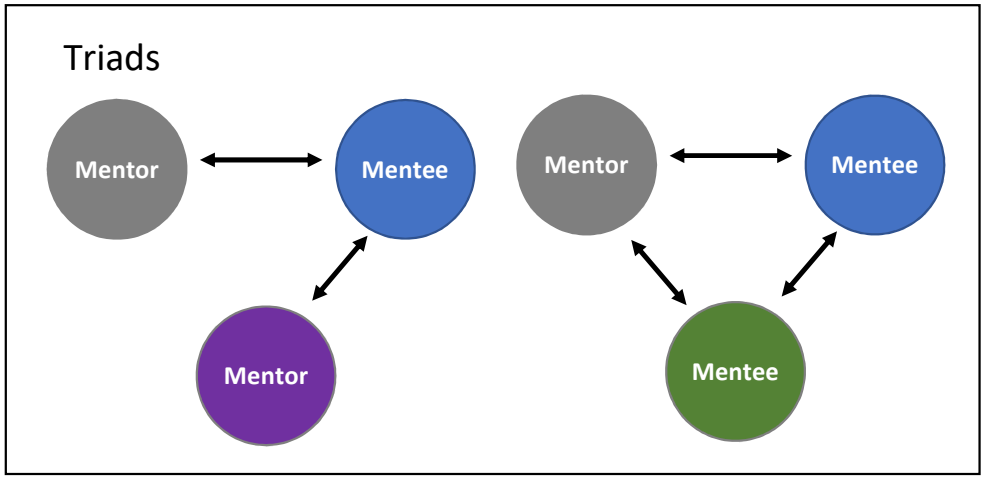
1. Initiation,
2. Cultivation,
3. Separation, and
4. Redefinition

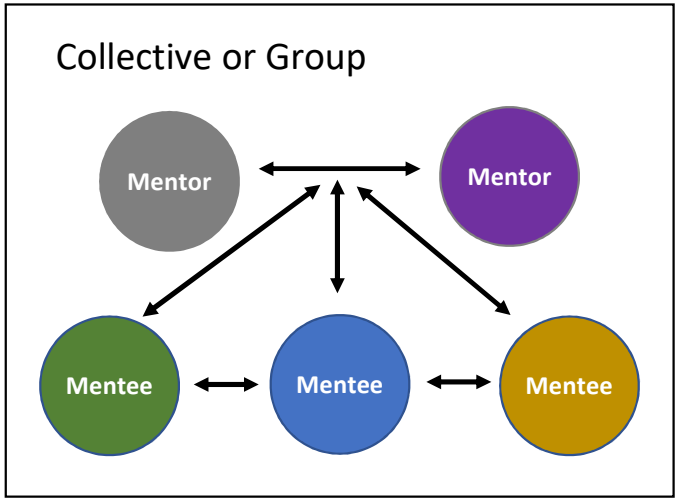
Ongoing collaboration and discussions are key to initiation and sustaining an effective mentoring relationship that is responsive to the needs, goals, interests, and priorities of both mentors and mentees

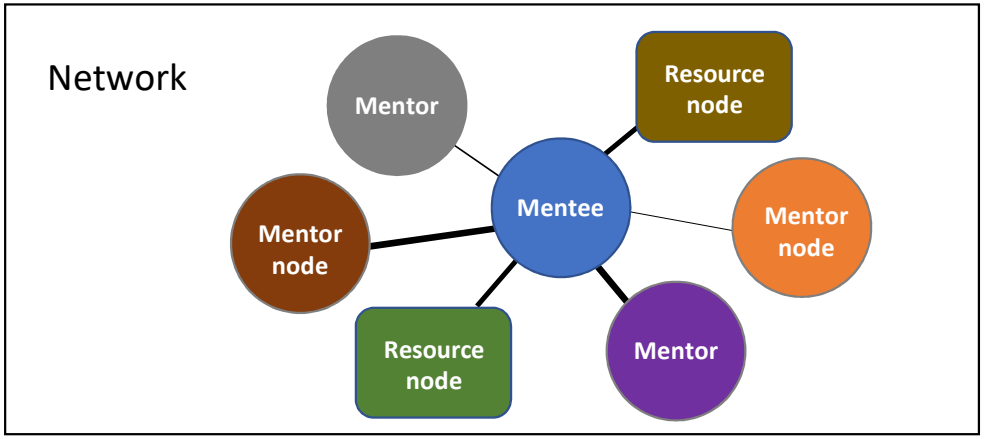
What is Mentorship? Structures

A **range of structures** support mentees' development, including:









What is Mentorship? Ineffective Experiences

Negative Mentoring Experiences

Mentorship becomes less effective when mentors:

- are absent,
- set unrealistic expectations,
- do not provide clear and relevant guidance, or
- engage in manipulative behavior, such as inappropriately delegating work to the mentee or taking credit for the mentee's work.

Negative mentoring experiences can occasionally arise from ill intent.

Negative mentoring experiences can also arise from otherwise good intentions

There are some—such as abusive supervision and harassment—that qualify as detrimental research practices.

How do Identities Affect Mentorship in STEMM?

Identity plays a pivotal role in the formation and development of social relationships such as mentorship.

Specific dimensions of identity—**science identity, cultural identities**—are linked empirically to:

- academic and career development
- the experience of mentoring relationships in STEMM

Mentorship can ameliorate negative effects of students' feelings of being "othered" due to their non-science identities in STEMM by increasing inclusion and psychosocial support.

How do Identities Affect Mentorship in STEMM?

Culturally responsive mentoring is a learned skill set in which mentors, regardless of their race or gender, show interest in and value students' cultural backgrounds and social identities. It may help students navigate invalidating experiences in academia, affirm belonging in STEMM contexts, and reinforce their belief in their own ability to be successful in STEMM.

Mentees without access to culturally responsive mentoring can experience **identity interference**, which can result in depression, reduced psychological well-being, and lower academic or professional performance.

Affinity-based mentorship groups can support individuals from UR groups in STEMM who may not otherwise have access to culturally responsive mentorship.

What is the Role of Mentorship in Medical Education?

The transition **from undergraduate to medical school or an M.D.-Ph.D.** program is a particularly vulnerable period and can highly depend on the competencies of the mentors that are involved.

> Seeking **input from multiple mentors** can help to augment the influence of any single mentor on a mentee's potential next steps.

Classical mentoring plays less of a role in pre-medicine preparation because there is a structured process with a **single gate-keeping admissions system**. Advising by dedicated professionals plays a more prominent role in helping undergraduates navigate this system.

The role of mentorship during medical school is **peripheral to the primary education and training designs**. However, functions of mentorship, such as advising, do play a role in medical school training.

What Works in Programmatic Mentorship?

For most of intervention programs with mentoring experiences, “success” is based on **a particular outcome variable**, such as the number of students who stay in STEMM or progress to the next career stage in STEMM.

Systematic attempts to **disaggregate the effects of the mentoring experiences** provided through comprehensive programs from other supportive experiences remains open.

Some programs note benefits from **mentee groups or peer structures**.

Significant **institutional support over time** and **intentional design** are also common.

What is the Role of the Institution?

Colleges and Universities can **broaden access to quality mentorship and support systems**, which may entail significant institutional change.

Current mentoring systems are structured to benefit the prototypical STEMM mentee. But mentoring can and has been used to develop **cultures of inclusive excellence**, which are more likely to support the development of diverse STEMM professionals.

What is the Role of the Institution?

Colleges and Universities can **recognize and address barriers to implementation** of effective mentorship at the institutional level include lack of:

- time,
- resources,
- rewards and incentives,
- expertise, and
- confidence to implement.

A commitment from institutional leadership to support mentorship could have a profound effect on the quality of mentorship and ultimately the development of undergraduate and graduate students.

What is the Role of the Institution?

Colleges and universities can **support more effective mentorship** on their campuses by

- Providing mentorship education
- Promoting the use of mentorship tools
- Encouraging faculty and staff to share mentorship challenges, innovations, and evidence with peers
- Evaluating mentorship effectiveness with validated measures
- Using data and research to hold broader conversations about mentorship activities and innovations

Report Recommendations to Individuals and Institutions

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How can we Create a Culture of Effective Mentorship?

The committee presents **nine sets of recommendations** to encourage a shift away from a culture of ad hoc mentorship and toward one of intentional, inclusive, and effective mentorship in all institutional contexts.

The first seven outline specific roles for participants in the mentorship ecosystem:

- institutional leadership,
- department chairs,
- program leaders,
- mentors,
- mentees, and
- professional associations.

The final two sets of recommendations are directed at agencies that fund mentorship programs and scholars of mentorship

How can we Create a Culture of Effective Mentorship?

Recommendation 1:

Adopt an Operational Definition of Mentorship in STEMM

Institutions and programs should adopt an evidence-based, operational definition of mentorship, such as the one used by the committee.

How can we Create a Culture of Effective Mentorship?

Recommendation 2:

Use an Evidenced-Based Approach to Support Mentorship

For example:

- Program leaders should support mentorship by ensuring there are evidence-based guidelines, tools, and processes for mentors and mentees to set clear expectations, engage in regular assessments, and participate in mentorship education.
- Mentees should acquaint themselves with evidence-based mentorship tools and strategies, including compacts, individual development plans, mentor maps, and mentoring accountability mechanisms.

How can we Create a Culture of Effective Mentorship?

Recommendation 3:

Establish and Use Structured Feedback Systems to Improve Mentorship at All Levels

Assessment and evaluation of mentorship are necessary to identify areas of strength and opportunities for improvement. Evaluation through structured systems may reduce unintentional bias and protect mentees who are in inherently more vulnerable positions as students and trainees.

For example:

- Institutional and departmental leadership should regularly and systematically review formal mentorship activities and programs to support development of mentorship skills and student success and well-being.

How can we Create a Culture of Effective Mentorship?

Recommendation 4:

Recognize and Respond to Identities in Mentorship

All participants in the mentorship ecosystem should recognize that identities influence academic and career development and thus are relevant and significant for effective mentorship.

For example:

- Mentors should learn about and make use of inclusive approaches to mentorship such as listening actively, working toward cultural responsiveness, moving beyond “colorblindness,” intentionally considering how culture-based dynamics like imposter syndrome can negatively influence mentoring relationships, and reflecting on how their biases and prejudices may affect mentees and mentoring relationships, specifically for mentorship of underrepresented mentees

How can we Create a Culture of Effective Mentorship?

Recommendation 5

Support Multiple Mentorship Structures

For example:

- Institutional leadership should support policies, procedures, and other infrastructure that allow mentees to engage in mentoring relationships with multiple individuals within and outside of their home department, program, or institution, such as professional societies, external conferences, learning communities, and online networks, with the ultimate goal of providing more comprehensive mentorship support.
- Professional associations should proactively facilitate the development of mentoring relationships among individuals from different programs or institutions, as needed, who can provide complementary or supplementary mentorship functions.

How can we Create a Culture of Effective Mentorship?

Recommendation 6:
Reward Effective Mentorship

For example:

- Department chairs, in consultation with institutional leadership, should use promotion, tenure, and performance appraisal practices to reward effective mentorship.

How can we Create a Culture of Effective Mentorship?

Recommendation 7:

Mitigate Negative Mentorship Experiences

Mentorship education for both mentors and mentees can help to reduce or prevent negative mentoring experiences. However, negative mentoring experiences do and will occur, and direct steps should be taken to minimize harm from such occurrences.

For example:

- Mentors should recognize that negative mentoring experiences can occur even with well-intentioned mentors and mentorship practices and be open to addressing unintended negative mentoring experiences with a neutral third party.

How can we Create a Culture of Effective Mentorship?

Recommendation 8:

Recommendations for Funding Agencies that Support Mentorship

Funding agencies play a key role in shaping the values of institutions and the projects that scholars pursue. As such, funding agencies' role in encouraging and supporting effective mentorship practices is essential.

For example:

- Funding agencies should encourage the integration of evidence-based mentorship education for mentors and mentees and assessments of mentorship into grant activities that involve undergraduate and graduate student research, education, and professional development to support the development of the next generation of talent in STEMM.

How can we Create a Culture of Effective Mentorship?

Recommendation 9:

Recommendations to Scholars of Mentorship

When the committee reviewed the literature on mentorship and mentoring relationships, it became apparent that more scholarship is needed on specific aspects of mentorship and mentoring relationships.

For example:

- Scholars should define and characterize negative mentoring experiences or ineffective mentorship in STEMM and investigate their prevalence and impacts, specifically addressing the possibility that negative mentoring experiences may disproportionately harm underrepresented students and compromise science and research itself.

Online Resource Guide

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What can You Find Online?

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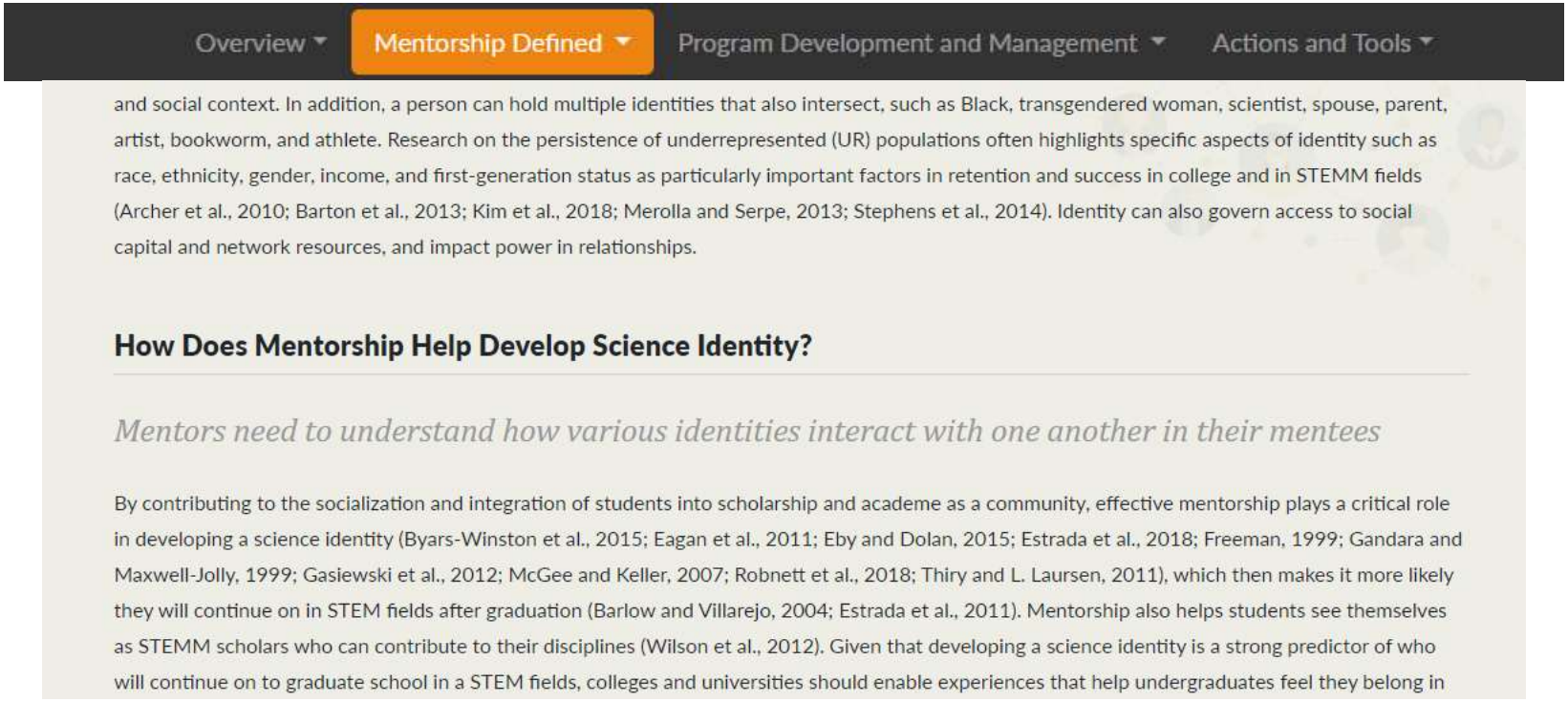

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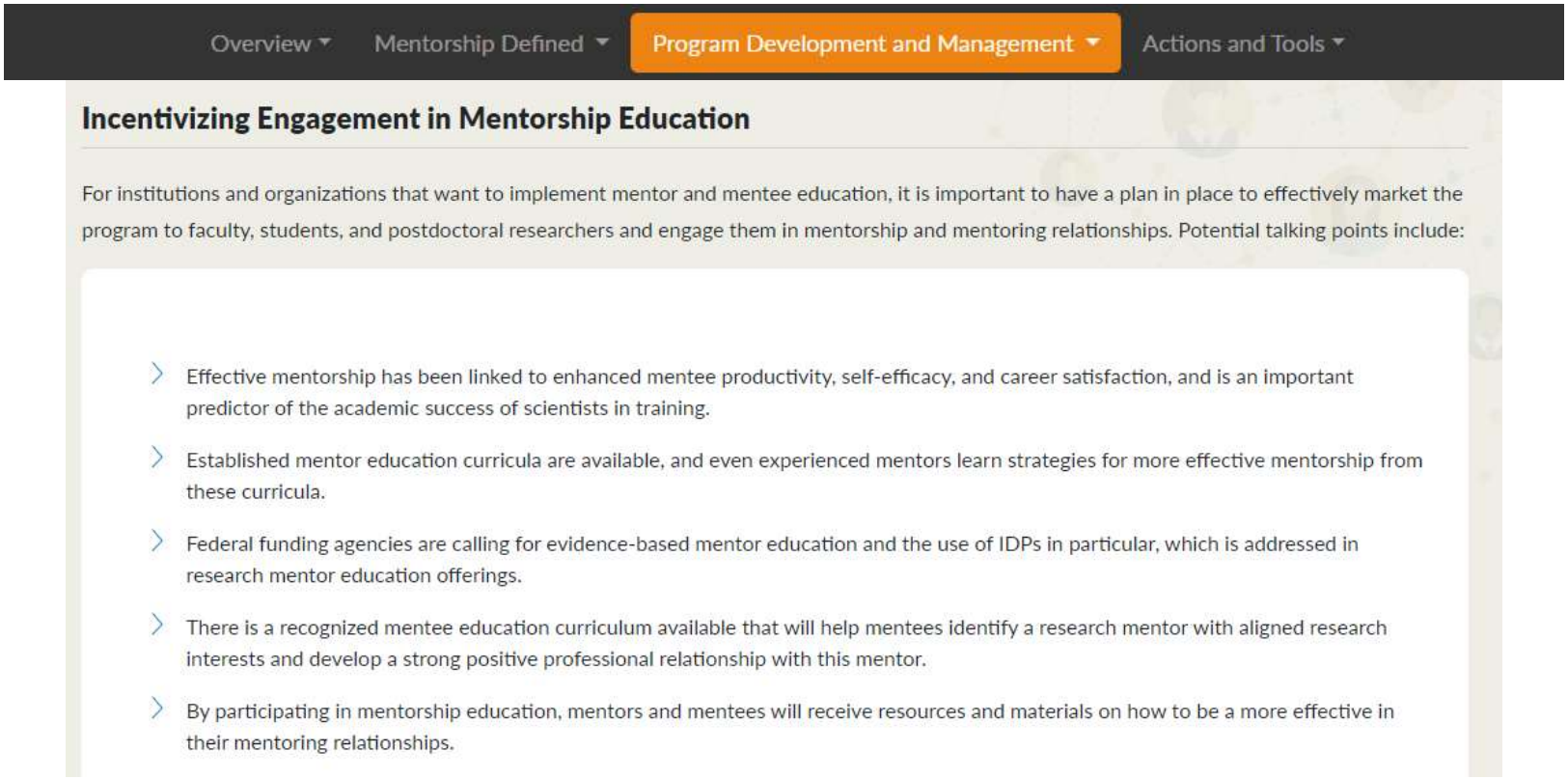

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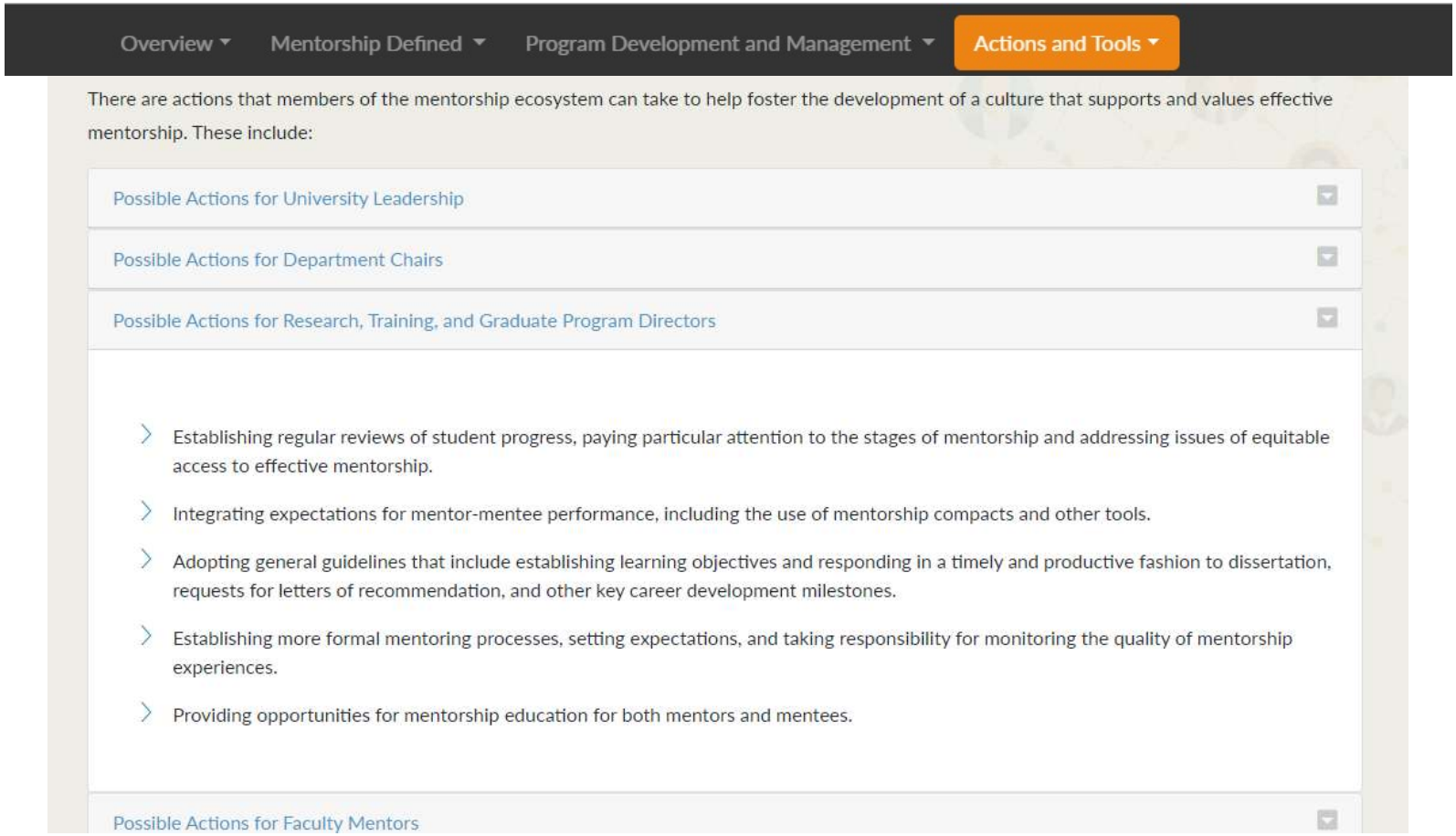

Discussion

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