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Mentoring Women in Math

A practical handbook for organizing a mentoring program and training the mentors

Content

Disclaimers

A. A note on gender

In the following, the terms "woman/women" and "female" refer to anyone who identifies as female, regardless of assigned sex at birth.
Furthermore, the authors believe that anyone who does not identify as cis male should equally be welcomed to a mentoring program for women if they wish so, even if they do not self-identify as female.

B. What is this handbook (not)?

This is not a theoretical book about mentoring, but a practical guide to organize an effective mentoring program (for women in mathematics in academia). We are neither qualified, nor do we attempt, to enter a scientific discussion about gender, but we merely speak from our own experiences as women in mathematics and as participants and organizers of mentoring programs and mentoring trainers.
This handbook grew out of our experiences from mentoring programs at the universities of Heidelberg and Tübingen, inspired by experiences of Carla Cederbaum and Anna Wienhard in the US, and was further developed in the framework of the SPP 2026. It also draws some insights from a mentoring program for all genders build on the same basis within the Excellence Cluster STRUCTURES.
We focus exclusively on mentoring female mathematicians in academia. If some of our experiences and suggestions can be helpful for other kinds of mentoring programs (e.g. for minorities, women in the industry, researchers in other fields, etc.), we gladly welcome adaptations of the handbook and the training suggested therein to these different settings.
It is a living handbook; open to growth and change. We welcome any feedback, suggestions, new idea, and experiences.

I. Introduction

I.1 What is mentoring?

The Oxford Dictionary defines mentoring as "the practice of helping and advising a less experienced person over a period of time, especially as part of a formal program in a company, university, etc."
Mentoring is based on the idea that an experienced person (the mentor) is paired with a less experienced person (the mentee), whether it be in a specific professional field or environment or in the context of higher education.
Mentoring practices differ considerably; different cultural and professional backgrounds lead to different understandings of mentoring. Whether in educational training, as a tool for hierarchical knowledge transfer or for knowledge-management in companies, or as part of the welcome culture of

an institution – the goals, the practice, and the principles of mentoring are divers and highly context-dependent.

Here we understand mentoring as a relationship based on an agreement among partners, which offers continuous and dynamic feedback among the partners, establishes a relationship through which an individual shares knowledge, skills and information over some period of time. It aims to foster the personal and professional growth of the mentee. By reflection on their own experiences the mentors also benefit from the relationship, and reverse mentoring is not excluded. .

The mentor supports the mentee when problems and challenges arise, but also engages in conversations with the mentee to share experiences. It is precisely because of this supportive role of the mentor that mentoring of marginalized groups is particularly important.

Here we focus on building up a mentoring program for women. However many aspects apply equally well for setting up a mentoring program for young scientists of all genders.

I.2 Why do we focus on women?

Women in science are significantly underrepresented. Female researchers in mathematics (as well as in other STEM fields) are underrepresented among their peers in most countries and on most career levels. The fact that the proportion of women decreases when moving to higher qualification levels and career stages is called the "leaky pipeline" effect. The leaky pipeline metaphor visualizes the career path of a researcher as a pipeline which starts at enrollment in a program of a university and ends at a (full) professorship. At each transition between different parts of the pipeline, the proportion of women in the pipeline decreases. These leaks may occur at the transition from a bachelor course to a master program, from a master program to a PhD program, or later. At what stages the effect is most notable and its size depend on the field and on the country, but it undoubtedly exists and can be measured across many different disciplines and countries.

Depending on the field and the specialization, it may vary where exactly the pipelines leaks. It is not easy to pinpoint reasons why the percentage of women decreases along a typical career path, but it is measurable that is does. The underrepresentation of women in science may make women feel isolated or disadvantaged. They may also feel that their presence in a scientific group is merely due to window dressing of their funding institutions, or perhaps to the necessity to fulfill a women's quota.

The goal of a mentoring program for women is to counteract this gender gap by empowering and encouraging women to take the next step in their career and tp continue in science , here specifically in mathematics. The mentoring program pursues this goal by providing women in science with female mentors who can serve as their role models, support and encourage them, and build a network of women in their institution or program, so that ultimately less female researchers drop out of the leaky pipelines. This is why mentoring for women in math wants to promote gender equality and help women pursue a career in science, despite or maybe because of male overrepresentation.

It can be argued that the presence of men in a mentoring program for women can be beneficial to the program, as mentors or as organizers. A female scientist can, of course, benefit substantially from a mentoring relationship with a male mentor, and allowing male mentors into the program significantly broadens the group of potential mentors. However, while it is relatively common for a young scientist to develop an informal mentoring with a male scientist (for example with a TA of an undergraduate class or with a more advanced student), it is rather unlikely to naturally find an informal female mentor, simply due to the lack of women further down the leaky pipeline. Some women might find it easier to connect with a female mentor, especially since some challenges of an academic career present themselves in a different form to women than to men. This can be approached by either allowing only female mentors, or alternatively by allowing male mentors but giving mentees the choice to specifically request a female mentor. On a slightly different note, forging a female-only

group group of mentors/mentees gives women the chance to perceive the entire bandwidth of how different women face the challenges of pursuing a career in a male-dominated field; they get to witness a wide range of strategies and behaviors which they might pick from in order to emulate them.

It can be tremendously beneficial to include men in the organizing team of a mentoring program for women, not least because this can increase the acceptance of the mentoring program within the institution.

I.3 Mentoring through transition points

The mentoring program we describe focuses on providing support through transition points. As described above, transition points are the main "leaks" were female researchers drop out. But even more generally, for any young scientist, the transitions points from bachelor to master student, from master student to PhD student, from PhD student to postdoc, from postdoc to faculty member are crucial for the career development.

Our focus on transition points has consequences for the mentoring partnerships.

A mentoring partnership consists of a mentee and a mentor. Ideally, the mentor is just one study phase or career stage ahead of the mentee, so that her own, rather fresh experiences enable her to empathize better with the challenges the mentee faces. At the same time, the mentor can maximally benefit from the reflection of past experiences for her further career steps. In this way, a professor will ideally mentor a postdoctoral researcher, a postdoctoral researcher will mentor a PhD student, etc.

I.4 Who can become a mentor?

Any female member from a mathematical community setting up a mentoring program can become a mentor. A mentor does not have to be a mathematical genius, or maybe know all details of the fixed term employment contracts law for researchers. On the contrary, it is helpful for the mentee to experience that even after years in academia, a competent math professional or student does not know the answers to all questions. Helping the mentee to find resources or people that can provide a solution is more important than providing the solution.

We would like to emphasize here that a mentorship program for women can also be supported and built by male researchers. Even though it is important to have role models and women at different career stages participate in the program, it is actually beneficial if it is not only an initiative of women at the institution, but also has the support from male faculty members.

I.5 What is expected of a mentor – and what is not?

A mentor is someone who already made the experience of overcoming the challenges the mentee is facing. She can give advice about studies and career and help the mentee develop strategies to address her academic, organizational, or sometimes personal challenges. If she can not give the advice her mentee is looking for, or if she is not aware of points of contact that can provide information the mentee needs, she uses the mentoring network (by talking to her own mentor, or another mentor on the same level as her) to research resources that might help the mentee.

Another important aspect of a mentoring partnership is active listening. This includes asking questions which broaden the mentee's mind and entice her to follow new trains of thought. The mentor does

not give ready-made solutions, but rather provides a cognitive framework that helps the mentee structure her own thoughts, feelings, and priorities. It is crucial that the mentor is aware of interpersonal differences, keeps an open mind, and does not try to force solutions that worked for her on her mentee. Most importantly, the mentor encourages the mentee and strengthens her confidence and her self-efficacy expectations.

Scientific advice can be a part of the mentoring relationship, but it is important that the mentor does not feel pressured to be able to answer every technical question perfectly. Rather, she makes her experience and her network accessible to her mentee. For instance, a professor may establish contact between the postdoctoral researcher she mentors and an expert in the mentee's field; or a master student may direct the bachelor student she mentors to the math help desk of her department, or maybe talk to her about how to approach the teaching staff for help.

Solving personal issues which are beyond the scope of a mentoring partnership is not the responsibility of the mentor. While there is nothing wrong with occasionally providing a shoulder to cry on, there are situations that call for the intervention of professionals in the social or health sector, and the mentor needs to be acutely aware of when it is better to direct her mentee to the appropriate resources. It is paramount that the mentor knows her own limitations and does not hesitate to admit (to herself and to the mentee) when she feels unable to help her mentee.

I.6 The mentoring agreement

Mentors and mentees are encouraged from the get-go to make their expectations clear. Mentees should define their mentoring goals and discuss them with their mentor at the beginning of the mentoring relationship. They can also discuss possible evaluation measures as to whether the goals have been achieved. More about goal setting can be found in the description of the mentoring training. Mentor and mentee can formulate their expectations of the mentoring relationship in a written agreement. The mentoring agreement should (if not in written form, then at least orally) also include the pillars of confidentiality, trust, support, and constructive feedback.

I.7 The group of mentors: equality that transcends career stages

Mentor and mentee should be ideally one career step apart, so that for the mentor the experiences that she made when she was at the mentee's career or study stage are still fresh in her mind. The mentee might see someone who is only one step ahead as more relatable and approachable. This results in the following mentoring chain:

<div align="center">

Professor
↓
Postdoc
↓
PhD Student
↓
Master Student (from 4th year)
↓
Bachelor Student (2nd/3rd year)
↓
Bachelor Student (1st year)

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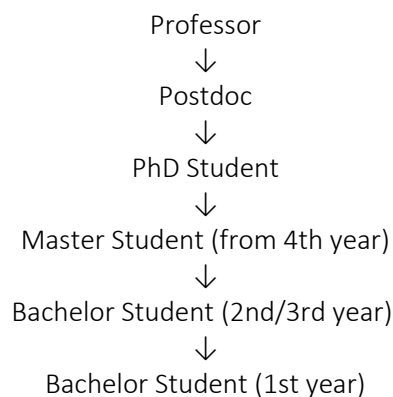
Even though the community of mentors consists of women at different stages of their careers, their hierarchy and different levels or seniority should not play a role when interacting in the framework of the mentoring program. The idea is that they jointly command a knowledge pool that is not only limited to scientific knowledge, but also individual personal experiences. Every mentor comes with her own personal history and her own wealth of knowledge, which may benefit other members of the network, no matter their ages or their places in the academic hierarchy.

We want to highlight this aspect: the impact of the mentoring program goes beyond the individual mentoring partnerships. It helps to create and establish a network at the institution or within the program which brings women scientists of different career stages together in a network that transcends the hierarchy. The mentorship program can thus be complemented by or embedded into other activities to foster the network building, for example monthly lunch breaks, joint discussion rounds, movie nights etc. which can address a wider group then the scientist participating in the mentoring

I.8 Mentoring pairs or groups

It is encouraged to let mentees choose between one-on-one mentoring and group mentoring. In the case of group mentoring, one mentor meets with 2 or 3 mentees at the same time, so that the mentees also interact with each other. Many mentees report lasting bonds with the peers from their mentoring groups and feeling encouraged by the contact with the other mentees. Mentoring groups are a good way of combing the benefits of traditional mentoring with peer mentoring.

Even in the context of group mentoring, mentors and mentees should be encouraged to meet one-on-one whenever the mentee wishes to discuss something in private. The organizer of the program should make clear that this is not an excessive demand on the mentor's time but a normal part of the mentoring relationship.

II. Launching and administrating the mentoring program

Before the launch of a mentoring program, some core decisions about the make-up of the program have to be made. Initiators and organizers might find the following checklist useful:

Checklist: decisions before the launch

1. Who can become a mentor/mentee?
2. How will potential mentors and mentees be recruited for the program?
3. How should mentors and mentees register?
4. When, how often, and how will a mentoring training take place?
5. Should there be other meetings for mentors and/or mentees?
6. How should mentors be matched with their mentees?
7. In what intervals and how should the organizers check in with the mentors and mentees?
8. When and how should the mentoring program be evaluated?
9. Should there be a certificate for mentors participating in the program?

The answers to these questions will depend, of course, on local conditions, and possibly on the emphasis that the initiators of the mentoring program might place on some of the mentoring goals. Below, we provide some experience-based guidelines and best practice examples (see Section V for a list of the provided material) which can be flexibly adjusted to the local needs.

II.1 The group of targeted mentors and mentees

Who should be allowed to become a mentor or a mentee largely depends on the academic system. Under some circumstances, the dropout rate of beginner math students is notoriously high; this tends to happen, for example, if students have to pick their majors right at the beginning of their university studies. In cases like this, first year students might need a lot of general support regarding methodological study competence and are better off in a (non-gender-specific) mentoring program for freshmen.
In academic systems which allow students to choose their majors later (e.g. at the end of sophomore year), mentoring programs that support women right from the beginning have been found quite helpful. The choice of a major or specialization can, in this case, be one of the leaks of the leaky pipeline, where women might drop out of a potential math career for reasons unrelated to their actual competences and interests.

II.2 Promoting the program to potential mentors and mentees

Promoting the mentoring program should be tailored to how potential participants can be reached most effectively, given local and structural circumstances. All-around advertising of the program on different communication channels ensures maximal reach. (Some potential mentors or mentees might not use social media, others might not regularly check their university emails, etc.) Ideally, the different channels are interconnected and refer to each other.

1. Email lists
2. Social media
3. Flyers
4. Posters

5. Newsletters
6. Personally contacting specific groups

Reaching out to potential mentors and mentees via email can be very efficient, since email distribution lists (e.g. of the math institute of a university) often allow to target very specific groups. However, an email advertising the mentoring program runs a risk of getting lost in the flood of emails that reach any user on a daily basis and not getting the recipients' attention.

Social media like Instagram, Facebook, Twitter, or others, are among the most used information channels of the student generation and should be integrated in the information strategy. It will vary from platform to platform what kind of content can be communicated most effectively. Instagram, for instance, is not adequate for longer texts, but can be used to generate attention (if possible using visual support) and to direct the users to a web page with more information. But also on other, more text-heavy platforms like Facebook it is advisable to keep the texts rather short and redirect the interested reader to the web page of the mentoring program.

Flyers and posters (to be put on display in highly frequented places of the university like the library) can also help generate attention, but text on posters should be very sparse.

Newsletters can put the past and future of the mentoring program into the focus: not only the current status of the program, but also past evaluations and successes and changes for the future are relevant. As such, newsletters are relevant for current participants of the mentoring program and possible future participants alike. It is important to include a link to further information and a contact.

It might be useful to personally reach out to new hires, incoming PhD students, etc. and inform them of the program, especially since these groups typically do not yet have well-established communication channels within the institute. However, this has to be approached very carefully, to avoid that they feel pressured to join the program.

It can be helpful to work together with the local institution, for example the local graduate school, student council, equal opportunity officers of the university, etc, to advertise the program and reach out to possible mentors and mentees.

The following checklist for promoting the mentoring program can be used when drafting emails, flyers, social media releases etc.:

Checklist: what information needs to be provided?
1. Goals of the program
2. Who can be a mentor/mentee?
3. Who organizes the program?
4. Link to the web page of the mentoring program
5. Link to registration and possibly a QR code
6. Contact for further questions
7. Possibly a reference to further information about mentoring
8. Possibly a reference to further information about women in science

II.3 Registration of mentors and mentees

All mentors and mentees need to be reachable (for the organizers as well as for each other). The straightforward way to ensure this is email, but many university members might prefer to be

contacted via a non-institutional email address; therefore it makes sense to ask at registration what each person's preferred mode of communication is. Reaching people via platforms such as ILIAS or Moodle takes typically longer than emailing them, since these platforms are not checked daily by many users.

Whether in the form of an online form, a fillable pdf, by email, or in person – registering for the mentoring program is also an opportunity for the organizers to get valuable information about future mentors and mentees. Their personal interests and goals might indicate who might be a good mentor for whom. After all, the mentor should be a person of trust for the mentee, and similarities might help create that trust and confidentiality. Suggestions for a questionnaire that helps match mentors and mentees can be found in the additional materials.

If the program targets a lot of potential mentors and mentees, registration via an online form might be useful: this makes it easy to administer large numbers of people, and the mentor/mentee matching can potentially be automated. However, registration via email or even in person might be enough. It may be useful to offer both in-person and email registration to accommodate people's personal preferences and facilitate the first contact with the program.

II.4 Scheduling the mentoring training

A mentoring training is necessary whenever a significant number of women joins the program. Each woman should participate in a training before becoming a mentor. If there is no training scheduled for the near future, interested women can in a first step join the program as mentees, without taking on the role of a mentor.

It is desirable to offer a training for the new mentors each semester (since the beginning of the semester is typically when now mentors and mentees join the program), or at least every year, but in practice the periodicity will depend on the turnover.

Trainings can be offered in longer or shorter sessions. It is important that the goals, the framework of the mentoring program, as well as expectations of mentors (and mentees) are clearly communicated.

If an external trainer is hired for the mentoring training, budgeting needs to be considered. Online trainings can usually be organized on a lower budget but come with some downsides: they will (and should) not allow for a large number of participants, and they give the participants less opportunity to bond as a group. It is recommended that the first training be in person; follow-up trainings (for mentors who join the program after the kick-off) can be held online.

II.5 Other events

The mentoring itself can be complemented by other events aiming at both strengthening the group cohesion among mentors and mentees and increasing visibility of women in math. Events that are mainly bonding activities for the mentors and mentees (like a hike or a pizza night) should be reserved to participants in the program. Other meetings, for example a monthly lunch break, or events that relate to the topic of women in science like talks of female mathematicians, joint museum visits, thematically related movie nights, etc. should be open to every member of the institution, regardless of participation in the program. These events help advertise the mentoring program to potential new mentors and mentees. They can also inform about the goals of the program and counteract the impression that the mentoring network is an intransparent, selective, or even secretive clique. Several of these events could also be open for all genders.

II.6 Matching (and re-matching) mentors and mentees

The idea of the mentor chain is that every mentee is matched to a mentor one step ahead in the career path (see Chapter I). Nevertheless, the more advanced the mentee is in her career, the less likely it is to guarantee such a match; in this case, it is acceptable that more than one career step separate mentor and mentee.

Overlap of hierarchical scientific relationships and mentoring relationships should by all means be avoided; e.g., a PhD student should not be mentored by her PhD advisor.
It goes without saying that explicit wishes for a matching should be taken into account, and that shared hobbies and interests of the mentor and the mentee can help strengthen the mentoring relationship. Many mentoring programs try to match mentors and mentees who have a similar scientific background. This might not be the best route to take for mentoring in the PhD/PostDoc phase, since the lack of women on these career levels often means that the mentee is in a position of dependence to all potential mentors with similar research interests.

Other factors to take into account are:

1. Should mentees preferably me matched with a mentor with a similar background? For instance, it might be helpful for a mentee from abroad to have a mentor with similar experiences of entering a foreign academic system. On the other hand, someone who has for a long time been familiar with the academic system from an inside perspective might be especially qualified for helping to navigate it.
2. Should mentees be matched with a mentor whose career goals are similar? Specifically, in countries where pre-service teachers of mathematics take part in the same university studies as math students (like in Germany), it might seem obvious that someone studying with the goal Bachelor of Education should be mentored by someone who is working towards a Master of Educations. However, changes of career plans are frequent, and nonstandard career paths like completing a Master of Education and then doing a PhD in math can be facilitated by matching mentors and mentees with mixed backgrounds.

To both these questions, there is obviously no one-size-fits-all answer.

The regular possibility of a re-matching (e.g. every semester or every year) is important as it provides an easy way to end mentor relationships and ensures that the mentees can benefit from the different experiences and perspectives of various mentors to get a broader outlook on their possible careers. However, if a mentee expresses the wish to continue her current mentoring relationship after the end of the turn, this should of course be respected. Mentors and mentees should be asked in an open-ended question whether they still wish to be part of the mentoring program, and whether they want to continue their current mentoring relationships.
Ending a mentoring relationship ahead of schedule should not be viewed as a failure on the part of the mentor or the mentee. If a mentor or mentee reports on unsolvable issues with her matching partner, it can be useful to initiate a dialog with both to find out more about the problem and whether it is an interpersonal problem or a feeling of excessive demands. The organizer of the mentoring program can act as a mediator, but the possibility of re-matching should always be on the table.
Re-matching can also be necessary in the absence of a conflict; if mentor and mentee cannot connect on a personal level or build some trust, the mentoring relationship does not fulfill its purpose.
It is important to not stigmatize the wish for a re-match and to communicate that mentors and mentees alike who wish for a new match are going to be heard.

II.8 Checking in with mentors and mentees

About once per semester, the organizers should check in with mentors and mentees alike. Checking in is important not only to know if the mentors need more support or resources, but also to assess if a re-matching is necessary, either because mentor or mentee have dropped out of math/academia, or because the mentoring relationship is not working out. However, checking in too frequently could be misinterpreted as controlling or overbearing.

II.9 Evaluation

Every mentor and mentee should be asked to give some feedback about if and how she felt the program was beneficial. A good time for a first evaluation of the program is 6 to 12 months after the launch. The program should be evaluated regularly (in view of mentors and mentees who joined the program later, as well as to take into account possible changes in the perception of the participants), ideally once a year. To ensure anonymity, many participants should be polled at the same time – this implies also that it is not good practice to poll the mentors/mentees when they drop out of the program.
If the main goal of the evaluation is to justify the continued existence of the program to externals (e.g. to funding agencies), it can be useful to formulate the poll in a way that allows for quantitative analysis, e.g. asking for multiple choice answers or answers on a Likert scale.
However, another important goal of the evaluation should be to further develop the program, adjust it better to local circumstances, and therefore ensure its quality. Asking open-ended question with free text answers will generally provide more detailed information.
An example for an evaluation questionnaire is provided in the additional materials.

II.10 Certificates

It is good practice to issue certificates to mentors and mentees who drop out of the program after active and successful participation. This is not only to recognize their commitment, but also to remind them of what the program has taught them. If the participants attended a mentoring training, it can be useful to their future careers to mention the training in the certificate.

III. Mentoring training

III.1 Goals of the training

The mentoring training aims at preparing its participants for their future role as mentors. More specifically, its goals are

1. to discuss the necessity of mentoring and its role in promoting woman in math,
2. to clarify the role of a mentor and the limits of a mentoring relationships,
3. to train participants in active listening and prepare them to adequately respond to their mentees,
4. specifically prepare the mentors for the first contact with their mentees, and
5. to transmit the core values of confidentiality and equality among all women in the mentoring program.

III.2 Framework conditions of the training

A number of participants between 6 and 12 is ideal. This makes it possible to have a lively fishbowl discussion (see below) and ensures a large variety of arguments brought forward in the discussion. A larger number of participants makes it difficult to give everyone the opportunity to be heard and to receive advice and suggestions, especially in the vignette module and for the preparation of the first meeting with their mentee(s).

The training benefits from a relaxed atmosphere; if the training is held in person, this can be supported by choosing a friendly location (not a classroom) and offering coffee or snacks.

Online trainings will need more frequent breaks than in person trainings and possibly an additional icebreaker. The schedule below does not specify break, with the understanding that breaks will be taken as needed.

III.2 Schedule (internal)

Module/content		Materials/tools	Duration
Introduction (Total duration: 25 min)			
Welcome	1. Welcome 2. Getting to know each other: introduction in pairs, introducing the partner to the plenum 3. Overview over schedule 4. Possibly: nomination of minute-takers	Schedule (external)	15 min
"Saboteurs"	Concerns, fears, expectations of the participants		10 min
Module I: Why mentoring for women in math? (Total duration of module: 45 min)			
Fishbowl	*"Are there not enough women in math? Should one take action?"*	Guiding question	45 min

	1. Division into two groups, explanation of method 5' 2. Preparation time 10' 3. Discussion 20' 4. Reflection of discussion and input 10'	Preparation materials	
Module II: What does mentoring (not) entail? (Total duration of module: 80 min)			
Mind map	What does the role of a mentor (not) entail?	Blackboard/whiteboard/flipchart	15 min
Input: feedback	Giving and receiving peer feedback		5 min
Role play with vignettes	1. One or two role play interactions in the plenum 10' 2. Breakout groups 35' 3. Reflection 15'	Vignettes List of contact points and further help Mentoring – how to	60 min
Module III: Preparing the first meeting with the mentee(s) (Total duration of module: 50 min)			
Input: ground rules and flexibility	Confidentiality, regular meetings, mentor pyramid, room for individual preferences	Blackboard/whiteboard/flipchart	10 min
Work in pairs: first meeting	Planning the first meeting with the mentee(s)	Pen & paper	40 min
Closing (Total duration: 15 min)			
	1. Flashlight "What did you (not) like, what was missing in the training?" 2. Invitation to the next event(s) (if applicable) 3. Encouraging to register for the mentoring program (if applicable)		15 min

III.3 Modules of the mentoring training

III.3.1 Introduction to the mentoring training

Minute-taking

Participants might want to take notes from the mentoring training. While taking notes helps some participants to focus, it can keep others from actively participating. Depending on the group of participants, one might therefore want to assign minute-taking duties, so that each participant is responsible for making understandable notes about one section of the training available to the others. However,

this would generate too much cognitive load for the participants of an online training, and one can also consider providing a handout.

"Saboteurs"

Reservations against measures that specifically promote the professional advancement of women are so widespread that usually even in the self-selected group of participants of the mentoring training, some (conscious or subconscious) doubts about the necessity and legitimacy of mentoring for women can be found. Moreover, some participants may be wary of the interactive parts of the training such as the role play and fear feeling exposed.

A negative attitude of one or more of the participants can easily spread to the other participants (verbally or nonverbally), so that they willingly or unwillingly end up "sabotaging" the training.

A good way to counter this proactively is asking the participants explicitly about their doubts about the program, as well as about their fears and concerns concerning the training.

Once the reservations against the program are made explicit, a space for discussion is created, and the (subconscious) negative attitude becomes a debatable and changeable opinion.

III.3.2 Workshop module: why mentoring for women in math?

In this section, the participants reflect on the goals of the mentoring program, its necessity, and its desired impact. They learn to counter arguments that discredit mentoring programs for women. The core part of this training module is a fishbowl discussion with the guiding question if there are enough women in math. The participants prepare for this discussion with the help of data about women in math as well as thought-provoking impulses that are provided in the form of handouts.

In the fishbowl discussion, the participants discuss the guiding question "Are there not enough women in math? Should one take action?". The participants split into two teams that have to defend opposing opinions in the fishbowl discussion (regardless of their actual opinions about that matter): either "Yes, there are not enough women in math, and action is needed!" or "No – woman who want to be in math are in math, there is no need for action!".

The fishbowl method

The participants are seated in two circles – an outer circle of listeners and an inner circle of speakers (the "fishbowl"). The inner circle engages in discussing the topic, moderated by a host. When a listener in the outer circle wants to contribute actively to the discussion, she takes up one of the free seats in the inner circle. When she does not wish to discuss any more, she makes room in the inner circle for another participant and goes back to a free seat in the outer circle.

Perks of the fishbowl method:

- Social interaction
- Being considerate towards the other participants is encouraged.
- Sense of active participation also for the persons in the outer circle.
- Smooth and frequent change of speakers makes provides a multitude of perspectives.
- Makes it unlikely to zone out since the seating arrangement puts everyone in the focus of the group.

Possible challenges and points to consider:

- The fishbowl method should be explained before the topic of discussion is introduced.

- Division into teams: both teams should be equal (in numbers, and if possible equal with respect to introversion/extroversion of the group members).
- Task and time frame need to be made clear.
- Preparation time for the participants to read the material, take notes, and think of a line of argumentation. It should be made clear if participants are expected to take notes.

Typical arguments:

We provide a non-exhaustive collection of arguments that are often brought forward by the debaters. Typically, the team arguing for action being needed formulated their arguments in reaction to the other team's argument, which is taken into account in the following list.

Team "No action is needed"	Team "Action is needed"
"Women are just not that interested in math, and we need to accept that."	"The percentage of women in math varies between countries, so it is implausible to assume that women are just inherently less interested in math. " "The leaky pipeline seems to indicate that in fact many women are interested in math but drop out nonetheless."
"If women want to give up their careers because they prioritize family, that's a perfectly valid choice and one should not try to interfere with it."	"It is unfair that only women are presented with the choice family vs. career." "Many women might drop out of a math career for reasons other than family. The real reasons might be less obvious, because it is more accepted by society to drop out for family reasons, as opposed to dropping out because of a perceived lack of support in the work group, subtle discrimination, or similar."
"It is patronizing to tell women to stay in math."	"Women are not forced or persuaded by their mentors to stay in math; the mentors merely show them options."
"Men are just naturally more gifted for math, so it's normal that there are more male math professors etc. "	"There is no evidence that men outperform women in math in secondary education. In fact, high school grades seem to even indicate the contrary."
"Some studies seem to indicate that men score higher on certain math related skills like spatial imagination, so we can assume that women are on average just not as gifted for math."	"Spatial imagination is largely irrelevant to modern mathematics. We have no empirical evidence that women are mathematically less talented."
"Many features are more or less Gaussian distributed in the population, and often the Gaussian curve of the male population has a larger standard deviation. It is therefore to be expected that while women might be on average as mathemati-	"The empirically unfounded assumption that the Gaussian distribution is a good approximation to reality even in the far ends of the curve is problematic." "It is inconsistent to assume that a feature is

cally talented as men, the outstanding talents on the far right of the curve are men. The leaky pipeline is therefore just a reflection of the distribution of talent and hence perfectly OK." | Gaussian distributed in both the male population, the female population, and the general population, since the combination of two Gaussian distributions is typically not a Gaussian distribution."

Reflection of the discussion

In a large majority of trainings, the team who argues against measures to promote women in math seems to "win" the debate. It is useful to discuss in what sense they won, and why this happened. It is worth drawing the participants' attention to the fact that we are usually more exposed to the arguments of the "no action needed" team, be it via the media, in conversations with colleagues/fellow students, or in our own private circles. Typically, the arguments brought forward by the "no action needed" team also tend to be more simplistic or at least easier to outline, which may generate the impression that this team won.

Quite frequently, the fishbowl discussion focuses on family related issues. The reflection phase of this module provides an opportunity to discuss why this happened and what other aspects were neglected. The trainer provides some input about possible means to promote gender equality in science like facilitating access to child care, networking opportunities for women, enhancing self-confidence of women, and creating an inclusive academic environment, with a focus on what mentoring can contribute.

III.3.3 What does mentoring (not) entail?

Mindmap: what does mentoring (not) entail?

The trainer asks the participants to brainstorm their ideas of what a mentoring relationship comprises and where its limits are. If (some of) the participants had previous contact with mentoring programs, they should be encouraged to think back to their experiences. The role of a mentor is contrasted with other roles which might have partial overlap (e.g. a tutor, a supervisor, a friend, a coach, a counselor, etc.), and the differences are highlighted. The key points are compiled in a mind map on the blackboard/white board/flipchart.

Input: peer feedback

The following exercise in breakout groups includes giving and receiving feedback. It is therefore beneficial that the participants reflect on the goals and rules of feedback before starting out with the exercise, especially since people tend to hesitate to give others feedback, whether out of fear to disturb the harmony of the relationship, or for being afraid of causing negative emotions like embarrassment, anger, or hurt. The group discusses these causes and what can be done to deal with these hurdles, like asking for permission to give feedback, clarifying the goals, including positive feedback, and structuring the feedback.

The trainer lays down some ground rules for how the participants should give and receive feedback during the following role play exercise. This can be along the following lines:

Giving feedback:

1. Include the positive aspects. We tend to focus on negative aspects, but positive feedback is equally helpful; your peer might not be aware of what they accidentally did right; it is important to reinforce successful behavior.

2. Be constructive. Think about how your peer can implement your feedback. Make suggestions for alternative behavior if you can.
3. Be concrete. Give examples for everything you say about the interaction.
4. Be respectful. Be aware that your evaluation of the interaction is just your opinion, and your peer has the right to disagree.

Receiving feedback:

1. There is no need to justify or explain yourself.
2. Listen to everything and try to understand the perspective of your peer.
3. You do not need to reach an agreement with the person giving you feedback.
4. Be respectful.

The scope of this reflection of feedback is wider than providing the appropriate backdrop for the following exercise, since mentoring itself includes feedback (in both directions).
The trainer therefore stresses that these feedback rules should also be followed throughout the mentoring relationship.

Role play "mentor – mentee"

The goal of this exercise is to try out possible interactions in realistic situations that may arise in the context of mentoring, and to reflect upon own beliefs, attitudes, and habits relevant to a mentoring partnership.
The exchange of opinions in the group of future mentors does not only provide feedback on how the mentor (in the role play) acted, but also widens the imagination and the spectrum of possible actions in a given mentoring situation for every participant.
Moreover, the open interaction strengthens the group cohesion among the mentors.
The task can be described to the participants of the training in roughly the following words:

> *Imagine meeting one of your mentees. During the conversation, different problems or questions (be they scientific, organizational, or private) may come up. The role play will train you to flexibly and adequately react to these different situations. The vignettes describe realistic concerns or questions the mentee may have. In groups of 3 to 4, you will take turns in playing the mentor, the mentee, and an impartial observer who can give feedback on the interaction.*

The "mentee" reads out loud the vignette (see additional material), or – better yet – acts according to it and presents the content of the vignette in her own words. The mentor reacts to the mentee's concern, and both discuss the topic as they would in a regular mentoring meeting. After the interaction, the "mentee" is the first to say how that interaction made her feel and which of the "mentor's" actions were helpful; then the "mentor" evaluates the interaction from her point of view. Lastly and most importantly, the observers give feedback and suggest alternative possibilities of action for the "mentor". Then the roles of mentor, mentee, and observer are swapped; the next interaction uses another vignette. After one or two interactions in the plenary group, the participants break up into groups of 3 or 4. The trainer switches between the groups, listens in, and gives feedback and suggestions – but only after every other member of the small group got a chance to speak.
To make the training more realistic, each participant should train to mentor someone of the same career level as her future mentee; that is, if the participant is a PhD student, her training partner should play the role of a master student, etc. Accordingly, the vignettes with the roles in the additional materials are ordered according to the different roles. It can be helpful to print the vignettes on paper of different color, each color symbolizing a role (e.g. master student).

In the plenary, the participants report their experiences from the breakout groups. Possible questions to ask include:

1. What went well?
2. What was difficult?
3. Did you agree in your assessments of the interactions? If not, why?
4. For what role scenario did your group not find a satisfactory solution?
5. What possible situations that didn't come up in the role play worry you?

This is a good point in the training to familiarize the participants with points of contact and further help that they may use to redirect their mentees whenever the question or issue of the mentee is outside the scope of mentoring or outside the competence of the mentor. An example of such a list (ranging from the campus counselor and the equal opportunities officer to information points about student loans and student housing) is included in the additional materials, but of course it needs to be tailored to the local conditions.

III.3.3 Preparing for the first meeting with the mentee(s)

Input: defining mentoring goals

The trainer discusses the importance of goals with the participants. The mentors should help their mentees define their goals for the mentoring relationship. Such a goal might be individual career development, a difficult transition step, participation in academic self-governance, or making contacts in a new environment. The trainer stresses that defining and evaluating goals should include the following steps:

1. The mentee formulates her goals and a time frame to achieve them.
2. The mentee defines criteria that allow her to determine if she has achieved her goals.
3. The mentee reflects on the feasibility of the goals and the time frame.
4. The mentee reflects on how she would like her mentor to help her achieve her goals.

The participants are asked to help their mentees with these steps in the first meeting(s) and to use these goals to formulate a mentoring agreement, possibly in written form.

Input: ground rules and flexibility

The trainer recalls the following fundamental aspects of the mentoring program:

1. Confidentiality between mentor and mentee goes both ways. It gives both parties the possibility to share personal experiences in a protected environment.
2. The mentoring chain ensures that every mentor can ask her mentor for advice, also concerning her own mentee (as long as she keeps confidentiality).
3. Regular meetings, if possible in an informal setting, help build trust. It is crucial to build the mentoring relationship before the mentee encounters problems or questions she needs her mentor for.

4. Within this framework of confidentiality and trust, there is room for individual preferences. It is, for instance, up to mentors and mentees to decide if they keep in touch via a messenger service or a conference tool, if they meet at the university or go for joint walks – as long as both parties feel comfortable with the setting.

Partner exercise: preparing for the first meeting

The participants work in pairs to prepare for the first meeting with their mentee(s). This is an important step to lower the psychological barrier of contacting and meeting with the mentee, who is usually a stranger. A detailed idea of how a first meeting could take place makes it easier to contact the mentee and helps to reduce possible nervousness or tension.
The participants are asked to imagine in detail what a first meeting could be like. They are guided by the following questions:

1. Where do you want to suggest to meet (online, in a café, for a walk, at the university, …)?
2. What do you want to ask your mentee(s) about herself/themselves?
3. What do you want to tell your mentee(s) about yourself?
4. How do you want to stay in contact with your mentee(s)? E.g. do you propose to already set up a second meeting, do you propose to email/text, etc., how often are you usually going to meet?

The result of the work in pairs can be discussed in the plenum; if time permits, two or three participants can volunteer to present their ideas for the first meeting.

IV. List of additional materials

IV.1 For the launch and administration of the mentoring program

1. Emails templates
2. Templates and examples for promoting the program
3. Questionnaires: registration and evaluation
4. Example "Contact points and further help"

IV.2 Materials for the mentoring training

1. Schedule (external)
2. Preparation material for fishbowl discussion
3. Instruction handouts: a) guiding question for fishbowl discussion
                              b) instructions for planning the first meeting
4. Vignettes for the role play
5. List of contact points and further help (template; to be adjusted to local circumstances)
6. Mentoring – how to

V. Further reading

V.1 About mentoring

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