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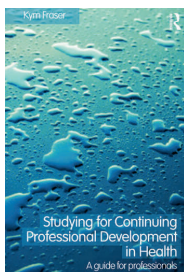
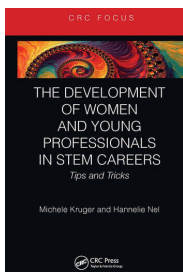
Professional Development for Careers in STEM



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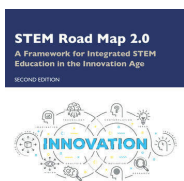
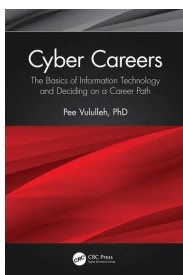
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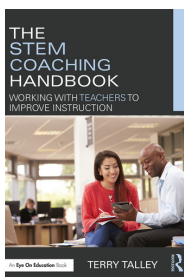
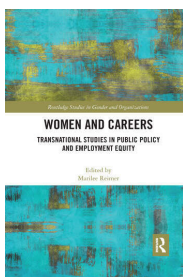
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Thinking Strategically about Your Career

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Ok, penguins, now that you “know yourself,” you have an inkling about your passion, and you can put EI to use, the next step is to help you navigate your career as a young professional/woman in STEM. This is where I teach you tips and tricks to fast track your career and set yourself up for success. This is the part where you don’t have to make all the mistakes I did, but make your own! Then write your book to help others! I dare you!

3.1 YOUR ATTITUDE DETERMINES YOUR ALTITUDE

As a young professional, it is easy to think that your employer owes you training, great projects, lots of money, promotion, and so on. **Your employer owes you nothing!** Huh? “But what about a salary?” I hear you say. Well, my friend, if you are not contributing by bringing in work (in other words, money) or doing a great job on projects, you are not even owed that, as you will be on the retrenchment list. But what will set you apart and keep you off that list is your attitude.

3.1.1 Attitude, Attitude, Attitude and Working Hard

Have I said it enough? Your attitude will dictate your success in life. Many employers feel that they can teach you the skills required by the job, if they have to choose from a similar list of suitably qualified people. But one thing that cannot be taught is the right attitude. That you are not just there for the salary, but to make a difference, take the company/division forward, and be the best team member! Remember, you are being paid while you are building your experience/CV!

Similarly, being able to work in a cohesive team, understanding the value of synergy, and **putting the team before yourself**, those things are imperative to any employer. Note how the above does not require an individual winner, as life rarely does.

Finally, the best attitude is the one that recognizes that in the end, hard work will not only be recognized, but appreciated, while amassing the required skills and experience to become a first-class person in STEM. In business, you can be the cleverest person in the room, but if you can't work hard, work in synergy as a team, and bring in the money, you are useless to the business. Just work hard on the above and the rewards will come. Work on that which you can control: your attitude and bringing all you have to the team.

3.1.2 Asking for Work

Do anything. Do everything. No, you are not above doing any job. **ANY JOB!**

Once it is known that you are the willing, enthusiastic, up-for-anything employee, it will allow you not only to grow your skills, but give your manager confidence that the tough projects are ideally handled by you, as you enjoy the challenge and you deliver. And honestly, which project would you rather have on your CV? Smooth seas do not make for good sailors and all involved will appreciate that. How will you hone your skills without challenges?

Then, once a promotion presents itself, it will not go to the employee that easily navigated the easy task (not memorable at all), it will go to the employee that was challenged and came out on top through collaboration, hard work, and resilience (very memorable). Even if you failed at the task, the fact that you were willing to attempt it, and take inventive steps to overcome challenges, will ensure you stand out from the crowd.

Ask for the tough stuff; it will lead to personal growth and promotion!

3.1.3 Seeing Obstacles as Opportunities

If it were easy, everybody would do it. Yes, I know you are sick of hearing this, but no truer words were ever spoken. If it is difficult, chances are you are lucky enough to generate a job out of it and be able to take care of yourself and your family.

If you are faced with a difficult task at work, instead of getting angry with management, you should view this as an opportunity to show what you are made of. Rise to the challenge and just **try**! Fortune favors the brave! What favors those that don't try at all?

I want you to view everything as if it were your own entrepreneurial business. If there is something that is “hard,” that creates an “opportunity” for you to do it instead of others, thus creating a job/business opportunity/advantage to promotion, why not try?

No one is going to think you are great for just doing your job. You get a salary for that. How will you make yourself memorable?

3.1.4 Getting Involved—The Story of a Bar Lady

No, it's not what you think. In my first job, after a period of time, buying stock for the company bar, packing fridges, and being bar lady every Friday afternoon at 4 pm fell to me. I took the task on with gusto! Why? Because we were a national company and the only way I could meet the national managers is when they came to the bar on a Friday after management and board meetings.

I was professional and friendly. When they later found that I was doing my bit on the business side and busting my butt, it was easier to talk about me, because they knew who “Michele” was—the friendly, professional bar lady assisting them on Fridays.

If you are the proverbial introvert, not participating in company activities (in other words, “I already give enough of my time during business hours”), then how do you expect to be promoted when no one knows who you are? When you are not willing to sacrifice personal time for company activities and be visual and friendly?

You are creating the image that you feel you are above the company. Don't. Participate and contribute to the company. It shows commitment and will give you a platform to show off your leadership skills. And your awesomeness, of course!

3.2 TAKING RESPONSIBILITY

3.2.1 Take Initiative

One of the most defining moments in my career was when I was supposed to design a treatment plant as part of a large team at my organization. My boss communicated to me that we would have a meeting where the different roles and responsibilities would be assigned.

Time came and went, yet the meeting just didn't take place. As I was new to the company and absolutely everyone in the team had more seniority than me, I was stumped. I felt new and did not want to point out that the lack of planning would come back to bite us. I also felt that as the lowest ranking person I could not arrange the meeting either. What I was feeling was the approaching speed of the oncoming deadline!

Eventually I went to the manager I felt most comfortable with and asked if I could start with some initial work just to better understand the problem. He agreed, and so I started putting the initial study together. Still the meeting with all the designers did not materialize. After completing the initial study, it was easy to move to the next step of the design. I roped in another newbie engineer and we started tackling the beast, so to speak. Still, no big meeting materialized. We just kept going until the design was done. And we made the deadline. That thing that clients value most.

Now look, it wasn't all just that easy. The other designers felt left out and were upset that the design was "given" to the less experienced ones (us). No good deed shall go unpunished—but on the back of this I was given a huge promotion, which to this day I still value and appreciate. The managers realized that we had taken initiative and delivered on time. That was the biggest lesson that anyone can get on taking the initiative.

If something needs to get done, take it on and do it! It's a big, beautiful opportunity!

3.2.2 Taking on Responsibility

Early in your career, the idea of taking on responsibility seems extremely daunting. You are still trying to figure out what you're doing and come to work every day feeling scared. All that you are hoping for is that one day soon you can do your job without fear.

Now, am I asking you to take on more? Yes, yes, I am, little penguin. No, I am not trying to torture you; I am trying to get you the best possible start in your career. You will not learn anything if you aren't being challenged. Smooth seas don't make for good sailors (again). I am saying the more you take on, the faster you will learn, and the faster the fear will leave you. Also, this will lead to faster promotions.

Not only that, but you will be known as the person who has **gumption** (look up this definition!), takes up a challenge, and has the right attitude, regardless of any typical hurdles such as age, gender, or race. You will be judged on merit and nothing else because you deserve it!

Hard as it may seem to believe, having gumption is the exception, not the rule. If you want to stand out and be noticed, have gumption!

3.2.3 Learning to Make Decisions, Even Wrong Ones

Every day of my life, something happens to point out to me that fortune favors the brave. In this instance, being brave is being able to make a decision: using the knowledge at hand to make an impartial, possibly wrong decision, but a decision nonetheless.

The great thing is that your boss knows you are likely to make mistakes; it's human. It's also how you learn. But to sit around and not make a single decision is a road to disaster. You will be known as the spineless one who constantly needs to defer to management/someone else. Not on my watch, my little penguin!

I am not talking about leaving a question unanswered due to the fact that you need more information; I am talking about not wanting to take a decision out of fear, even if it may seem obvious. Gumption, people!

If you are not sure, ask, but please do not sit back in fear. Like a colleague of mine once said: Every day without a decision can cost millions, so have the gumption to do something about the problem!

3.2.4 Making My Boss's Life Easier

Your boss is also just human. Someone with dreams, ambitions, and the need for others to like them. They too want to be successful, appreciated, and recognized. Just like you.

There is a reason someone is your boss, respect that. Make their lives easier by thinking ahead and becoming indispensable. Insist on going to meetings

with them so you can learn from them. The best part of this is also learning where they need help and providing it. And if it all goes horribly wrong, you learn how not to do things! As you know it's not easy to acknowledge that you are not coping and your function as a subordinate is to provide support to your boss. Support away!

Be proactive in taking on tasks that will lift some of the burden on your boss, but indicate you are doing so to free up time for your boss to find more business opportunities, otherwise they may feel threatened by you. That's another book.

3.2.5 Working on a Team

The best way to forge a good relationship with your colleagues is to work on the synergy that comes with being part of their team, but also know that you need not always take the credit. There is a famous saying that goes: **"If you don't need to take the credit, you can move mountains."** So, decide: do you want to move mountains and make this world a better place, or do you want to have credit for something much smaller because your pride will stifle the project?

This is also relevant when working in teams or across business units. Who cares who did what? The **TEAM** made it happen. The **TEAM** can make it happen again, or even bigger ... if you will let them!

3.2.6 Deadlines

Deadlines are non-negotiable. If you want to annoy your boss, colleagues, or clients, miss a deadline. Deadlines are usually time sensitive for a reason, be it funding, need, or politics, it doesn't matter. You set the deadline yourself (most probably). If you want to be famous for anything, be famous for the one always making their deadlines. **ALWAYS**. Enough said.

3.2.7 Becoming Aware of My Own Productivity

Do you waste a lot of time on email, social media, and chatting to colleagues? Take into consideration: what are you being paid for? Being productive. If you were spending your own money as a client on you, would you be happy with your productivity? Should the bosses have to choose to retrench or promote someone, would it be you (due to your current productivity)?

Why does it matter? It matters because there are other people out there like you, other companies like yours, and the only differentiating factor if you are delivering the same quality is: Yup, you guessed it, productivity, earning per hour for effort put in.

Don't be the one that's easy to get rid of.

3.2.8 Relationships with Clients

Clients are just people, too. People with families, financial pressures at home and at work, trying to deliver the best possible solutions for their stakeholders. They, too, are held accountable for the quality, budget, and time it takes you to deliver whatever project you need to do. They, too, just want to look good to their managers and advance up their career ladders.

Making your client look good is a win-win situation. Ultimately the people for whom you are delivering the service, for example the community, will win when the project is delivered on time, at a high quality and within budget. You win, the client wins, the community wins. Yay!

3.2.9 Making Promises

You Made a Promise. Keep It. If the production of the relevant deliverable is in your hands, you keep your promise. No excuses. **You made a promise!** Make sure that you are realistic about the deadlines you set for yourself and communicate with your client. It is **always** better to under-promise and then over-deliver, exceeding expectations!

However, if the production of the relevant deliverable is not in your hands, don't make a promise you can't keep. Do **NOT** promise your client that you can deliver within a certain time if you have not checked with your team. You will be setting your team, yourself, and your client up for failure.

3.2.10 Be Consistent

People don't want nice (promises of early delivery), they just want consistency. They want you to deliver a quality product on time, every time. **Consistently.**

Clients and co-workers also want you to be consistent in your behavior. They want to know who will be arriving at work tomorrow and what can be expected of them. They don't want a friendly, high-performer one day and a grumpy under-performer the next.

This applies to every part of your life: family, community, and at work. Just be consistent. In your behavior, in your delivery, and in your love. This creates a safe and secure environment for everyone involved.

3.3 PROFESSIONAL REGISTRATION IN STEM

3.3.1 Why You Should Do It

One of the most powerful yet most feared tools in our professions is professional registration. “Ag, no Michele! I don’t wannaaaa ... and it’s sooooo hard!” I hear you say. And that, my dear penguin, is exactly why you should do it!

“But there is so much prejudice and it’s often unfair!” I hear you add. This is where I have to defend these professional bodies (for which I served on a committee). I want you to put your EI hat on: Imagine how difficult it is to hand out professional registration without upsetting someone, keeping standards high, and still complying with government legislation. Oh and of course, still being able to convince volunteers to give up their own precious time to do the assessments, yet still being able to pay administrative salaries so that the registrations can roll out. And on top of all this, try to stay relevant and try to preach benefits of being registered. Not so quick to criticize **now**, are you.

Yes, it’s hard. It’s supposed to be! It tells people you know what you are talking about. Professional registration implies **you made it in your profession** and you have not only the skills to implement what is required of you at a very high standard, but **MOST IMPORTANTLY**—you know when to say that you don’t have the skill, experience, or knowledge to do what you are asked of you. We all have different fields of specialization, mine being water and wastewater treatment process design. I am a professionally registered engineer. Under **NO** conditions should I ever be involved in the structural design of these treatment structures, unless I retrain myself in the structural design field. Don’t be shy or afraid to say you cannot do something; it’s not your field of expertise, and that the client should employ a specialist. Just as a geotechnical specialist will never tell me what process units I should use, I will never take a chance and ignore their recommendations. You know what you know ... don’t mess around, as your registration will be stripped from you should you be negligent or found acting recklessly. Just don’t go there. **EVER!**

Tied to your professional registration will inevitably be you signing some sort of code of ethics applicable to your field and legislation. This implies that every client will have a way to reach you should you act unethically, mess the client around, or try to rip them off financially. Just don't do it. **EVER!**

3.3.2 Tips on Registration

One of the best tips I can give you is to convey (depending on the specific requirements) **EXACTLY** what you did and how you were the hero. Think of it as a semi-interview: Why you should make it into a special club.

Use your wording carefully. Instead of saying "I was involved in..." say "I was responsible for ..." or "I specifically did..." Remember, the tea lady was to an extent also "involved" in your project. She made sure you stayed awake and made your deadline!

Be very specific. If you were the one interviewing you, what would you want to hear? Just a vague reference to a project, or something that would give you the confidence to give the stamp of approval, knowing your name is on that stamp? Give the people doing the assessment the confidence (and evidence) they need to give you this great honor. Otherwise, you just didn't earn it in their view, although in your head you know you did. So, coming back to registration being "unfair"—is it really unfair or are you just being unclear/lazy/arrogant in your communication? Why should these people put their heads on a block for you? Give them good reason to do so.

Another important tip is to write up your experience as you finish a project. One of the most difficult tasks is to try and remember what you did 5 or 10 years ago and then try to find your manager of back then to sign off on it. Even worse, what if you did not leave the previous company amicably? How are you going to get that experience signed off on? If you write as you go along, your report is ready by the time you have enough experience.

It's important to remember that registration is in your hands, not your mentor's/manager's. If you are spending years doing the same thing, you won't be eligible to register. It's up to you to find out what experience you need and to put pressure on your manager, ensuring you cover all the experience required in the least amount of years. If you don't, this can lead to a situation where you are not eligible for promotion, which may require registration.

1 Preparing to study

Learning outcomes

By the end of this chapter readers are expected to be able to:

- identify different types of continuing professional development (CPD)
- articulate reasons for choosing a particular type of CPD, and
- identify questions to ask a course teacher before enrolling in a course.

Introduction

Health care professionals (HCPs) engage in continuing professional development (CPD) as a matter of course throughout their careers. On a day-to-day basis CPD can be as informal as learning on the job by watching colleagues or reading professional journals and magazines. Regularly the CPD in which we engage is more formal; for example supervision of our work by a colleague, attending workshops and enrolling in accredited courses. While formal CPD is the focus of this book, the ideas of learning that we discuss can equally be applied to the informal CPD in which we regularly engage.

Enrolling in an accredited course, regardless of the level or length of commitment that is required, can be daunting. Any course that we take will require a commitment, not just from us but often from our families and our employers. In this chapter I want to discuss that commitment in terms of the reasons for enrolling in a course, impact on family, and the impact on us as individuals.

Preparing to undertake formal CPD

When it comes to learning, we have choices and it really helps to know what those choices are so we can make conscious decisions about how we plan to engage with CPD. Believe it or not, the reasons why we undertake formal CPD can influence the ways in which we choose to engage with the

course; they can influence the ways in which we choose to learn. Reasons for engaging in CPD include:

- we need a particular qualification to remain in our current position or to move into another position
- we want to learn new skills in order to improve our practice
- we want to improve our understanding in order to improve our practice, and
- our employer wants us to enrol in a specific CPD course.

This isn't an exhaustive list and it is highly likely that more than one reason underpins our choosing to study. Put simply, if we enrol in a course because we need the qualification, and we aren't particularly concerned with what we learn from the course, we may choose to put in a minimum effort just to pass the course. We can choose to memorise information, knowing that while this is quicker than learning for understanding, it is unlikely that we will remember this information much past the assessment of the course. On the other hand, if we want to enhance our understanding and learn new skills, then we will need to study in such a way that we can make sense of the course, for example by applying new ideas to our work environment, choosing our assignment topics so that they can influence the work that we do, and so on. Different ways of learning is the topic of Chapter 3. There is nothing wrong with being strategic about how you choose to study. What's important is that you know that there are different ways to learn and that there are pros and cons with each way.

Choosing the course that is right for you

So what sort of CPD makes sense for you at this time in your life? The reasons why we want to undertake CPD will help us to choose the CPD opportunity that will be of most use to us. Table 1.1 shows a range of possibilities, from enrolling in a master's level course through to having a company representative demonstrate a new product. If it makes sense for you to take a course, and you have determined the level (non-accredited/accredited/postgraduate/undergraduate level), you may find that there are numerous options from which you can choose. Your time is precious and it is important to check out the alternatives so that you choose the course that is most relevant and useful to you. There are some common factors to look for in a course, regardless of the level of course. Are there clear opportunities for you to seek the support of teachers? Will the assessment help you to learn and to apply information to your work context? Is there a mix of learning opportunities provided (e.g. group work, case studies, lectures, etc.)? It is worth investigating a couple of courses to determine which one suits you best. Course descriptions and frequently asked questions (FAQs) are usually provided on the institution's website.

Table 1.1 Different reasons for undertaking continual professional development (CPD) can influence the type of CPD that may be relevant

<i>Reason for undertaking CPD</i>	<i>Type of CPD that may be appropriate</i>
Promotion requires a particular qualification – e.g. a master's degree.	University-accredited courses or courses from the relevant professional body. Talk with colleagues about their experiences of courses available and select one that suits your requirements.
Need to learn a discrete skill, or a discrete set of information – e.g. about a new drug.	A practical workshop; a meeting with a company representative; one-to-one demonstration from a peer; supervision etc.
Need to understand a substantial area of information and skills and demonstrate that you have that understanding.	Assessed undergraduate or postgraduate level, accredited course or module; a series of interrelated workshops; professional journal articles or books combined with supervision.
Requirement for your practice, such as a Nursing and Midwifery Council requirement.	Accredited course.

Advice from colleagues can be invaluable. In particular, colleagues who have taken a course in which you are considering enrolling can comment knowledgeably on the course and the teaching of the course (refer to the section 'Ways teachers help students to learn' in Chapter 3 to see the sorts of things that constitute good teaching practice). I also suggest taking the time to talk with the course director or teacher. Talk with them about any aspects that you want insight into. Find out what their role is and what support they can provide you with to help you to complete the course successfully. You may want to find out how much study time you will need each week, what resources are provided, what the assessments are and what equipment you might need (for example a computer with internet access). You might also ask to be put in touch with a recent student of the course. It will be your precious time and effort that you spend on the course. A little 'homework' in choosing the right course can make the world of difference to your learning experience.

Time commitment and support

Completing a CPD course takes time and effort. Even if our employer provides time to attend the workshop/course, we will need to devote our own time to complete the assessments and study requirements. Doing so is often at the cost of spending time with family and friends or pursuing other activities. It's highly likely that your own time already has many demands placed upon it. For example, you may have family responsibilities such as shopping for an elderly parent, your share of household responsibilities (cooking/cleaning/grocery shopping/bill paying and so on), child care, etc.

To enrol in a course of study, you will need periods of uninterrupted time when you feel able to study and you may well need to negotiate support to make this time available. (This aspect is discussed further in Chapter 2.)

Having chosen to do a course that will require commitment of your own time outside of work, it's important to involve the people in your life if you anticipate needing their support and understanding. Do the people in your life who can support you:

- know why you are taking the course?
- understand how much time you will need each week to devote to this work?, and
- know what you need from them in order for you to succeed?

Before undertaking a course it is useful to articulate the reasons for studying, the barriers to studying and ways to engage family and friends in helping you to successfully complete the course.

Ourselves as learners

Confidence and motivation are keys to learning, as they are to most things in life. Sometimes our confidence about learning is low because of our learning experiences earlier in life. We need to remember that we learn all of the time in our everyday lives. We learnt to drive (perhaps), we learn to use new systems and processes at work, many of us learnt how to raise children, etc. The list is endless. Every one of us knows how to learn in particular situations and every one of us can learn how to learn for formal CPD. Like most things, becoming better at learning takes some practice, time and thought.

It takes time to develop all of the elements that contribute to the successful completion of CPD courses (e.g. writing, reading, study strategies, learning approaches). Be kind to yourself. Your work will improve with time, effort, feedback and reflection. Only you can give yourself the opportunity to improve. Sometimes you will need a tip or a strategy to improve; at other times you will need something more substantive than a 'quick fix'. You may need to rethink your approaches and experiment to find what works best for you. This book will help you to think about and practise your learning. Your family, friends and colleagues may also be helpful. We will explore 'learning' in Chapter 3.

Case studies

In this book you will be introduced to three different fictional health care professionals or 'characters'. In many of the chapters a character's particular situation, struggles and successes will be explored in relation to the topic of the chapter. The characters are representative of different types of real-life

situations. One of the characters may reflect your situation or perhaps particular issues and concerns that are relevant to you may be found in different characters. My reason for including each of these characters is to make the ideas found in the chapters come alive and make sense.

Marisa

Marisa is a forty-three-year-old registered nurse who has recently taken up a position as a practice nurse in a local GP clinic. The clinic has six full-time doctors, two practice nurses, a health care support worker and two receptionists. The practice has decided to run a monthly diabetes clinic and Marisa has been asked to run the clinic. Marisa has never run a diabetes clinic and knows very little about diabetes.

Marisa and Susan, one of the practice GPs, have discussed the professional development and support that Marisa will need to help her to take on this responsibility. There are lots of different possibilities from which to choose. There are several one-day diabetes workshops that Marisa can attend, or she can read a diabetes text or journal articles, or she can enrol in a university-accredited course at the graduate or undergraduate level. Because of the knowledge and skill level required, they have agreed that Marisa will enrol in an undergraduate level course of 20–30 credit points. Susan has agreed that the clinic will pay for the course and provide Marisa with time to attend any face-to-face commitments. Marisa will study and write assignments in her own time. Also, Marisa will observe several clinics of the diabetes specialist nurse (DSN) in the local diabetes team and will be supervised by the DSN for the first three months of clinics that Marisa holds. After that she will call the local diabetes team if she needs advice or is uncertain about the care of a diabetes patient.

Ben

Ben is twenty-two and has worked in various jobs since finishing his A levels when he was eighteen. After spending two months in hospital as a patient he decided that he wants to work as a health care professional. He has been accepted to do a Diploma of General Nursing at the local university. Ben is about to start his first year of the course and has moved into his parents' home.

Kris

Kris is fifty-one years old and is a ward sister of a twenty-four-bed surgical ward. She is responsible for managing a junior ward sister, six staff nurses and eight health care support workers. Kris works 9a.m–5p.m. in her current role. She did her training in her late thirties and became a nurse at forty when her children were teenagers. Kris is a single parent.

She has been a ward sister for two years and is interested in applying for promotion to manager of the surgical ward. This role would increase her responsibilities to include budget holding, development of protocols, staff CPD, and development of the service, and increase the number of wards within her remit. In her recent appraisal Kris and her line manager agreed that Kris would do the Diploma in Health Service Management through the Royal College of Nursing Institute. To do this course Kris will need to complete six, undergraduate level-2, 20-credit-point modules. They are each fourteen weeks long and Kris expects to complete the course within two years.

The next chapter

In this chapter we discussed choosing the course that will meet your learning needs, engendering support from family and friends to help you complete your course of study and we briefly touched on building confidence to study. In the next chapter we will look at the nitty gritty specifics of managing our study – where and when to study, motivation to study, planning our study and studying with people.

FORMING AN IT CAREER PLAN

7.1 Introduction

Businesses worldwide are now using the latest technologies to stay ahead of their competitors. Consequently, the need for skilled, educated, and capable IT professionals is growing drastically.

The process of carrier planning is time consuming but plays a crucial role in reaching one's target goals within a required timeframe. One may suffer long-term consequences if one does not plan properly. What individuals want to achieve in their life's work is fundamental to who they are. Every individual creates his/her own unique experience that forms their perspective on the world. One's job preferences will be guided in part by his/her previous experiences as well as influenced by his/her environment, mindset, and the resources available to them. An individual's impressions about his/her culture, personality, and resources may affect his/her career choices. One should develop informed and realistic career aspirations to get the most out of his/her studies and reach his/her initial career goals. Career planning in IT is essential as it will help an individual assess and select the right options from among the many sectors in the field, such as software, hardware, networking, and much more.

7.2 Getting Started in Information Technology

Many of those who pursue IT careers are also drawn to the values of teamwork, helping people, overcoming challenges, and positively changing the world. If you are looking for a position that will regularly test you, pay well, and offer opportunities for advancement, a career in information technology is a great place to start. Since IT career options are diverse, the first step to consider is to focus on what

you enjoy or hate about what you are doing *now* and what you want to do *next*. Think about whether you wish to continue in your current direction or take a different one.

When you have settled on a plan of action, write down the steps you need to take along the way. Do your homework and consult with experts in the field to get their guidance. Reflect upon and take note of any shortcomings you will need to address so as not to hinder you from completing your next moves. Identify deficiencies that could make you less marketable as an applicant and seek to strengthen those by networking or obtaining a credential.

7.3 Identify Your Passions

If you are looking for a role that makes you happy, the IT field has specialties from which to select. Research what you feel would be the perfect match for you, determine your own personal interests first, and then seek to satisfy them in the professional sphere. Consider the following questions for yourself:

- What level of interest do I have in IT?
- Why do I think I should try an IT career?
- What do I do on the computer when I am not working?
- Does my browsing background have anything to do with resolving a technological issue?
- Do I like troubleshooting technological problems?
- Do I like learning new things?

Whether it is about ourselves or other people, passion can be difficult to describe and articulate; however, we all acknowledge it when we notice it. Passion is what drives you to conquer challenges and reach your goals.

Today, everything is impacted by technology; hence, many factors go into people's passions when it comes to IT. If you keep up with technology and the pace at which it advances, you may crave to transform this hobby into a profession. As an IT professional, you will help your customers and enable your organization to reach its goals. Businesses depend on IT to help them meet their challenges, making IT professionals indispensable.

7.4 Shorten Your Interest List

Successful self-evaluation helps narrow down your interest list and provides a checklist of your career ambitions. We are all passionate about doing something, but we might have too many passions. Sometimes, our passions may not sustain us, or the passion we have may not suit our professional life. It is quite common for people to possess too many interests and not decide how to focus on just one. With limited time it is impossible to focus on all, so we must narrow them down to spend more time developing expertise in the one or a few that are most important to us.

After you have explored your career interest, you should next research the career itself. The process can be time consuming depending on the field or the current job market. You may want to talk to people who are already in the career, or find volunteer work, internships, or part-time work to gather more information. Your activities in these areas will help you narrow down your interests and determine what you truly care about.

Aligning your passions with your professional life gives you comfort and helps you live a fulfilling and sustainable life. Many people have multiple interests and talents, but emphasizing one or a few is a better use of one's time. Being resilient and persistent in a particular interest can lead to success. Developing a personal philosophy will guide you toward your goal and keep you on track. Engaging in multiple activities such as internships, volunteer work, and freelancing might help you focus on one thing.

7.5 Network

We live in a social world where our lives require interacting with other people. Building relationships in IT is vital to succeeding in your career. Networking is the most powerful way to further your progress in your career. In the sense of career growth, networking helps you form relationships to assist you in achieving your career goals. Via networking, people share advice and knowledge relevant to resumes, cover letters, job search strategies, and events or seminars.

Networking can happen in physical or virtual spaces and can happen anytime. Remember that each new partnership you form extends

your network, and this in turn gets you closer to success. There are a number of networking techniques to use that can be highly effective. Let's consider some of these in the next section.

7.6 Networking Techniques

Professional organizations. Professional organizations host meetings, conferences, and activities that will be attended by important people in the field. For example, you can find out more about companies such as the Association for Computing Machinery (ACM), the world's largest academic and informational computing society. If you become a member, you can gain access to professionals with whom to connect and build your professional network.

Volunteering. Even if you volunteer outside of your profession, volunteering can lead to meeting new people who can help you advance in your career. Interacting with others and pursuing shared interests allow you to keep contacts that can benefit you in the future. Several companies offer students paid and unpaid internships to help them develop essential skills for their profession as well as the opportunity to meet new people.

Expert experience. You can reach out to people in your chosen field and seek their expertise and experience. Experienced professionals can help you in your own progress by sharing how they chose their field and what makes them successful.

Part-time employment. While full-time employment is your main goal, filling in some gaps with a part-time job could help you find associates and contacts who can assist your professional network. It also enables you to gain valuable knowledge along the way, which can be used on your curriculum vitae.

7.7 Build a Robust Curriculum Vitae

Your curriculum vitae (CV) demonstrates to employers that you have the required expertise to do the job. To prepare for an IT career, you will need a solid CV that accurately reflects your skills. Detail all

acquired education, experiences, internships, achievements, and anything relevant to your role.

Building a good CV requires examining the job requirements and learning about the organization. This will give you the knowledge to add information that is essential to the work since recruiters often have little time to review a CV. During your interview, you will be given a chance to expand on any skills that were not included in your CV.

7.8 Go on the Job Hunt

Job hunting is a vital aspect of a reliable career plan in IT. There are different types of jobs that are categorized under IT, so understanding the different types is crucial. Payment scale and the overall objectivity of a given job are key factors to observe while conducting a job hunt in IT. Before applying for a job, it is essential to understand the job type as well as its required skills, functions, and duties.

A professional IT expert can help you to find the right direction in job searching. They can provide sound knowledge about expanding your knowledge and how it can apply to your profession. It is essential to know what kind of questions might be asked in an interview. A person might need to practice discussing information security, for instance, to help him or her to do well in an interview. Before you apply for a job, it is always essential to determine which job characteristics relate to your passion. If your interests are not related to your job, it will just be a waste of your time and it will not give you the satisfaction you want to achieve through your professional work.

Social media platforms such as Facebook, Instagram, and WhatsApp can be good sources of job listings. LinkedIn is the biggest platform for job advertisements. Here you can find only work-related posts to help build your profession. Based on an individual's qualifications, it remains highly essential to cross-check all IT jobs at your disposal and make the right decisions about the most promising ones. This eventually translates into job satisfaction and general career growth.

7.9 Chapter Summary

As technology continues to advance there will be an increased demand for IT-skilled professionals who can help take business and

organizations to the next level. If an individual plans to embark on an IT career, he/she must choose a career plan that entails organizing a training path and setting goals. Many organizations provide training on various IT skills via online videos. Individuals can utilize such services to acquire the required knowledge to execute their job duties and plan for certifications as part of developing their CV.

Information technology is the best career option for reasons such as good pay, career stability, and positive work and life balance. The wide range of jobs in the IT field allows people to choose any type of job they are interested in. Producing a good career plan, committing oneself to learning, and adapting to technological changes can help you achieve career goals. By choosing an IT career, you also help society as everything in today's world runs on technology. A career in IT will offer growth potential and an excellent opportunity to turn your talents and passions into a career.

Chapter Review Questions

1. Why is career planning in IT essential and crucial?
2. Name two considerations when forming an IT Career Plan.
3. A career in IT will offer growth potential and an excellent opportunity to turn your talent into a career. Do you agree or disagree with this statement? Why and why not?

10 Effective STEM Professional Development

Carla C. Johnson and Toni A. Sondergeld

Need for Professional Development to Change Practice

As the knowledge base on educational reform and improving teacher quality has grown over the past decade (e.g. Darling-Hammond, 2010; Desimone, 2009; Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2007; Putnam & Borko, 1997), it has become more evident that traditional professional development (PD) formats do not result in sustained improvement of teacher practice and/or student learning. Fortunately, we know a great deal about what types of PD experiences translate into changes in teacher practice that are linked to growth in student learning of STEM content and skills. Desimone (2009) conducted an extensive review of published research in this area and developed a *Core Conceptual Framework for Professional Development* that included five key components that were consistently connected to programs that produced results in either teacher or student outcomes. *The Core Conceptual Framework for Professional Development* requires collective participation, active learning, coherence with policy, extended duration, and a focus on learning new skills in the context of building content knowledge. Each of the five components will be described in detail in the following paragraphs.

Collective Participation

The likelihood of teacher participation in PD resulting in change in teacher practice is increased when more than one teacher from any given school is included in the opportunity (e.g. Desimone, Porter, Garet, Yoon, & Birman, 2002; Johnson, Kahle, & Fargo, 2007). Further, collective participation also improves the sustainability of change in teacher practice (e.g. Johnson, Fargo, & Kahle, 2010). Teacher PD is very constructivist in nature, as teachers attend workshops with other teachers and engage in discourse about their practice as they consider new strategies and grow their understanding of content and of their own students. Unfortunately, less effort is placed on keeping participants connected following the PD, and participants devote their time to implementing

new practice and have little availability to reach out to those outside of their school/district.

Recently, more PD programs have purposefully required teams of teachers to participate, and the results have indicated that informal and formal professional learning communities are established. With teams of teachers from the same district or building participating, teachers have an in-house support system for implementing what are often challenging changes to their pedagogy. Collective participation ensures more buy-in to the reform on the school level and provides much needed support to improve the odds of achieving intended outcomes for teachers and students of the STEM PD program. Collective participation is also a key component of PD focused on achieving integrated STEM instruction. Teams of teachers should be provided time to plan together as well as learning together and reflecting on implementation of integrated STEM curriculum (such as the STEM Road Map). Therefore, collective participation during PD and also during school planning time is a critical component for adoption of the STEM Road Map curriculum.

Active Learning

Active learning experiences within PD have been strongly linked to positive teacher outcomes (Baniower & Shimkus, 2004; Darling-Hammond, 1997; Johnson, 2011; Johnson & Fargo, 2010). Moving from a teacher-centered classroom toward implementing PBL and integrated STEM requires opportunities for teachers to experience the curriculum they will deliver and acquire the new content and skills in the context of the learner. Therefore, traditional PD format of “sit and get” focus is not adequate, and in many cases, these types of PD result in little to no change in practice. Active learning should comprise at least 80% of the duration of the PD program. The PD facilitators should model the use of skills as they deliver new content to participants. Teachers should grapple with trying to solve the same problems their students will be presented with and should also be engaged in reflecting on how the new activities and/or curriculum might look in their own classes and what types of accommodations will be necessary to meet the needs of all learners. Next, participants should have opportunities to practice delivery of new instructional models and content with their peers in the PD setting.

Coherence

PD programs have the best chance of impact on teacher and student outcomes when the goals of the PD program are aligned with policies at the school, district, and state levels as well as existing teacher beliefs regarding STEM. This is an area of challenge for some programs, as a focus on STEM or the teaching of science is sometimes not a priority of a school and/or district due to increased high-stakes testing pressures in the areas

of mathematics and language arts (e.g. Fullan, 1993; Johnson, 2013). However, for schools intending to adopt the STEM Road Map as their curricular guide and tool for delivery of instruction, alignment should be a non-issue. One challenge in the area of coherence may be existing teacher beliefs regarding the integration of STEM across the curriculum, which is required for STEM Road Map implementation. Schools/districts moving forward with the STEM Road Map should spend some time in discussing the benefits of integration with teachers and provide support for teachers to learn and implement new PBL pedagogy as well as time to plan with other teachers.

Duration

We have learned a great deal regarding the duration of PD programs over the past decade and now understand that for change in practice to take place, over 80 hours of PD must occur (e.g. Banilower, Heck, & Weiss, 2007; Cohen & Hill, 2001; Fullan, 1993; Guskey, 1994; Johnson & Fargo, 2010; Supovitz & Turner, 2001). Further, these contact hours should be spread across at least one academic year of implementation to provide support for teachers as they are using the new pedagogical content knowledge with their own students and reflecting on the outcomes. Formats that have been used in many settings include 5–10 days of PD in the summer followed by monthly sessions on Saturday or a released day from school. This allows the PD facilitator to provide just-in-time support for teachers who may be struggling with implementation or may need to have critical feedback from their peers on how things are working in their classrooms. The duration of PD for teachers who are using the STEM Road Map curriculum will also be essential to be delivered in this format to provide opportunities as described above but also to allow for teams of teachers to plan for delivery of the various PBLs across the school year.

Content Knowledge

At the elementary and middle school levels, a focus on content knowledge within PD has been fairly a routine as most teachers in these grades do not have a bachelor's degree in the specific content area. Research has shown that the most effective PD programs include new strategies taught within the context of the content that will be delivered (e.g. Gonzales et al., 2003). The STEM Road Map will require teachers to be familiar with some content (big ideas) from other disciplines in order to engage in discourse with their students regarding their work on associated projects/problems. Therefore, PD focused on enabling teachers to implement the STEM Road Map curriculum modules should have a clear and purposeful focus on STEM content knowledge included in each grade-level's curriculum.

Further Support for the Components of Effective STEM PD

In addition to Desimone's (2009) study, the Core Conceptual Framework for PD was examined in statewide implementations of STEM PD programs funded through Race to the Top. The programs ranged from K-2 focus on mathematics, science, and/or engineering and literacy to elementary, middle, and high school STEM-focused PD. While specific content covered in the PD varied, all programs were required to be developed with a focus on collective participation, active learning, coherence with policy, extended duration, and building content knowledge in order to be funded by the state initiative. The overall findings revealed a positive impact overall for the state on enabling teacher quality in STEM areas to be significantly improved as a result of participation in the program (i.e. Johnson, Sondergeld, & Walton, 2017). More specifically, analysis of content knowledge assessments, surveys, and direct teacher instructional observations data revealed that implementing the Core Conceptual Framework for PD in each of the STEM PD programs led to significant increases in teacher content knowledge, beliefs, and attitudes toward reformed-based STEM instruction and implementation of reform-based methods in the classroom across programs. Thus, regardless of the grade level or content area focused on, the Core Conceptual Framework for PD demonstrated its effectiveness for promoting PD that improved teacher quality.

Data-Driven PD

When teachers are learning to implement new instructional practices learned through PD, there is a need for regular and collaborative formative evaluation (Guskey, 1997; Joyce & Showers, 2002). Formative evaluation means teachers, administrators, and/or PD providers collaboratively examine standardized and informal data sources to inform the direction and assess the effectiveness of PD implementation. Data such as standardized test results, classroom pre-post assessments, student and teacher surveys, and teacher observations should all be used to inform decisions about PD.

Using data to drive decision-making in PD should not be linear in fashion. Rather, it needs to be a cycle of inquiry used to provide information to PD developers and educators. This reflective cycle should be continuous and focus on questions such as "What are the most effective strategies for improving student learning?" and "What are the instructional needs of my classroom?" (Hayes & Robnolt, 2010). With these questions in mind goals about classroom instruction, student achievement can be collaboratively developed based on the data. To promote this process of data-driven PD, time needs to be set aside for teachers

and PD developers to meet and discuss data, goals, and the direction of PD. This also means that PD developers must be flexible enough to modify PD content based on student and teacher needs that become evident through this data-driven process. Further, this process must be structured in such a way that teachers are taught to collect, interpret, and use data since this is not typically a skill teachers learn in their traditional educational training.

Using a data-driven PD process allows teachers to take greater ownership over their learning and implementation of the PD. When teachers are involved in data-based discussions about the effectiveness of the PD in their classrooms, they typically develop greater buy-in to the initiative. Resultantly, higher levels of teacher buy-in have been shown to produce increased levels of implementation fidelity and greater chance of long-term initiative sustainability (Datnow & Stringfield, 2000).

Creating Individual STEM Professional Development Plans

In today's era of accountability, many states and districts require teachers to create yearly Individual Professional Development Plans (IPDP) (e.g. Massachusetts, New Jersey, Ohio, Vermont). Oftentimes these IPDPs are a component of the state's teacher evaluation system, and templates for completing an IPDP are frequently provided by states or school districts. Regardless of the state, IPDPs serve as a tool to help teachers meet their professional learning needs with the ultimate goal of improving student learning. Additionally, IPDPs need to be aligned with state standards for teacher learning and continuous improvement and are typically evaluated for their effectiveness in providing teachers with the skills needed to be effective in the classroom.

To develop a STEM IPDP, a five-step process should be undertaken: (1) determine PD needs, (2) set goals, (3) identify resources, (4) develop timeline, and (5) reflection. First, educators must self-assess to determine their PD needs. Student data along with professional experiences should be used to drive this stage. For instance, if a teacher notices her students are struggling in a particular area of the curriculum or realizes that due to content standard changes in the state she will be teaching something new that she is not entirely confident about, she might choose either of these areas to look for PD citing these reasons as justification.

Once area(s) of needed PD are identified, specific goals related to the STEM PD content should be set. These goals must also align with state PD standards and need to be measurable. One might think of a teacher's STEM PD goal as similar to a student-learning target. With this in mind, a specific STEM PD goal might be something like "Incorporate more integrated STEM project-based learning into my classroom instruction." This is measurable in that the teacher can actually track if they do this

or not by comparing what they did over the last few years to after they receive integrated STEM PBL PD.

After specific PD goals are established, teachers need to identify where they will be able to obtain the PD aligned with their goals and determine a timeline for completion. Often, school districts do not have the resources or expertise on staff to enable delivery of individualized PD plans. Teachers should explore their local universities and regional education centers as a source of potential professional growth opportunities. Also, with the increasing emphasis and focus on STEM, many informal education agencies and business/industry partners have sponsored workshops and learning experiences for teachers and students. As we shared in this chapter, it is important to build a plan for your PD that includes the key components of effective PD. Therefore, when you develop your plan, you should build a collection of experiences that are related that extend across the academic year that include both short-term and long-term goals to be achieved throughout the STEM PD.

Finally, teachers should be reflective of their STEM PD experiences since their IPDP is most likely a component of their state's teacher evaluation system. STEM PD reflection should be a continuous process whereby teachers are examining their own confidence and beliefs about their new teaching content and practices they are learning. It is also critical that teachers consider the impact of their new STEM PD on their student learning as measured by classroom assessments, standardized tests, and/or student attitudes toward doing STEM class work. Establishing a reflective feedback loop between STEM PD and teacher/student outcomes allows school leaders to ensure that educators are receiving the tools needed to be successful in the promoting student learning.

Planning for District-Level STEM PD

District-level PD should be planned strategically with as much attention to individualization for teachers as possible. It is clear that district-level PD has historically focused on very general skills and strategies that all teachers are required to attend. Unfortunately, this approach does not tend to the need for teachers to continue to advance their individual pedagogical content expertise and most who attend these types of sessions do not feel connected and likely do not receive the intended benefit of the PD.

Schools that are planning to move toward implementing a grade level, program, or whole school STEM focus should approach PD for the staff in a very collaborative manner. First and foremost, teachers will need collaborative planning time beyond any time that is provided within the PD to ensure success of implementation. This is something that school leaders should consider and make necessary accommodations for up front. Second, the PD should be structured to provide an interactive overview

of integrated STEM. Allow for teachers to participate in a STEM learning environment and to discuss how they individually and as a discipline fit within an integrated STEM context. Third, intensive PD on problem and/or project-based learning and engineering design thinking should be provided to ensure that all teachers are empowered to utilize this STEM pedagogy. Finally, a majority of the PD time should be focused on providing teacher teams facilitated time to develop PBL topics and modules aligned with the context of the school or to take STEM Road Map modules and modify as necessary. Encourage teachers to implement at least two modules (four to five weeks) in the first year of the STEM effort. Finally, district-level PD should include a focus on measuring individual teacher growth and the transformation of the learning environment. Encourage teachers to engage in reflection on their practice and to use this as a way to iteratively develop their own PD plans for the future.

References

- Banilower, E. R., Heck, D. J., & Weiss, I. R. (2007). Can professional development make the vision of the standards a reality? The impact of the National Science Foundation's Local Systemic Change through Teacher Enhancement Initiative. *Journal of Research in Science Teaching*, 44(3), 375–395.
- Banilower, E. R. & Shimkus, E. (2004). *Professional development observation study*. Chapel Hill, NC: Horizon Research.
- Cohen, D. K., & Hill, H. C. (2001). *Learning policy: When state education reform works*. New Haven, CT: Yale University Press.
- Darling-Hammond, L. (1997). *Doing what matters most: Investing in quality teaching*. New York, NY: National Commission on Teaching and America's Future.
- Darling-Hammond, L. (2010). *The flat world and education: How America's commitment to equity will determine our future*. New York, NY: Teachers College Press.
- Datnow, A., & Stringfield, S. (2000). Working together for reliable school reform. *Journal of Education for Students Placed at Risk*, 5(1), 183–204.
- Desimone, L. M. (2009). Improving impact studies of teachers' professional development: Toward better conceptualizations and measures. *Educational Researcher*, 38(3), 181–199.
- Desimone, L., Porter, A. C., Garet, M., Yoon, K. S., & Birman, B. (2002). Does professional development change teachers' instruction? Results from a three-year study. *Educational Evaluation and Policy Analysis*, 24(2), 81–112.
- Fullan, M. (1993). *Change forces: Probing the depth of educational reform*. New York: Falmer.
- Gonzales, P., Guzman, J. C., Partelow, L., Pahlke, E., Jocelyn, L., Kastberg, D., & Williams, T. (2003). *Highlights of the trend in International Mathematics and Science Study (TIMSS)*. <https://nces.ed.gov/timss/>
- Guskey, T. R. (1994). Results-oriented professional development: In search of an optimal mix of effective practices. *Journal of Staff Development*, 15(4), 42–50.

- Guskey, T. R. (1997). Research needs to link professional development and student learning. *Journal of Staff Development*, 18, 36–40.
- Hayes, L. L., & Robnolt, V. J. (2010). Data-driven professional development: The professional development plan for a reading excellence act school. *Reading Research and Instruction*, 46(2), 95–119.
- Johnson, C. C. (2011). The road to culturally relevant science: Exploring how teachers navigate change in pedagogy. *Journal of Research in Science Teaching*, 48(2), 170–198.
- Johnson, C. C. (2013). Educational turbulence: The influence of macro and micro policy on science education reform. *Journal of Science Teacher Education*, 24(4), 693–715.
- Johnson, C. C., & Fargo, J. D. (2010). Urban school reform through transformative professional development: Impact on teacher change and student learning of science. *Urban Education*, 45(1), 4–29.
- Johnson, C. C., Fargo, J. D., & Kahle, J. B. (2010). The cumulative and residual impact of a systemic reform program on teacher change and student learning of science. *School Science and Mathematics*, 110(3), 144–159.
- Johnson, C. C., Kahle, J. B., & Fargo, J. (2007). A study of sustained, whole-school, professional development on student achievement in science. *Journal of Research in Science Teaching*, 44(6), 775–786.
- Johnson, C. C., Sondergeld, T. A., & Walton, J. (2017). A statewide implementation of the critical features of professional development: Impact on teacher outcomes. *School Science and Mathematics*, 117(8), 350–351.
- Joyce, B., & Showers, B. (2002). *Student achievement through staff development* (3rd ed.). Alexandria, VA: Association for Supervision and Curriculum Development.
- Loucks-Horsley, S., Love, N., Stiles, K. E., Mundry, S., & Hewson, P. W. (2007). *Designing professional development for teachers of mathematics and science*. Thousand Oaks, CA: Corwin Press.
- Putnam, R., & Borko, H. (1997). Teacher learning: Implications of new views of cognition. In B. J. Biddle, T. L. Good, & I. F. Goodston (Eds.), *The international handbook of teachers and teaching* (pp. 1223–1296). Dordrecht, The Netherlands: Kluwer.
- Supovitz, J. A., & Turner, H. M. (2001). The effects of professional development on science teaching practices and classroom culture. *Journal of Research in Science Teaching*, 37(9), 963–980.

7 Diversity and Inclusion in Institutional Development in Science and Engineering in Switzerland

A Bird's-Eye View

Ursula Gut

Introduction

This chapter explores different perspectives on power and privilege in the context of institutional development and diversity in academia. It addresses the question of how to introduce and enhance the institutional¹ embedding of processes that facilitate innovation in research, fairness and inclusion in parallel, using a mixed compilation of theories and research results from different domains, including sociology, social and organisational psychology as well as system theory. It also explores underlying patterns that tend to self-perpetuate prevailing structures or offer promising approaches to foster open-minded and adaptive organisations.²

It also draws on my direct observations and data obtained on the current situation of male and female researchers during my practical experience as an institutional developer and diversity coordinator. The data and reflections should throw light on the interface between diversity and inclusion practice, and selected theoretical approaches as well as help to deal with the current situation as an essential first step towards increased fairness, diversity and inclusion.

Methods

Data collected recently by the Human Resource Department of the Swiss Federal Institute of Forest, Snow and Landscape Research (WSL) was statistically analyzed. The focus was on interactions within the organisation with white female researchers as an example of a minority group working in the domain of natural science research in Switzerland. Further input came from direct observations as a participant in the Swiss Federal Institutes of Technology (ETH) Domain,³ the outcomes of organisational surveys at WSL and inputs from an interview cycle with the members of the human resources (HR) board of the ETH Domain and the members of the Directorate of WSL. The analysis was intended

to contribute to the general understanding of key conditions researchers need to meet in academia, and drew on explanatory theories and research results from the literature.

The theoretical analysis was based on the work of Geoffrey Hodgson (2006), who provides clear definitions of terms such as ‘institution’ and ‘organisation’. Dobbin et al. (2011) provide a set of preconditions to explain and analyze the degree of inclusiveness of an organisation at a given point in time. Lenski’s analysis (1984) on power and privilege, as well as the theoretical framework of Luhmann (2012), offers relief from conceptual impasse and helps to enlarge perspectives. The latter in particular is helpful for understanding communication processes. In addition, Davidson (2011) on leveraging differences provides a new focus on the domain of managing and coordinating diversity.

These different theoretical perspectives and studies suggest that a substantial growth in fairness and inclusion depends on multiple factors, such as the prevailing culture of an organisation and existing societal norms as well as the relative proportion of diversity groups in a given organisation. In essence, they offer different approaches to addressing the question as to why a shift towards more inclusive environments is challenging. They also provide conceptual frameworks that challenge prejudice and may generate promising ideas to foster inclusion in practice.

Findings

A glance at the basic essentials of life situations of most researchers, in particular of those younger than 40 years, reveals that their work setting is becoming increasingly demanding. Research is driven by a permanent competition for the best ranking positions within worldwide measurement systems based on quantitative indicators comparable to those in banking. To assure survival and success, academic organisations, especially those at the top of the league, have optimised production by radically increasing flexibility, which requires an increased job mobility of researchers. All organisations of the ETH Domain are tending to raise the number of short-term contracts. At WSL, 55 per cent of the male researchers and 80 per cent of the female researchers worked in non-permanent positions in 2014. In addition, openings regarding permanent positions are reserved for experienced researchers in highly specialised research or technical domains.

At the same time, the performance mandate of the Swiss Federal Council for the ETH Domain for the period 2013–2016 states, among other things: ‘It will support women at all levels and in all functional groups. It will ensure a substantial increase in the proportion of women in management positions and on decision-making bodies’. The Swiss Federal mandate unlocks a wide area between gender-oriented policies and the realities in practice.

As an example, in 2014 at WSL, 321 persons worked in research; of these, 198 were male, and 123 were female. Nine men were in the position of head of department, but only one woman was. Similarly, there were 34 male and 5 female group leaders (see Table 7.1). Furthermore, all of the WSL Directorate were white males. Some of the researchers worked in permanent positions. All scientists in a higher hierarchical position than researcher occupied permanent positions. At WSL the probability of obtaining a permanent job in research averaged roughly 10 per cent for the 35–39 age group in 2014. As a result, most hierarchical decision-making power, as well as most prestige, is still in the hands of white males.

According to the ETH Domain's political performance mandate, a multitude of projects, such as the 'Fix the leaky pipeline training program' of the ETH Domain and various other equal opportunity programmes, have been, and still are, carried out. In most research organisations, few of them have led to sustainable embedded processes or have had a measurable impact on the distribution of career or leadership positions according to gender. Only one of the four research organisations, headed by a woman director, does better, which fits in with the findings of Dobbin et al. (2011, p. 386) that suggest that 'firms that lack workforce diversity are no more likely than others to adopt [diversity] programs, but firms with large contingents of women managers are more likely to do so'.

The research organisations in the ETH Domain produce excellent research and are correspondingly ranked high; however, there is no clear functional necessity for more diversity and inclusion. Under these circumstances, what basic understanding of diversity and inclusion best fits the current situation? Which type of embedding best serves the purpose of the organisations' 'key business': namely to produce

Table 7.1 Percent of WSL Scientists in Different Hierarchical Levels

<i>Position</i>	<i>Male</i>	<i>Female</i>
Short-term temporary staff	3.0	8.1
Trainees	4.6	10.6
PhD students	21.2	21.1
Post Docs	7.6	13.8
Research assistants	4.0	8.1
Researchers	35.4	31.7
Group leaders	17.2	4.1
Senior scientists	1.5	0.8
Program leaders	1.0	0.8
Department leaders	4.6	0.8
Grand total	100.00	100.00

Source: WSL, Human Resources Department 2014 (pers. comm.).

high-quality research generating innovation? How does this fit with the research organisations' aim to continuously improve their ranking positions with respect to production indicators, such as number of papers published in renowned journals? And what about the goal of the Swiss Federal performance mandate to enhance equal opportunity and fairness?

Diversity coordination in the past has, in practice, been mostly understood as a kind of service involving trouble shooting. Diversity seems to have been perceived as a source of potential problems that might hinder knowledge production. The activities of the Human Resources Department were mainly taken up with handling a growing number of non-permanent contracts, with little capacity to consider diversity issues. The political performance mandate of the ETH Board, however, implies that the WSL Directorate is interested in diversity in the context of real institutional development and sees benefits in including diversity groups, such as women, different age groups or members of different hierarchical levels (Davidson, 2011; Lenski, 1984).

To better understand what type of benefit such a decision-making body may perceive as being motivating, the question 'who gets what and why?' (Lenski, 1984, p. 1), or more formally what represents power, privilege and prestige in academia, will be briefly examined. According to Lenski, privilege and prestige are defined as a function of power, where power is the key variable. Furthermore, power is based on commonly accepted laws and rules of persuasion and incentive. Some groups in academia benefit from the privilege of a permanent position, whereas others do not. They have higher incomes and more decision-making rights and duties within the organisation due to their position. The commonly accepted convention of competitiveness is a major individual, group and organisational driver. In practice, each male or female researcher, including the members of the decision-making body and of other minority groups, is part of the system driven by the worldwide ranking system (h-index) of publication performance. They function as agents of the consensus to strive for additional power, privilege and prestige within the system.

Dobbin et al. (2011, p. 387) suggest that 'for legitimacy-enhancing innovations adoption will be driven primarily by corporate culture, not by need [for more diversity]. More important than a firm's ... susceptibility to regulatory scrutiny will be its past pattern of attentiveness to social norms'. To a certain extent, within WSL and the ETH Domain, no effective social norm or pressure exists with explicit constraints issued by male peer groups or decision-making bodies related to equal opportunity regarding minority groups or increased diversity per se. Indeed, the subliminal message is to advertise positions emphasising equal opportunity to allow female career opportunities and to use politically correct wording. Practice shows, however, that the often assumed norm

that research in natural sciences is traditionally reserved for men has not yet been completely extinguished in either male or female minds.

Direct observations indicate that most male researchers, especially those who are part of a decision-making body, are either very sensitive to issues related to equal career opportunities for female researchers or members of other minority groups or not interested in them at all. Real or potential requests from members of any minority group tend to immediately provoke conscious or unconscious resistance. Members of decision-making bodies and most male HR managers seem to behave as if they were brought to bay whenever the issue arises on the horizon. Most discussion partners then compete in producing a multitude of arguments. Decision-making bodies seem to consider activities to facilitate the organisational embedding of processes enhancing the inclusion of minority groups as part of an important political, but not pressing, project.

From the observations, experience and interviews, however, it is clear that each member of a decision-making body is in some respect part of a minority group due to their age, position in the hierarchy and so on, and feels occasionally unfairly treated. In 2014, the Directorate of WSL decided to widen the perspective by creating a staff function embracing institutional development as well as diversity. In practice, this involved implementing conceptual outcomes in the development of the institute through staff development activities and open discussion of diversity and inclusion issues. Positive effects are already apparent since discussions have become more open and fruitful. Furthermore, most members of the decision-making body and the research staff sense that they may benefit personally from jointly developed actions.

Taking Action on Survey Outcomes: Inclusive Institutional Development Policy and Strategies, Training Modules, Focus on Career: Work-Life Balance and Facilitating Day Care

The results of a staff survey on possible domains of action regarding different groups of researchers, such as part-time workers, researchers with young children and members of the decision-making body, as well as a list of propositions established in collaboration with the staff council, led to the following steps being selected for 2015 by the Directorate of WSL. Most of the actions are designed to cover at the same time a current organisational challenge (a need) and to improve the working conditions of a particular minority group. As an example, training modules to optimise the annual performance appraisals, including individual development in career opportunity discussions, will be introduced to all members of the decision-making body from the position of group leader onwards. Other examples are the introduction of two bottom-up sounding board processes that will consider possible improvements for

long-term researchers older than 58 years and, with respect to a work-life balance, collect best practice on how to facilitate childcare.

At WSL, a process of institutional development means making a joint effort to gradually adapt prevailing and often unconscious norms and rules towards a naturally embedded construction of a more inclusive environment for different minority groups. These groups include those based on age, gender and different positions in the hierarchy. Since literally everybody is part of at least one minority group due to their personal characteristics, a development towards more inclusiveness may also increase their effectiveness to contributing to qualitatively high-end research and help to enhance communication and managerial skills.

From the point of view of the Diversity Coordinator, these developments may serve to promote diverse teams with members from often very different backgrounds and with different ways of thinking. This should foster more acceptance of different values and ways of doing something and enhance people's willingness to openly discuss any perceived fields of tension. The following statement on gender diversity could serve as a basis for all minority groups: 'Gender diversity can provide different perspectives and insights. The combination of these offers a wider range of ideas and, thus, greater creativity, facilitating decision-making processes' (Díaz-García et al., 2013).

Another interesting and recent development is that the Directorate of WSL decided to implement a subgroup as a task force to shorten the decision-making processes for institutional development and diversity, including staff development issues. The task force is composed of the associate general director, two directors representing the research departments, the head of finance and HR as well as the institutional developer and diversity coordinator. Research results from Dobbin et al. (2011) suggest that the most effective actions to foster diverse and inclusive organisations are task forces and mentoring programmes. Therefore, this decision to implement a task force can be considered a first valuable, trendsetting step.

Conclusions

Promoting the development of a more inclusive environment in an organisation means encouraging a more diverse group of employees. This is challenging in the technical world of natural science research in Switzerland as a corresponding boost in performance is not directly evident from the point of view of traditionally white male-dominated decision-making bodies. Consequently they tend, at first, to see no functional necessity to foster diversity and inclusion. Conscious or unconscious adherence to prevailing peer group values and goals at individual, group and organisational levels often serves to perpetuate the present situation. As the report of the European Commission EUR 24905 (2011)

suggests, the majority of academic organisations in Europe and Switzerland are currently similar in their settings. However, both theory and research findings indicate that diverse populations can do better than monocultures since different task-oriented points of view foster better quality decision-making and team performance (Díaz-García et al., 2013). Leveraging differences helps to improve the results of the 'key business' (Davidson, 2011).

The research findings of Dobbin et al. (2015) 'suggest that the regulation of specific behaviour may backfire, but that engaging people in helping to achieve organisational goals may succeed by influencing their motives'. Insights drawn from my experience in and reflection on institutional development and diversity at WSL and the ETH Domain lead to the same conclusions.

According to Luhmann (2013), power and communication function as a result of selection processes to reduce complexity in order to benefit organisations.⁴ The function of power can thus be described as a generalisation of the relevance of individual decision-making processes. The members of decision-making bodies have power due to their positions in the organisation. Moreover, the receiver of any message is free to select from a range of messages, according to his/her individual selection processes. Thus the members of decision-making bodies are not forced to comply with prevailing norms or prevailing peer group values, especially if they could hinder the development of their organisation towards more innovation and inclusiveness.

The people with the most power, privilege and prestige in an organisation may still choose to help to create structures and processes to enhance the fair treatment of very different individuals. In the end, this will also usually be in their own personal interests.

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Notes

- 1 'Institutions are systems of established and embedded social rules that structure social interactions' (Hodgson, 2006, p. 18).
- 2 'Organisations are special institutions that involve (a) criteria to establish their boundaries and to distinguish their members from nonmembers, (b) principles of sovereignty concerning who is in charge, and (c) chains of command delineating responsibilities within the organisation' (Hodgson, 2006, p. 18).

- 3 The ETH Domain consists of ETH Zurich, EPF Lausanne and the four research institutes Eawag, WSL, Empa and PSI.
- 4 Due to the limited capacity of concentration of the human being, influencing power only can take effect if the result of a selection process of a participant is communicated to another participant who accepts it as a reduction of his mental possibilities or the range of possible actions, without proceeding to a selection process on his/her own.

References

- Davidson, M. (2011) *The end of diversity as we know it: why diversity efforts fail and how leveraging differences can succeed*. Oakland: Berrett-Koehler.
- Díaz-García, C., González-Moreno, A. & Sáez-Martínez, F. J. (2013) Gender diversity within R&D teams: its impact on radicalness of innovation. *Innovation: Management, Policy & Practice*. 15 (2), 149.
- Dobbin, F., Kim, S. & Kalev, A. (2011) You can't always get what you need: organizational determinants of diversity programs. *American Sociological Review*. 76 (3), 386–411.
- Dobbin, F., Schrage, D. & Kalev, A. (2015) Rage against the iron cage: the varied effects of bureaucratic personnel reforms on diversity. *American Sociological Review*. 80 (5), 1014–1044.
- European Commission, EUR 24905 (2011) *Structural change in research institutions: Enhancing excellence, gender equality and efficiency in research and innovation*. Luxembourg: Publications Office of the European Union.
- Hodgson, G. M. (2006) What are institutions? *Journal of Economic Issues*. 40 (1), 1–25.
- Lenski, G. E. (1984) *Power and privilege, a theory of social stratification*. Chapel Hill, NC: The University of North Carolina Press.
- Luhmann, N. (2012) *Soziale Systeme: Grundriss einer allgemeinen Theorie*. Berlin: Suhrkamp Verlag.
- Luhmann, N. (2013) *Macht im system*. Berlin: Suhrkamp Verlag.

11

The STEM Coaches and Professional Development

Administration Professional Learning

In Lancaster ISD, Kyndra Johnson shared the district's vision and two goals for each campus: the goal for STEM implementation and the goal for higher student achievement. Johnson saw the two goals as working simultaneously in preparing students for their futures. Through data-driven conversations with the campus leaders, Johnson gained an understanding of the unique needs of each campus as they addressed student learning, achievement, and STEM implementation. Using student achievement data was not about playing "got-cha" but was about knowing the kinds of supports each campus needs. The conversations built a strong bond between the district and the campuses.

In Texarkana ISD, Denise Fisher, STEM coordinator and K-12 STEM coach, learned that to coach an administrator in STEM is sometimes like walking a tightrope. It is hard to maintain a perspective on the balance needed between initiatives for student achievement gains and the district's initiative for the infusion of STEM strategies and student engagement. Fisher stated that some principals are open and allowed the coaches to set the targets and expectations when it was about the STEM curriculum:

But, others are not as open. They are only focused on the initiatives for student achievement and filtered all other initiatives through that lens. Although they know other initiatives are important, they are driven by how their campus will be judged by test scores.

In both situations, they as coaches knew that they could not achieve their targets without a high-quality curriculum, good instructional practices, alignment of instruction to assessments, and focus on the qualities of a well-rounded, successful graduate from their programs. Principals may not have the time to know and do everything that needs to be done for the instructional program on their campuses. Often they may not have the knowledge or skill set to go about setting it up and maintaining it.

It was the role of the Texarkana's STEM instructional team to support principals through a partnership. They partnered for developing knowledge and skills in the integration of STEM-based, quality instructional programs for their students, staff, campus leadership team, and themselves. As teachers and administrators began to trust the STEM instructional team, principals began to realize the STEM focus could fulfill their goals. The STEM initiatives provided the rich instructional climate needed on their campuses for increased student achievement to be possible. As an instructional team, Fisher's team understood that the development of a deep understanding of STEM-based strategies is along a continuum towards the Big Picture. According to Fisher,

As Chip and Dan Heath, in their book *Switch* (2010) called it, "the picture postcard." That is the picture of our final destination, the beautiful and peaceful place, where we want our campuses and graduates to be at the end of our journey.

Their first steps were to set up professional learning for principals in a safe, learning environment where they could let down their guard, take risks, have discourse, and collaborate with their peers for planning and implementing best practices for their students' and teachers' success. Based on gaining an understanding of STEM programs they know the "what" and the "why": what STEM looks like and the value of an integrated STEM-based program. They became prepared to watch and look for STEM integration and instructional strategies in the classrooms on their campuses. They also worked through how to hold teachers accountable for their efforts in making STEM part of the everyday routines in their classrooms.

As principals began to observe for STEM integration, coaches would accompany them on "learning walks." Coaches helped the principals to pick out the subtle changes that occur when there is a STEM focus in the classroom. The coaches talked about what it should look like, what they wanted to see in the way of instructional strategies, and the culture and climate of a learning-centered classroom. It was beneficial to coach about the little things that popped up as they were observing and they were able to think through how to follow up in the moment.

As principals and STEM coaches observe teachers engaged in instructing students, often what is not observed is as important as what is observed. For example, teachers may miss an opportunity to integrate STEM ideas and strategies such as a career connection comment while engaging in a PBL. Providing in-the-moment feedback to a teacher about a missed instructional opportunity can be powerful in changing their future instructional practice. The benefits of being there to coach principals during learning walks were the opportunity to reveal and discuss the fine lines between a STEM and non-STEM focus; what it looks like and what it doesn't.

Often, the Texarkana principals used the cadre of STEM coaches to help them understand what to do as teachers pushed back. They heard their teachers complain and vocalize how uncomfortable they were with the changes that were occurring, and when their former routines were being challenged. Principals were asked to justify why they allowed coaches the right to examine the usefulness of long-held instructional practices that had been successful in the past. Why were these strategies now being questioned, adapted, or abandoned? Teachers complained about the lack of time to add one more thing to their already crowded syllabus. They worried about decreasing the time spent on test preparation without the guarantee of high tests scores. By understanding STEM and having a deeper knowledge of STEM instructional practices, principals who already understood the why, and the how, were now able to support their teachers, to motivate and assure them that the destination is worth the effort.

As with all growth processes, it is important not to judge teachers by the failures they encounter as they try new strategies. Sharing a teacher's successful implementation of STEM or a new instructional strategy with the principal is important and, just as important, is keeping the principal apprised of the progress being made. The principals, through their walk-through protocols, are observing for changes and rating them. But it is of utmost importance that teachers are not judged on their unpolished attempts at new strategies.

The value of having STEM coaches as partners for the principals' initiatives is that principals are able to count on the coaches to support their teachers—being available as their teachers are practicing the new STEM-based strategies and gaining skills towards their proficiency and their students' increased growth. Principals need to assure teachers that each annual evaluation and walk-through would not be influenced by the failures they are observing as teachers practice their new skills and grow from their failures. As long as they are reflective in their practice, and plan for growth through these attempts, these missteps are acceptable. Principals need to let their teachers know that practicing skills for increased proficiency is their

expectation: the campus leadership team is expecting to see growth in each teacher, and a lack of effort towards growth will not be accepted.

According to Denise Fisher in Texarkana there was a strong partnership between the district STEM team and the principals. Campus and district leaders partnered with her for a presentation about the district's successful STEM integration in an invited presentation for the National Research Council and National Academy of Engineering in Washington, DC:

For one principal, I wrote the portion of the presentation for his campus and collaborated with him as he wrote the script about how coaching helped to make integrated STEM successful on his campus. He was really open to collaboration and allowed me to respond to some questions as well. Another principal was not as open and wanted the spotlight all on him as he shared his campus' successful STEM initiatives. In my mind that was OK, we were a team. It was wonderful to see how we had come together to celebrate the journey for their campuses and for their students.

Teacher Professional Learning

Lesson Studies

Among the many professional learning opportunities for STEM teachers, doing lesson studies can be one of the most beneficial. As teachers work in a collaborative session to design a lesson, they take turns observing each other as they teach the lesson. The practice has a long history in Japan and it is correlated to improving teaching and learning in the classroom: M. Yoshida outlines the process in a paper presented at the 2002 Lesson Study Conference.

Book Studies, Articles, and Blogs

The teacher that is interested in the trends and resources for STEM education need look no further than the Internet. Networks such as Facebook, Twitter, LinkedIn, and Google have groups with similar interests in STEM. The forums and blogs are rich in ideas, strategies, and case studies by familiar authors in STEM education as well as those who are dipping their toes into the STEM pool and are intrigued! Many of the resources and interviews for this book were generated by responses from the STEM groups I communicate with.

There are many websites distributing books that focus on STEM, PBLs, engineering design challenges, and others focusing on changing mindsets

for the challenges that students of today will face in their lives after graduation.

Online Learning

Having a STEM teaching endorsement with your college degree in a STEM field is seen as a benefit for recent college graduates. College, university, and other STEM organizations, such as the NASA Endeavor STEM Teaching Certificate Project, are available online and are gaining popularity as a way to get a master's degree in STEM. Many of these courses require participants to provide evidence of implementation of STEM instructional practices in order to get certification. As more funding becomes available through the Federal grants focused on STEM education, an endorsement in STEM may increase employment opportunities for many generalists.

Conferences

There are several reasons a campus leader may choose to support STEM teachers' participation in off-campus professional development through conferences promoting innovation in STEM, PD sessions and workshops, or other training. This is true even after taking into consideration the sacrifice in student learning if they do not receive the same caliber of instruction through a substitute teacher, or the funds required for travel and registration expenses are taken from a limited budget. Campus leaders make the decision based on the needs of the students in the teacher's classroom and campus goals. The benefits of STEM teachers participating in off-campus professional development are found in the ideas, knowledge, and skills brought back to the campus. If implemented, those ideas will move the district and campus initiatives closer to meeting their goals.

Campuses that have recently adopted a STEM approach to learning are at the cutting edge of innovation in educational practice. With the introduction of the K-12 Framework for Science Education and the release of the NGSS many resources are now available which should be evaluated. Conferences have presentations and exhibitors, and allow for previewing many resources in one location very efficiently. Attendance at STEM-related conferences also allows for networking with others in the same roles who are evaluating resources for the same purposes.

Conferences that provide all types of resources can be found at many levels, from local and state education groups and organizations, to national

and international professional organizations. National organizations such as the National Science Teachers Association (NSTA) and the National Council of Teachers of Mathematics (NCTM) hold annual and regional conferences where many presentations focus on STEM content connections. Teacher organizations at the state level also sponsor conferences, which support new ways of integrating STEM into their content areas. Organizations such as the Science Teachers Association of Texas (STAT) sponsor the annual Conference for the Advancement of Science Teaching, better known as CAST, which draws over 8,000 participants annually. More than a third of the conference sessions and vendors in the expansive exhibition area focus on ways to bring science into the 21st Century through strategies that are STEM focused.

Additionally, many universities, museums, education organizations, and publishers provide one-day to week-long sessions, workshops, and institutes where participants focus on one type of instructional strategy such as project based learning, or engineering-based strategies for use in the STEM classroom. These types of PD are more expensive and require extensive planning for teachers to be out of their classrooms. Often the added burden of days off-campus is worth the benefits of deeper learning and the greater likelihood the new learning will be implemented into classroom instruction.

Virtual Conferences and Workshops

As I was searching online for STEM coaches, Cindy Rubin contacted me. Through our messaging I found out that as a STEM-based technology coach Rubin collaborates with groups of technology coaches who have common dilemmas. She is a former high school teacher at a STEM campus in the greater Boston area. Using her expertise from education, she facilitates virtual meetings, made up of STEM technology coaches. By coaching each other in ways to solve technology integration issues about new software components or in using the components the districts have provided, they find ways to enhance STEM education. She was supporting them as they were supporting their campuses.

Rubin states that smaller districts and STEM academies often have teachers who want to integrate software but do not have the support, or who are alone in their search for solutions. Rubin became the facilitator for a group of coaches who are trying to solve problems for the success of the teachers they are serving. "As a teacher," she muses, "when you coach other teachers you become a grass roots organization." They meet via Skype or Google Hangout, coaching each other on different classes that they are instructing. When one of them runs into problems related to the technology they are using, they coach

each other. Rubin pulls them together weekly and facilitates addressing their list of concerns. Everyone contributes evenly. It always has to do with integration of technology in the classroom and how to best utilize the systems the teachers have for maximum usefulness to the lesson. As a professional learning community (PLC) they are identifying and solving problems together.

Rubin as the moderator runs the agenda, listens to other people's issues as they collaborate, and ensures the group works through all suggestions. At times she contributes suggestions as well. The structure of the PLC has someone taking minutes so they can reference the minutes, make comments, and send them out to others in the group who could not attend.

As a STEM curriculum writer and consultant, Rubin finds the need to adjust what she is planning to the learning needs of the group she is presenting it to. She integrates the appropriate technology according to the grade and age group and the learning goal. "I was writing computer science curriculum when I was at the high school. I was exploring computer science curriculum, through MIT media lab, many other programs, game development and web design."

To stay current Rubin participates in many seminars and reaches out to those in the community who know more than she does. She has experience in business and looks to this sector for help as well. She invites businesses to join the network to help educators with similar issues. She advises, "A lot of people who are out in your network will connect with you. Sign up for professional development and coursework online so that you can have a rich background for your students."

Part II

Summary, Conclusion, and Resources

Being a STEM coach is a relatively new role in the education community. Instructional coaching has become more popular as the potential impact of a master teacher who acts as a campus coach becomes recognized and appears in education research. To be an effective coach the skills needed are more than for those who are considered a master teacher in their one content area, or being the most experienced on the campus.

An effective coach is one who is able to have those powerful conversations with an educator built on a relationship of trust, to bring about a commitment to change their instructional practice, for the achievement gains of their students through a lens of being college and career ready. Coaching goals include being purposeful and thoughtful in planning for coaching, and taking the steps to:

- ◆ Establish a relationship
- ◆ Use an effective coaching cycle
- ◆ Lead impactful professional learning communities
- ◆ Provide a diverse selection of professional learning opportunities
- ◆ Be a vehicle for reflection and growth.

The transition into a STEM campus requires a series of steps taken with the portrait of a STEM graduate in mind. The portrait is of one who is college and career ready with a view of the world through the lens of STEM. A learning environment that invites exploration, missteps, and growth that comes from

authentic problem-solving and designing solutions is required. The careful development of this learning environment, which is student-centered and nurtures creativity and an open mindset, is just the beginning. Part III provides some insights and resources as you consider your plan of action.

Resources

References

- Achieve, Inc. (2013). *Next Generation Science Standards (NGSS)*. Washington, DC: National Academies Press.
- Darling-Hammond, Linda (2012). *Creating a Comprehensive System for Evaluating and Supporting Effective Teaching*. Stanford Center for Opportunity Policy in Education, www.smmcta.com/uploads/9/9/4/2/9942134/evaluation_research_stanford_2012.pdf
- Heath, Chip and Heath, Dan (2010). *Switch: How to Change Things When Change Is Hard*. New York: Broadway Books.
- Heller, Joan I., Daehler, Kirsten R., Wong, Nicole, Shinohara, Mayumi, and Miratrix, Luke W. (2012). Differential Effects of Three Professional Development Models on Teacher Knowledge and Student Achievement, *Journal of Research in Science Teaching*, 49(3), 333–362, <https://www.researchgate.net/publication/259129061>
- Hord, Shirley M., Rutherford, William L., Huling-Austin, Leslie, Hall, Gene E., and Knoll, Marcia Kalb (1987; revd 2006). *Taking Charge of Change*. Alexandria, VA: ASCD.
- Ingersoll, Richard and Strong, Michael (2011). The Impact of Induction and Mentoring Programs for Beginning Teachers: A Critical Review of the Research, *Review of Education Research*, 81(2), 201–233, http://repository.upenn.edu/cgi/viewcontent.cgi?article=1127&context=gse_pubs
- Kee, Kathryn (2006). Saying It Like a Coach, *National Staff Development Publication*, (November), <https://coachingui17.wikispaces.com/file/view/Say+It+Like+a+Coach+NSDC+Kathy+Kee.pdf>
- Ronfeldt, Matthew, Farmer, Susan Owen, McQueen, Kiel, and Grissom, Jason A. (2015). Teacher Collaboration in Instructional Teams and Student Achievement, *American Educational Research Journal*, 52(3), 475–514, <http://aer.sagepub.com/content/52/3/475.full.pdf+html>
- Vescio, Vicki, Ross, Dorene, and Adams, Alyson (2008). A Review of Research on the Impact of Professional Learning Communities on Teaching Practice and Student Learning, *Teaching and Teacher Education*, 24(1), 80–91, <http://www.k12.wa.us/Compensation/pubdocs/Vescio2008PLC-paper.pdf>
- Yoshida, M. (2002). Overview of Lesson Study in Japan, presented at Lesson Study Conference, www.rbs.org/SiteData/docs/yoshidaoverview/aeafdd638d3bd67526570d5b4889ae0/yoshidaoverview.pdf

Organization Websites

NASA Endeavor STEM Teaching Certificate Project—www.us-statellite.net/endeavor/
National Council of Teachers of Mathematics (NCTM)—www.nctm.org
National Science Teachers Association (NSTA)—www.nsta.org

Science Teachers Association of Texas (STAT)—www.statweb.org
Southwest Educational Development Lab (SEDL)—www.sedl.org/cbam/

Author's Recommendations

Although not cited in the chapters of Part II, the books listed above are ones that I have read while learning about how to become a better STEM coach. Friends and colleagues recommended many and some were purchased because I heard the author discuss their views and I wanted to learn more. I hope they become a source of information for you.

In her 2013 book, *The Art of Coaching: Effective Strategies for School Transformation*, Elena Aguilara suggests many highly successful strategies that are effective for coaching in all content areas. It has become one of the dog-eared books on my shelf as I am searching for more impactful ways to support those that I coach.

I have also found the expertise of Jim Knight in his 2011 book, *Unmistakable Impact: A Partnership Approach for Dramatically Improving Instruction*, to be invaluable when trying to understand how coaching plays a pivotal role in building capacity in teachers for student achievement. He provides a view of the big picture as well as the smaller view into the needs of a teacher in the classroom.

Authors Linda Gross Cheliotas and Marceta Fleming Reilly, in *Coaching Conversations: Transforming Your School One Conversation at a Time* (2010), provide examples of situations and strategies to use to make it easier to become effective in coaching for changed behaviors. They provide protocols that are easy to follow and can be used in multiple situations.

Results Coaching, The New Essential for School Leaders (2010), written by Kathryn Kee, Karen Anderson, Vicky Dearing, Edna Harris, and Frances Shuster, provides the “why” and the “how” for the need to change the way we work as school leaders. To be a facilitator of change, intentional changes in our language and communications skills are needed. From my initial introduction to Cognitive Coaching with Kee in GCISD in my role as a TOSA, to my current role in professional development, those skills are of value to me. I credit Kee with my skill set to be silent so I can hear to understand rather than use autobiographical listening, to use positive presuppositions about a person’s intent, and to be thoughtful in my responses and questions so that they cause deeper thinking in those who have asked me to coach them.