

# Teaching Pharmaceutical Chemistry: Getting to the heart of the matter

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*"We have to remember that what we observe is not nature itself, but nature exposed to our method of questioning."<sup>1</sup>*



I find this quote by Werner Heisenberg, the 1932 Nobel Laureate for Physics, significant in that it reminds me of the fact that science is really about observing, questioning and trying to make sense of the wonder and marvels of nature around us. There is also a sense of humility present because our observations and conclusions are limited by our methods of questioning. It is so very different to what often happens in a science classroom, namely transmission of facts and concepts, with very little of the wonder and amazement of the world around us and how this body of knowledge was created through the centuries. We also do not always realise how significant our methods of teaching and assessment are and how the questions we ask ourselves and our students influence their learning and the future.

I would like my students to experience a sense of wonder and amazement as we observe and question chemistry in the world around us, and specifically as it relates to pharmacy. Students who study any scientific subject do so for many different reasons and, as a result, have different types of motivation to study. One student will grumble and say: "All those difficult chemical structures I still have to learn tonight". Another student will be excited and exclaim: "The most remarkable formulas in mathematics!"<sup>2</sup> It is usually followed by a spirited explanation with bright eyes and loads of energy. The latter student does not need a curriculum, assessment criteria or examinations; those are just things that use up precious time that could be used to go and discover yet another beautiful and exciting formula, reaction, compound, plant or microbe.

I love teaching because there is an immeasurable emotional and cognitive reward for presenting a great lecture in which students interact with me and the material. As a result, they effectively construct new knowledge and above all, start to fall in love with the subject, just like the student I mentioned in the previous

paragraph. It can lead to high intrinsic motivation in a student who continues to engage with the subject matter not only to master it but also because of the sheer pleasure of curiosity and the satisfaction of finding answers in order to understand the world better. It can cause a spontaneous move away from the ubiquitous and often only reward for some students, which is getting enough marks in an exam in order to pass, in order to get a degree, in order to get a well-paid job one day.

I concentrated on developing my Pedagogic Content Knowledge (PCK)<sup>3</sup> during the first years of my teaching career. It is the methodology a lecturer develops to teach subject matter effectively to ensure optimal learning. I started to realise that no matter how much effort I put into my teaching, or analyse and try to improve how I present content in the classroom, it will always be only one small part of the learning process. I also became increasingly aware of the role of the affect on a student's learning.

I started to reflect on the attitudes and beliefs about teaching and learning of my teachers and their teachers, whom I consider to be my parents and grandparents in science and music. For example, from the teachings of Shin'ichi Suzuki (1898–1998)<sup>4</sup>, a famous Japanese violin teacher, I learned that *"Where love is deep, much can be accomplished"* and that *"Talent is not inborn or inherited, it has to be learned and developed."* The Hungaro-Belgian violinist and teacher, Andre Gertler (1907–1998) once said: *"Anybody can play the violin. Bring the street sweeper in from the street. I will teach him to play."*<sup>5</sup>

Learning to play the violin can be just as complicated as learning Pharmaceutical Chemistry. I believe that if Mr Suzuki can teach a four-year-old child to play a Mozart or Bach violin concerto from memory musically, surely the same level and enjoyment of learning can happen in a chemistry classroom. Two key factors play significant roles in this learning process, namely love and a deep-seated belief of the teacher in the unlimited potential of the student, regardless of background and perceived ability.

To bring this back to teaching Pharmaceutical Chemistry, it is common knowledge that students find it hard to adjust to pharmaceutical chemistry in the second year of the curriculum. Despite the relatively high entry requirements for the BPharm degree, a number of them still fail despite diligently attending lectures and spending many hours studying. I decided to embark on a phenomenographic study that specifically created a space for students to speak and provide insight into their study beliefs

and practices when studying Pharmaceutical Chemistry. This study was initiated during my participation in the 2018–2019 TAU fellowship programme.<sup>6,7</sup> I was hoping to gain insight into the world of my students. Maybe we could find solutions to the incongruency between my effort, their efforts and their mastery of the subject.

It was humbling to experience the students speaking about their experiences. Some students came with a cry for help. Others came with passion in their voices and hearts, displaying an eager willingness to share what they need or what they would like to contribute.

Apart from providing knowledge about how they study, the process of opening up a space where students could speak freely and frankly with me has changed our relationships. It has added aspects of humanity, heart and spirit without which education to reach each one's most profound potential cannot be reached.<sup>8</sup>

A few answers to one of the questions in the semi-structured interviews: "Why did you decide to take part in this study?" were very poignant and in some cases heart-breaking:

*"No-one has ever asked me about how I study."*

*"Because I've been struggling."*

*"I think it's very important that you lecturers find out how we learn because after all you're teaching us and we are the ones that take in the information so how you teach, yes that's important, but how we learn that's also equally important if not more important also."*

*"It sounds like a very transformative initiative that like a teacher is very concerned about students and how they really feel because we are, we are the ones that go through this all day. We are the ones that experience all of this, so you trying to understand us from this other side. Right now, where we are, some lecturers are just talking to students, it feels like its two different people. Whereas we're supposed to like be in the same page supposed to be like working towards the same thing."*

*"You must bring this to the floor, stand next to us."*

I noticed a need for apprenticing and nurturing in many of the comments.<sup>9</sup> The knowledge gained from this study also challenged me and called for changes in my perceptions, beliefs and practices as a lecturer. Presumptions based on anecdotal evidence and discussion with colleagues have been replaced with facts.

The participants' stories have left me with questions such as:

- a. Are methods of acquiring and building knowledge not maybe as necessary or even more important than the knowledge itself? Are we providing that adequately? Should it not be an integral part of the curriculum? How can it be done?
- b. To what extent has our lack of incorporation of such methods in conjunction with subject knowledge, excluded our students from accessing powerful subject knowledge? How has that hampered life-long learning?
- c. How do our large cinema-style lecture venues alienate and separate us and our knowledge from our students?
- d. How can we come closer to our students, especially in large classes?
- e. How can we foster a sense of being one big team instead of a lecturer upfront talking at a class?
- f. What can we do to instil a belief in our students that they have unlimited potential?

The fact that most of the students have never been taught any study methods specifically for chemistry is an issue that needs to be addressed as a matter of urgency. Chemistry is a subject that is traditionally taught deductively, and as a result, often leads to learning by memorisation. This practice also does not speak to the requirements of the seven-star pharmacist.<sup>10</sup> (Note: Since the original list was published, three more qualities have been added, resulting in the concept of the ten-star pharmacist.)

It is time. It is time for change and renewal in our ways of doing.

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