

Teaching Statement

I have always believed that the idea of a university education is one of the development of a complete human being. This is what draws me to teaching not just the process of training a student in a given field or for a particular job. Consider that a small child learns constantly. In other words we might say that human beings have a desire to learn that is inherent. Part of this process is the desire to understand as Aristotle put it. This has many aspects including the experience of the senses followed by a realisation of the knowledge of this experience. So, the experience of learning has both physical (the senses) and mental (the mind and emotions) aspects which are not easily differentiated. This is why the full education of a human being really requires both. A young child achieves this way of learning often through play which opens a new world to him. This is a world of both the mind and body working in tandem. Importantly, play has no reward or punishment associated with it. Every adult still remembers that play was a joy for itself with no thought linking it to anything else. It seems the process of learning and consequently understanding a certain 'something' is so natural and enjoyable that it is done just for itself. What happens as a person 'grows up'? This joy seems to be lost and is to some extent replaced by a search for 'pleasure' and an avoidance of 'pain'. The socialisation process seems to exacerbate this cycle. What then is the purpose of the teacher in such a world? Surely, it is to reawaken this joy of learning, for one hour or so to let the student forget about that other world that occupies him the remainder of his time.

What is mathematics? In a sense there are really two aspects to mathematics, the first includes its well known attributes such as the ability to think logically, systematically and an ability for abstract thought, the second includes the ability to think creatively. The first of these attributes are gradually absorbed as part of the method of mathematics; they are continually reinforced by the teacher and form part of his overall objectives in teaching mathematics. Alternatively, it must be remembered that mathematics is a creation of the human mind. This is exemplified by the fact that mathematics has an ability to make the implicit, those ideas which are mere vague notions, explicit. It seeks patterns where none have been observed before or where, because of old modes of thought, they were not seen. It takes those aspects of life which can't be named and names them; it takes a simple concept and abstracts that which is most unique about it. In other words mathematics seems to be a way of refining and perfecting an inherent ability that human beings possess naturally. This second aspect forms the creative part of mathematics which cannot be taught simply because there is no method to creativity. Creativity is something which arises when a human being is presented with a problem which must be solved where known approaches have failed to make any headway. Although no method exists to 'teach' creativity it can be encouraged to flower on its own especially through the free play of the mind as a problem is studied through metaphor, imagination and approaches that at first appear alien to what is known. This is where the discovery approach provides a good starting point to the process. For example, the student is presented with a problem for which a task must be accomplished; the teacher may then choose various teaching approaches such as small group discussion to consider alternative approaches or carefully guided questions which focus the student attention and removes dead ends and stumbling blocks as well fostering critical thinking and a well organised argument. Although this process is time intensive it promotes a creative problem solving approach which is sorely needed in our modern world and it focuses the mind so that a systematic/logical approach becomes part of the thinking process.

Students often complain that mathematics is 'hard', so it appears to some degree alien to their usual way of thinking, this may be because it is a discipline which makes use of one particular way of thinking which requires a continual effort to maintain. This of course plays a role in how mathematics is taught. I believe that a new mathematical concept, for example the idea of a point in a coordinate plane or symbolic algebra, needs to be taught in as simple a way as possible since such concepts form the basis for other concepts built upon them. This ensures that students from diverse mathematical backgrounds are able to cope with a new concept while those students more familiar with the idea are reminded of it. In addition, I believe that important concepts should be taught as much as possible through a process where the student discovers the concept through carefully guided questions and student-teacher interaction. Although this is often not possible during a one hour lecture due to time constraints it should be a part of the process taking place during regular tutorials. It should be noted that different mathematical fields use distinctly different concepts requiring very different ways of conceptualisation. For example, whereas geometry requires an ability to visualise geometric shapes, algebra requires an ability to deal with highly abstract concepts and vector calculus requires both. This means the way that these concepts are taught varies for each particular case. One course may best be taught using aids such as solid objects e.g. in geometry and also for the concept of symmetry groups while a different concept requires a different approach. More physics oriented subjects such as classical

mechanics often require good physical understanding and here simple demonstrations such as angular momentum conservation of a rotating person alternately raising and lowering his arms is an aid to physical understanding and in the development of mathematical models.

While at first it may not seem so, mathematics is both an activity of the mind and surprisingly, of the body. Mathematics is learnt by doing, the mind can construct or absorb mathematical concepts but it also requires an aid to make its ideas visible symbolically whether on paper or a chalk board. The student must reason and make his points step by step, the paper aids him, the hand writes, it tells the mathematician if his initial idea will succeed in the real world in front of him. The teacher must be sensitive to this process. One of the best ways to bring mathematics to life for the student is to do so in the same way it is brought to life within the teacher. In other words to be an inspirational teacher requires at least a deep knowledge of the subject and an individual joy in its practice. It is this excitement for the depth of the ideas within mathematics and the experience of how a step by step process leads to something remarkable that can be transferred to the listener but not in a passive way. It is when the student not only listens but participates in the process of understanding that true learning takes place. Even if this is the case this does not guarantee that the teacher is capable of being a good teacher. There are too many examples of great mathematicians who could not teach. So, there are other aspects to being a good teacher. A lecturer must care about teaching itself as well as possessing a desire to provide or be the conduit of the learning process. In other words teaching must also be something which a lecturer is committed to as part of his life as a lecturer. If this commitment is present then the lecturer will actively participate in the teaching process rather than simply 'lecture', a failing which has a long history.

There is yet a third aspect and that is what happens when the teacher teaches and the student learns. It is really a two-way process and in a way it is the transference of a way of thought, the concept being taught, or the ability to think this way in the student. When this process occurs the teacher needs to be constantly aware of what is happening in the mind of the student. The teacher can become aware of the learning process through careful observation of the student; eye contact especially tells the teacher a great deal about what is happening in the student's mind. Every beginning teacher has seen that blank stare in the face of a student when understanding has not dawned or the look of enlightenment when it has. It acts as a learning experience for the teacher as well who should always be open to learning from his students. In other words the teaching process also teaches the teacher to be a better teacher. The need to teach well always uncovers aspects of his subject or the teaching process which the teacher must clarify within his own mind. This may be an aspect of mathematics which the teacher thought he understood but of which he was not a complete master. Teaching always reveals such weaknesses. Alternatively, it may have to do with the way a concept is being taught but which requires a new teaching strategy at a moment's notice even when the teacher did not prepare for such a contingency. In addition, it must be kept in mind that teaching also acts as an unconscious example to the student of what it is to be a teacher/mathematician. The teacher's character, what he considers important in the subject, how he teaches it and many other unconscious signals sent by the teacher may influence the student.

Teaching itself is a process where the teacher must carefully prepare, as best he can, what he wishes to put across to the students. This can vary depending on what is being taught and the process itself often requires a creative approach. A lecture or lesson always relies on properly stated objectives for the task at hand. The assessment process also requires careful thought depending on the particular subject being taught and what central objectives must be satisfied. For example, the subject content may be tested through assignments whereas fundamental concepts can be examined through an oral examination which always demands a thorough understanding to answer searching questions. In other cases where a subject is undergoing new developments and needs new creative ideas to progress an essay outlining its main structure and possible future directions provides a way to examine the student thinking process. The assessment process is always changing and adapting depending on the success of previous approaches to find new ways to improve the teaching process. While student assessment measures how well the objectives have been met they also measure to some degree how successful the teaching has been. One way to check on student learning, instead of through standard assessment procedures, is to have regular sessions where the teacher evaluates student learning by posing example problems and then, through questions and discussions, allowing the students to guide the solution process. This also applies to the understanding of fundamental concepts, for example Cauchy's Integral theorem in complex analysis which is highly non-intuitive. This process can bring out those areas of greatest difficulty in student understanding and allow time to alleviate the problem. In addition, such sessions can be used to allow student evaluation of the teacher and the teaching process through comments. This allows the teacher to further improve the teaching process as an ongoing process rather than through student evaluation at the end of a course.