The account of a learning experience from secondary school

Introduction to Secondary School Teaching Task 2 – Learning

I am going to focus on my learning experience in terms of the learning theory put forward by Tall and Vinner known as the Concept Image / Concept Definition theory. In brief, their paper puts forward the idea that we associate mathematical concepts in our head with either a definition or an image, and this affects the way we learn and how we use the concepts. The concept definition is defined as "a verbal definition that accurately explains the concept in a non-circular way". The concept image describes the pictures we associate with the concept, or a collection of memories such as the first time it was introduced to us. Vinner argues that the image and the definition are quite separate, but that they may be linked for a particular concept.

I am going to examine my experience of learning about quadratic equations, and specifically the lesson where we were shown graphs of quadratic functions. When I first came across quadratic equations, it was merely as an abstract algebraic problem. I could recognise a quadratic in a variety of different forms, and my concept definition was sufficient: $\mathbf{f(x) = ax^2 + bx + c}$. However, my concept image was confined to solving for solutions at $f(x)=0$, and although I had a good grasp of factorisation and completing the square, I had no idea of the graphical representation. When we were first introduced to it, we drew out some graphs of our own, and I appreciated in a graphical form the importance of negative x contributions, and the parabolic shape of the equation.

My concept image was expanded to include an idea of what the graph of any particular quadratic would look like – I already knew why $x^2=0$ only had one solution, but now I had a graph to relate it to. When I got two solutions, I could envisage the graph in my head, and I could relate the x^2 coefficient to the orientation and steepness of the curve as well. These extra experiences to add to my concept image were not strictly necessary for solving an equation – it was still easier to solve algebraically than by drawing out the graph, and usually knowing what it looked like wouldn't affect how I approached the problem. However, it meant that when I moved on to calculus, and started examining the relationship between a function and its derivative, I found it much easier to understand because I could relate to maximums, minimums and, later on, points of inflection. The knowledge expanded to my use of cubics and beyond, since graphical representation is possible for all polynomials regardless of the ease of solving an equation algebraically. Once my concept image was firmly established, I could then use my knowledge to work backwards, and after solving an equation algebraically and finding stationary points I could then construct a sketch of the graph from my knowledge of what would produce such results. My concept image, though not an aid to what I was doing when I formed it, became essential.

Bibliography

Concept definition, concept image and the notion of function by Shlomo Vinner of the Hebrew University, Jerusalem and David Tall of the University of Warwick.