

Future Possibilities for Education

Future improvements in the learning process can come from faster learning, or the relevancy of what we learn to bringing meaning into our lives. We can expect the future to require learning more than we have been, if only so that we become more aware of the consequences of our actions in the fields of ecology and economics. We are accustomed to thinking of education primarily as a preparation for earning a living, but as we grow closer to exhausting the earth's ultimately limited resources, it behooves us to prepare people for enjoying themselves while placing minimal demands on the earth's natural resources.

Now that so much of human knowledge is available on the web, we might expect to put less emphasis on knowledge itself, and more on how to access that knowledge when we need it. However what we really want from knowledge is relevance and meaning which depend greatly on context. Some of the context comes from what we know about the source of the information, but the most important aspect of context is where the information arrives and what we already know. In other words it takes already assimilated knowledge to assimilate new knowledge. The key factor becomes the interface between these two kinds of knowledge. That is why analogies play such an important role in teaching. We need to be able to integrate the new knowledge with what is already known. In deference to the limitations of teachers as to what they need to know, it is understandable that we allow them to specialize in this or that subject matter, but we should be aware that this specialization reduces the number of analogies that teachers can draw on from different fields of endeavor.

In every area of study we begin by the observation of patterns of repetition. The most archetypal of these patterns come under the study of symmetry. Arguably symmetry is the discipline most suited to unify the widest group of studies and lead us to identify the greatest number of analogies. We do empower kindergarten and elementary school teachers with teaching multiple subject matters, but in general we don't expect them to understand anything but the most elementary levels of symmetry. This is unfortunate because we are ignoring the discipline that could bring the greatest level of unity to different expressions of culture, since the laws of symmetry are shared by the whole universe, and manifested in the art of all cultures..

If we analyze the foundations of education, we can see that it has to begin with perception, and the most important of these for communication purposes are sight and sound. Of these much greater bandwidth is devoted to sight than to sound. Sight offers us virtually simultaneous perception in two dimensions at relatively high resolution, whereas sound is limited to expression in the single dimension of time. What differentiates human consciousness from that of animals is most importantly language. We acquire language when our mother points to objects and actions in the real world while repeating the word that is associated with that aspect of the real world. Spoken language is a succession of words made up of one or more sounds known as phonemes. The words have been assigned meanings, whereas the phonemes are used again and again to combine in different ways to make up different words. Once spoken language has been acquired it becomes possible for the child to learn written language. This is done by assigning specific sounds to the letters of the alphabet, and then using these to map to the sounds of the phonemes and the words they make up. While the recognition of the shape of the letters is made possible by our basic two dimensional visual perception, and with practice becomes extremely rapid, the recognition of words is subject to a linear process, and cannot happen much faster than we can talk. Once we process information into

written words we not only slow down our absorption of information to something close to spoken language, but we also eliminate any meaning we can interpret from the sound expression of the words. We can glean additional information from the visual observation of the speaker, which is why video conferencing holds any appeal. If we could encapsulate information in a way that was directly accessible to our full two dimensional visual perception, we might be able to assimilate information much faster. This is why it is said that a picture is worth a thousand words, and to some extent this is accomplished by charts and diagrams. To extend this further we need a greater familiarity with the archetypes which lend themselves to surface perception, and or assign specific meanings to them as we do for words. These archetypes are various manifestations of symmetry in the form of tilings and tessellations, and seem a good place to begin such explorations.

Apart from being slow to communicate information, the linearity implicit in reading has the additional disadvantage that it is difficult to make short cuts to the information we really require, which remains embedded in the text. To some extent these problems can be circumvented by a table of contents, or an index. It is worth noting that an index would not be functional were it not that the alphabet has been mapped to the sequence of whole numbers. While we may not be aware of which letter corresponds to which number, we are fully aware of which letters occur before each other which is what allows us to locate the word or name that we want in an index or a telephone directory. In fact we can make a case that we have not fully understood a set of relationships until we have correlated them to our numbering system. This approach has the additional advantage that we are required to identify the variables that define a situation. In this way numbers can be perceived as a form of language that unifies our perception of all that is. The very fact that computers work as well as they do with the very simplest of all numbering systems, the binary, validates this point. What we need now is software for the human brain, that provides the same advantages to our own hardware. We are already operating with a variety of such software, known as reading writing and arithmetic, but they suffer from the disadvantage that they have not been thoroughly integrated with each other. In many cases different disciplines have evolved different vocabularies or notational systems to deal with essentially the same phenomena. A good example would be symmetry, where crystallographers, mathematicians and artists all talk about similar phenomena in very different languages. To some extent this is the inevitable consequence of successive discoveries each requiring some new form of description to add to existing knowledge. This multiplicity not only wastes time and energy of the student but actively causes confusion. However a time should come when we take an integrated overview, and start using a thoroughly coherent method of description. There is every reason to believe that the notational system based on the orbifold, advocated by John Conway, would bring a much needed order to the description of symmetry. However people's preference for the familiar perpetuates these confusions. It will take a generation or two to effect a transition to a more orderly system, and this will only be possible with strong leadership from the educational system. Challenging as this may be it should not inhibit us from incorporating improvements into the system.

We don't need to wait for the educational system to start educating our children. Pattern recognition is a prerequisite for learning, and we can accelerate the process by the simple expedient of incorporating into the child's environment those patterns that we would like to be recognized, and the ease with which these patterns can be recognized can be enhanced by what we might term synaesthetic mapping. Synaesthesia is when data which usually triggers one form of perception triggers a second mode of perception.

While rarely occurring amongst humans as a natural phenomena, it can be experienced artificially under the influence of hallucinogenic drugs, and in this digital age can easily be mapped once an algorithm has been chosen. An example could be in symmetry, where color is not a necessary component, but recognition can remain elusive. The important ingredients of symmetry are mirror and glide reflections, and especially axes of rotation in different numbers. Typically objects or patterns may contain up to three different kinds of rotational axes. When these are colored according to the number of repetitions in 360 degrees the patterns sing out to us, begging to be recognized. This remains true for both 2 and three dimensional patterns. Once we have learnt to recognize the patterns, the color enhancement can be discarded as no longer necessary. The beauty of this situation is that it can be begun by surrounding the cradle with such objects long before speech has been learnt. Such a system might be helpful learning the alphabet. Children's books frequently utilize brightly colored letters though to the best of my knowledge this is not in systematic way to facilitate learning. Perhaps we would need a more structured and ordered alphabet before such a system would be desirable. The failure to get established of such languages as Esperanto or loglan should make us very cautious about attempting such a change. In the mean time while synaesthetic mapping conveys redundant information it may be useful in establishing pattern recognition, and can be discarded when no longer needed.

In summary the educational system we are currently utilizing may be restricted by over reliance on words and linear presentations, compared to area perception and full utilization of our optical perceptual bandwidth. A departure from strict linearity in books is the use of footnotes, giving us an option of additional detail. They share much in common with links on a web page. We might facilitate access to links by displaying them in an array close to the verbal linear material to which they were related. It is even possible to imagine a geometrically arranged display of links which allowed access to additional verbal material when wanted. It would be helpful to be able to visualize such a totality of all knowledge that utilized a kind of fractal like self replicating structure. One such suitable structure could be a central sphere surrounded by a series of concentric partially transparent spherical shells which incorporate two dimensional tilings on them. We could perceive these as flat tilings when we wished, so that we could communicate them as if they were a flat page when we wished to; but at the same they could be assembled together when we wanted to visualize them connected as a spherical shell. These components would have systematic links to components on smaller and larger shells. If we wished we could make provision for other links like wormholes to any part of the information matrix. It might be useful to visualize other spheres identical to and surrounding our original sphere, but we never want to lose sight of the fact that one of them is central. This provides the unity and interconnectedness of the whole system. The first information to be mapped in this way should be the symmetrical manifestations themselves, which would occupy a kind of hierarchy with the simplest being closest to the central core of simplicity itself. Once we had arranged these in a form that optimally lent itself to visualization, we could search for analogies in other fields of knowledge until we found a suitable place for locating such knowledge in the larger scheme of things. The advantage of all this would be the ease with which we assimilated new knowledge because of the similarities to what was already known. Let us hope that we can reach a level of understanding where democracy can work and that some of these innovations can avoid the worst potential consequences of our past activities.