Increasing the Velocity of Knowledge

By Gene Frodsham, MS, S.E.

The complexity of calculations and the development of new materials and methods have increased the amount of knowledge necessary for engineers to learn. In response, the National Council of Examiners for Engineering and Surveying (NCEES) and the American Society of Civil Engineers (ASCE) propose increasing the education requirements for licensure to a bachelor's degree plus 30 hours (B+30). The movement to require essentially a master's degree was done without sufficient consultation with practicing engineers; there is a far more efficient solution available.

The leaders of these organizations are correct that the problem is one of time. However, it is not one of *more* time. Instead, we need to implement means of presentation that increase the *rate* of learning, also known as the velocity of knowledge.

The underlying principle has always been known, as shown by sayings like "a picture is worth a thousand words," "seeing is believing," and "experience is the best teacher". This describes a transfer of knowledge greater than the 300-500 words per minute that is typical when reading text with 2D pictures. "Seeing" operates in four dimensions from any viewpoint. With the concept of "seeing", we have an efficient way to display all human knowledge operating in reality.

The necessary technology is now off-the-shelf. Computer gaming gives ready-made tools for developing 3D environments to show any process or procedure. Goggles are available for the display of this virtual reality. MathCad and other programs give us the ability to show problems in the traditional calculation format.

We can thus create a world in which we build and watch every interaction in real time in any amount of detail, from any position, in four dimensions, and even be a part of them. From the present operating system of being in a room looking out a window on the far wall, we can now be immersed with knowledge all around us – on every surface, or suspended in space with the entire volume used for presentation.

There is no end to the density of information and the interconnection of knowledge that can be achieved. In every area, unlimited and flexible visualization will allow the tailoring of learning. Every child can have an education equal to the best prep schools with tutors for every class. Feedback from the virtual reality learning programs will provide the "educational research" to ascertain the methods of learning that are actually used by people in practice.

This concept applies to all areas of knowledge – from engineering, math and chemistry to biology and languages, and even to the skills of mechanics and other trades. Every process can be experienced as though the student were doing it. In virtual space, layers of information can be displayed at a glance – geometry, material specifications, installation instructions, nomenclature and traditional calculations.

In engineering, buildings and machines can be simulated in three dimensions; all loads can be shown and all code references can be indicated. There is then no more need for "black box" spreadsheets and other software that give more decimal places, but not more significant figures. In construction management, the student can see a project being planned and built and learn to do every position, inspection, calculation and report from the start.

Medical and biology classes can be conducted in the virtual world where every structure, chemical reaction and physical process is observed. The student can stand in the middle of space and see the atoms and chemical reactions, along with all the data, procedures and calculations.

Math and computer programming can be taught with all information available, including applied problems or proofs and derivations. Electronic designs can be seen operating at the level of the structure of the electrons, transistors or chips, a 3D operation in real time. Languages can be taught by intensive immersion.

We need a human interface language for creation and operation of the display of virtual knowledge. The interface language can be acquired by children, becoming an inherent part of growing up as they progressively learn the complexity of the interface. By contrast, engineers currently must become familiar with multiple interfaces using large numbers of explanatory books. A common standard human interface will save great time and effort.

Increasing education requirements will not do what is necessary; increasing the velocity of knowledge will. The layering and interconnection allowed by "seeing" knowledge creates multiple paths for learning and the tailoring of lessons for each student, fostering both rigor and flexibility and allowing the student to choose the best way in which to learn. This would give everyone a powerful tool to extend their knowledge and the boundaries of their understanding, at the greatest possible velocity.

Coordination of these interfaces and the methods of displaying knowledge must be the responsibility of the engineering societies. It is time for engineers to take their fate into their own hands and start this process that will benefit every field, profession, and type of work.

The parts already exist. The programming has been created. The hardware is now in place. The coordination to create the protocols for the data and standards for presentation remains to be done. The benefits are far beyond just engineering – the whole of human knowledge can be displayed and experienced. It can be learned by immersion with the tutors and processes optimized for each individual, resulting in a revolutionary increase in the velocity of knowledge. This method will cut years from traditional education programs and expand the scope and abilities of everyone. It is a project that is worth the effort of a generation, and an extraordinary inheritance to bestow upon future generations.▪

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