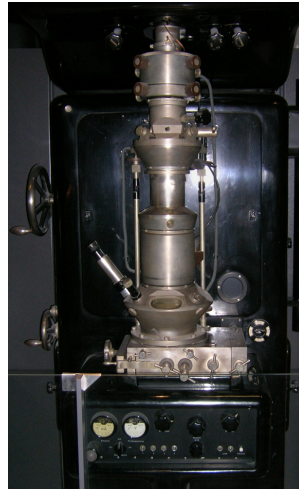


How important are material tools in the production or acquisition of knowledge?

Object 1 : The first electron microscope created by Ernst Ruska



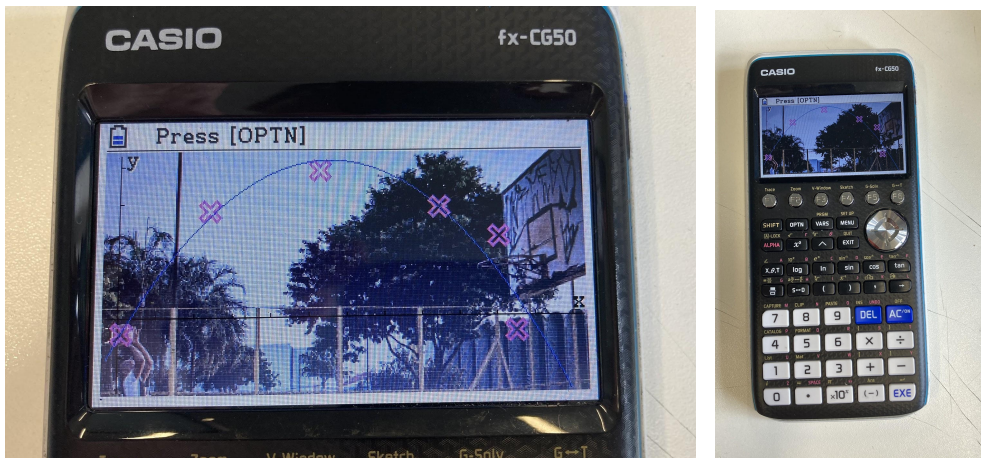
My first object is the first electron microscope, a powerful microscope created in 1931 by Ernst Ruska, the first of its kind to allow scientists to magnify objects to scale factors of x50 million.

The microscope is an instrumental tool for the acquisition of scientific knowledge, because it allowed scientists to observe tiny particles that could not otherwise be seen using the microscopes available at the time.

These nano-scale observations allowed biologists to prove fundamental theories and improve pre-existing knowledge to a higher degree of certainty. For example, the high degree of magnification allowed biologists to obtain visual evidence for the cell theory, that all living organisms are made of cells. The discovery also allowed biologists to expand their knowledge about existing metabolic processes such as cell division by mitosis, which could be observed directly. Without access to the microscope as a tool, it would have been impossible to gain this scientific knowledge and understanding.

The electron microscope is also an example of when tools are important to acquire new knowledge. The immense magnification was used to analyse a large variety of new samples that were beyond the scope of traditional light microscopes, and this led to the discovery of new organisms. The analysis of small samples had tremendous new applications in virology, pharmaceuticals and structural biology. The first electron microscope was crucial in the creation of the cryo-electron microscope which is used to create 3D-images of individual proteins such as DNA. This highlights the importance of tools in the propagation of knowledge to acquire new knowledge.

Object 2 : My Casio calculator

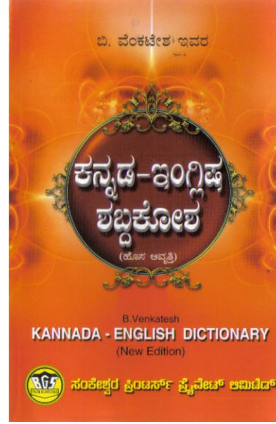


My second object is my Casio-CG50 graphing calculator, which I use in mathematics and science lessons everyday.

My calculator is an important confirmatory tool that supports my acquisition of mathematical knowledge. Traditionally, knowledge in particular areas of mathematics such as complex arithmetic is acquired from first principles, which means that the knowledge is based on manual arithmetic calculations. Since the calculator has the functionality to perform the same calculations digitally, it is used to quickly verify the manual arithmetic, and improve the degree of certainty of knowledge. For example, by applying acquired mathematical knowledge about binomial expansion, I could calculate the square root of 1.99 from first principles to be 1.41 but the calculator is an important tool to verify this answer, and thereby validate my knowledge about the procedure. In other words, the calculator facilitates a higher degree of certainty about the mathematical procedural knowledge that is acquired.

Additionally, my calculator is important as a tool to model real-life situations mathematically and produce new knowledge through estimation and extrapolation of these models. The calculator allows us as knowers to gain a more quantitative, mathematical knowledge about day to day phenomena, because it enables us to model functions onto images from real world contexts, and extrapolate the modelled functions to make predictions and produce new knowledge. For example, in my calculator, I have imported an image of a player throwing a basketball towards the hoop and using the calculator as a modelling tool, I was able to model a quadratic function for the parabolic motion of the ball. The equation for this parabola is then useful to predict values and produce new knowledge like the height of the ball at the vertex of the curve and the horizontal distance travelled by the ball, highlighting its importance as a modelling tool.

Object 3 : Kannada to English dictionary



My third object is my Kannada-English dictionary, which I have used to translate between the two languages that I can now speak fluently.

A dictionary is an important material tool in the acquisition of linguistic knowledge, especially for non-native speakers, for whom a dictionary supports the acquisition of knowledge about specific vocabulary.

The dictionary may also be a useful tool for speakers who are fluent in English. Despite my fluency in English, I find certain words easier to understand in Kannada - for example, I associate 'prosperity' with the Kannada word ಅಭಿವೃದ್ಧಿ (Abhivruddhi) and the dictionary is a tool that helps me translate the word to its English equivalent.

However, the experience and expertise of a bilingual speaker may be more important than the material tool in the acquisition of knowledge about Kannada or English as a language, because a level of fluency and exposure to both languages is necessary to acquire deep knowledge. In languages, culture is embodied by certain words that a dictionary cannot describe, limiting its importance. As a fluent speaker with exposure to both languages, I can identify concepts that are not precisely translated by dictionaries - one example is that the dictionary translates ಎಡವಟ್ಟು (yedavattu) to 'awkward', but I can translate it more correctly, as 'peculiar'. Only a bilingual speaker can identify smaller differences, which illustrates the limitations of the dictionary as a material tool.

Similarly, while dictionaries provide word to word translations, nothing can truly replace the authentic experience of absorbing the language from a community of native speakers. Certain words and concepts may even be so unique to specific cultures that the dictionaries cannot translate their meaning. An example is the childrens' game of ಲಗೋರಿ (lagori). While a dictionary can translate the word itself, playing the game with a community of native Kannadigas allows the knower to absorb the complete significance of the word. This experience is more significant than the material tool of a dictionary in the acquisition of linguistic knowledge.

Since dictionaries have to be published on paper, they are also limited by the fact that they are frozen in time, whilst language keeps changing and evolving. This means that the dictionary falls back as a material tool because it is always out of date and missing new words that are being created.

938 words

References:

Object 1 : Smith, Y. (Aug 23, 2018), History of the Electron Microscope, News Medical
<https://www.news-medical.net/life-sciences/History-of-the-Electron-Microscope.aspx>

Object 2 : Photograph from author's private collection

Object 3: Photograph from author's private collection