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## **Secondary Science Projects: Does Sophisticated Mean Better?**

Daniel Tan Kim Chwee and Boo Hong Kwen

A group of Secondary Two students were doing a project to determine the amount of caffeine in five different brands to know “which tea contains the most caffeine and so that we can avoid drinking too much of it. Hence we cut down our chance of getting harmful effects caused by caffeine.” They boiled the tea leaves, filtered off the leaves and extracted the filtrate using chloroform. They then used a spectrophotometer to determine the amount of caffeine present in each brand of tea by studying the absorbance of ultraviolet light at 274 nm by each sample.

Another group of Secondary Three students carried out a project to determine how much iron nails rust in different parts of Singapore and to provide explanations for the findings. The students hypothesized that iron nails rust faster in the following kinds of environment:

1. Areas with heavy rainfall
2. Areas close to the industrial zones
3. Areas near the sea
4. Areas close to busy roads

The procedure involved project students distributing iron nails in petri dishes to their schoolmates living in the various parts of Singapore and these nails were weighed at

regular intervals. They assumed that the greater the percentage increase in mass, the greater the rusting.

The Secondary Two students' project seemed more impressive than the Secondary Three students' project as it involved more laboratory work and the use of sophisticated equipment. Thus, one would believe that the Secondary Two students are doing a better project than the Secondary Three students, and would be inclined to award them a better grade.

During the question-and-answer session, the Secondary Two students were asked to explain the term "absorbance" which occurred many times in their report. Strangely, none of the students were able to offer even the slightest suggestion. It should be reasonable to expect that though not having encountered this concept in their school science curriculum, in the course of their project they should have thought about the meaning of this key term on which the project appears to be based. One would think that it should be reasonable to expect them to be able perhaps to suggest that the term "absorbance" relates to absorption of ultraviolet light by the caffeine. The Secondary Two students were also asked what they thought was the meaning of the term "nm" in the context of the statement "Caffeine extracted from each tea was measured in UV spectrophotometer to record absorbance value at 274nm". After a lapse of several minutes, one of them ventured the answer, "newton metre". This seemed to indicate a lack of understanding of the use of spectroscopy in the quantitative analysis of caffeine – one wonders why the students decided to use spectroscopy in the first instance. When

probed further as to whether their investigation could be conducted in the absence of sophisticated scientific equipment such as the spectrophotometer, the students replied that there would be no way then of carrying out their investigation. Such a response from the students is disconcerting as it would seem that not only did the students not understand their method of investigation, they also did not do much literature search on ways to determine caffeine in tea. These certainly give rise to questions as to how the students managed to propose such a project in the first instance.

To summarise, sophistication does not always mean better, and students' ability to produce a report does not mean that they understand what they had done. We do not have anything against the Secondary Two students' use of a 'sophisticated' instrument provided they understand the basic principles involved – otherwise the instrument becomes something merely to impress others. In contrast, though not perfect, the Secondary Three students' project work was within the ability of the students to perform and understand, and related to what they learn in class – the topic of redox in chemistry. Project work should be relevant to students, within their ability to understand what they are doing, and enable them to produce knowledge instead of merely 'reading it off from the instrument'.

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