Fig. 2 Role of imagery and drawing in the conceptualisation of any specific content area

Subjects were equally divided in their stated preference for diagrammatic or written expression. However, their written responses indicate that they were more at ease with propositional descriptions and less comfortable with using drawings. Some common alternative conceptions about the working of the human body were also identified.

Forming a visual image and manipulating its components enhances learning and problem-solving. In this study, we used analogical thinking as a data gathering tool, but found that it served a pedagogical function also, by facilitating visualisation. We propose that in the case of human physiology, visual imagery is a mediator for drawings to function as a tool for thinking and learning.

References


in an international setting. In an effort to establish such scientific and literate society; this paper argues that children’s scientific attitudes as well as their attitudes towards science must be nurtured. By possessing positive scientific attitudes and attitudes towards science, it is argued that children will have strong inclination towards science and hence have strong tendency to embark themselves in science related careers.

**Underlying Theoretical Framework**

In the field of attitude research, there is a significant debate between two schools of thought regarding the meaning of attitude itself. Attitude, as conceptualised by Krech, Crutchfield and Ballackey (1962) embrace three distinct components: the affective, the behavioural (conative), and the cognitive. More recently, another school of thought, represented by Fishbein and Ajzen (1975) contend that attitude measurement should be concerned solely with the affective domain, and that the behavioural (conative) and cognitive components should be assessed separately. Nevertheless, as pointed by Koballa (1989), regardless of whether it is the age-old trilogy or monology of attitude one has accepted, what is important is that attitudes are learned either actively or vicariously, and therefore, can be taught.

Essentially, attitudes towards science involve feelings, opinions, beliefs, and appreciation, which individuals have formed as a result of interacting directly or indirectly with the various aspects of the scientific enterprise (Hasan & Bileh, 1975, Munby, 1983). It also covers emotional reactions someone exhibits towards science (Gardner, 1975). The term "scientific attitudes" on the other hand is perceived as desirable attributes of scientists in professional work and could be categorized as interests, adjustments, appreciation as well as values. These attributes include open-mindedness, critical mindedness, suspended judgment, curiosity, intellectual honesty, skepticism, rationality, objectivity, and questioning attitudes (Kozlow and Nay, 1974; Krynoiwsky, 1985). Gauld refers to scientific attitudes as the execution of that particular approach to solving problems, assessing ideas and information and making decisions. Cognizing the wide array of definitions of scientific attitudes, this paper offers a different insight to these definitions of scientific attitudes; viz. it refers to attributes needed in executing higher order thinking, especially solving problems, judging ideas and making decisions. It could therefore be argued that having such attributes could ensure someone not merely being able to interpret the scientific knowledge and method as well as other things concerning their daily lives experiences.

In this paper, the prime aims are twofold: the first segment will focus on the concept of attitude towards science and scientific attitudes. In this section, extensive literature review on those concepts will be conducted, which ultimately bring about authors’ unique conceptions of attitude towards science and scientific attitudes. In line with the definition, relationship between scientific attitudes and critical thinking dispositions – dispositions needed to inspire someone to think critically will also be highlighted and discussed. The second segment will present empirical finding about students’ attitudes towards science and scientific attitudes. In this final section, discussion will focus on the differentiation in students' attitudes towards science and scientific attitudes with respect to gender, race and educational level.

**Research Design and Procedures**

The respondents involved in this study survey study comprise 493 Form Two, Four and Matriculation students from several secondary schools. The sampling technique used is stratified sampling (Neuman, 1999). By employing stratified sampling approach, the researcher first divides the population into strata (Form Two, Four and Matriculation). The second step involved is systematically draw sample from each strata. By employing this type of probability sampling, the relative size of each strata can be controlled and monitored by the researcher.

**The Instruments**

The main data-gathering instrument in this study is questionnaire, which includes: i) an adaptation of attitude towards science questionnaire developed by Gogolin and Swartz (1992) and ii) an adaptation of scientific attitude questionnaire developed by Kozlow and Nay (1976). The attitude towards science questionnaire comprises of 48 items and generates six distinct scores rather than a composite attitude towards science scores, viz. perception towards science teacher, anxiety towards science, the importance of science in the society, self-concept in science, enjoyment and motivation in science. The scientific attitude questionnaire comprises of 23 items, which measures students’ critical mindedness, suspended judgment, respect for evidence, honesty, objectivity, and willingness to change opinions. The instruments used in this study have been justified in terms of its validity as well as reliability.

**Main Findings**

Mainly, it was found that students’ attitude towards science is high and there exist significant difference in terms of students’ attitude towards science with respect to level of educational experiences. As for the scientific attitude, analysis reveals that overall, Malaysian students possess strong inclination towards respect for evidence and honesty. However, their objectivity and
suspended judgment are very low. Detail analysis reveals that students' cultural background has significant impact in shaping their attitudes towards science as well as scientific attitudes. It is interesting to discuss how their cultural and psychological environment shape and orient their perceptions towards science and hence their scientific attitudes. To conclude, the attitudinal profile provides viable information about the status of science education in Malaysia. This is because, the attitudinal profile generated, tacitly reflects not only the effectiveness of the Malaysian science curriculum in resulting attitudinal changes in the students, but also to science teachers whereby they need to reflect upon their content as well as pedagogical content knowledge so that the end product of children's formal science experience is not only students' acquisition of scientific knowledge (cognitive development) but also changes in terms of students' attitudes (affective psyche) – an aim which is boldly written in the Malaysian science curriculum.

References


Student's Alternative Conceptions in Pressure, Heat and Temperature

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Objective
To study the undergraduate physics students' misconceptions about some selected basic concepts in thermodynamics.

Significance of the study
At the core of physics education research is the desire to improve instructional strategies for the benefit of student learning. In the physics community, there has been much research undertaken to this end yielding revealing data about what and how students learn. The identification of various misconceptions has led to new ideas for teaching physics both at the secondary and undergraduate levels.

Heat and thermodynamics is a conceptually rich area of undergraduate physics. From the point of view of misconceptions it seems not to have been explored much. Especially in the Indian context so far there has...