

Science Teaching and Teacher Verbalization

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Abstract

Certain verbal utterances in the classroom by teachers prompt peculiar internalization by students. The result is appropriate if the utterances are precise. If they are not, the internalization is such that incorrect learning results. This paper identifies verbal utterances which can produce an incorrect internalization of learning. These utterances are classified as specific (meaning correct, usage wrong), non-specific (meaning and usage incorrect) and incorrect (correct in context, meaning incorrect).

Introduction

Why do we as teachers of the various areas of science compromise the very principles which we so diligently strive to impart to our students? Within our classroom the stress on scientific methodology as the correct procedure by which truth is processed is without question. Yet our verbal utterances sometimes belie this assumption.

The learning process is evaluated by us as being a desirable or an undesirable response pattern depending on the behavior exhibited by the student. This evaluation which consists of different approaches (direct oral questioning, testing procedures, homework, etc.) prompts us to conclude whether or not the response pattern is a logical consequence of our training objectives. If the response pattern does not fit well with our objectives we further conclude that proper learning did not occur. However, this does not mean that some learning is not manifested. To the contrary, learning has taken place and in some cases retention is prolonged.

Although the actual process of learning is unknown, it is accepted that learning requires the manipulation of symbols. Learning stems from thinking which results from the process of conceptualization and internalization of a peculiar response pattern. Rothkopf (1) describes thinking as a series of mathemagenic¹ behaviors. These behaviors include:

- 1) Translation: where written or spoken symbols are transformed into an internal pattern.
- 2) Segmentation: where the internal pattern is separated according to intonation and rhythmic organization.
- 3) Echoic responses: where segmentation is influenced and modified or augmented by other associations previously internalized.
- 4) Mnemotechnic devices: the incorporating of various methods or devices to improve retention.

If Rothkopf is correct "echoic responses" should command our attention. If problem-solving procedure requires input from the environmental

¹ mathemagenic: mathema (that which is learned), and gignesthai (to be born).

totality of the student's associations, and if these inputs are incorrect the resultant behavior is an undesirable response pattern.

Certain verbalizations by teachers in the classroom situation are manifested in subsequent student behavior. In most cases the situation is compromised and no harm is done. But in some areas of content these verbalizations continue to be made without correction and the student continues to internalize these verbalizations. The resultant response behavior is incorrect and becomes a major factor hindering effective thinking. These verbalizations are classified as specific, non-specific and incorrect statements.

Specific Statements

Specific statements are defined as utterances which can be made without violating proper identification. In other words, it is not the intrinsic meaning which is stated incorrectly but the manner of usage. The usage in the teacher's mind may be rationalized but to the student a specific statement must be translated literally. Echoic responses are thus influenced by this part of the student's internalization process.

An illustration of this utterance type involves the International System of Units (SI) where a meter is stated as being 39.37 inches long. Although used for many years in some industries and in scientific circles SI has not been used by the general public. Since the use of this decimal system of measurement will be introduced into daily activity in the next few years it is imperative that the basic parameters be treated intrinsically rather than by comparison.

The International System of Units should be introduced as a coherent system and not as a comparison to the imperial system. A meter is not 39.37 inches (nor is a yard 0.914 of a meter) and this figure of inches should not be used as a conversion unit. If a conversion unit is used it immediately becomes valid to ascertain the length of the inch. By doing so, the question remains, "how long is a unit of measurement?" The situation has become circular reasoning without instructing or having the student discover the actual parameter of the metric system. The result is a student unable to use SI to maximum effectiveness.

Non-Specific Statements

Non-specific statements are identified as utterances which violate elemental definitions. Not only is the intrinsic meaning of an element stated incorrectly but the manner of usage is also incorrect. It appears that the non-specific statements represent those things used as tools within a particular discipline yet probably were not developed by that discipline. The result is a restriction in the fullest use of that tool.

An example is the concept of the undulating statistical surface mistakenly introduced as the concept of the contour line. The undulating statistical surface is a concept used to describe a three-dimensional surface either real or abstract and is a measurement of volume. The surface is defined by control points having X, Y and Z coordinates. Z

coordinates represent data above a datum at the X, Y location of a control point and may represent: 1) information that can actually occur at a point; 2) information that is derived and can occur at a point (totals); and 3) information that is derived and cannot occur at a point (ratios). Furthermore, the slope length and gradient that occurs between control points is assumed to be constant as the actual surface shape in abstract cases is unknown. The result is an inferred surface symbolized by isolines on a two-dimensional plane which if real could be field-checked but if abstract cannot. The reliability of the surface is dependent upon mathematical procedure and is subject to various bias.

In Earth Science the contour idea is used in "reading" topographic maps and for the understanding of force fields. Developed as a method by which terrain surfaces are "read" and later used in the observation of temperature and other measurements the approach creates variation from the proper use of the undulating surface concept. The undulating surface concept should be developed separately in its own right and with premises intact. It is not exclusively the domain of terrain representation and should not be so presented. The concept must be developed separately as a tool and used with exercises designed to practice its use and heighten understanding.

Incorrect Statements

Incorrect statements are defined as utterances which are correct considering the context in which they are used but intrinsically are incorrect. These utterances outside of their context as used can be seen to be false and contrary to logical thought.

The frequently encountered incorrect statement is "north (on the map) is up." The statement when using a wall map may be considered "correct" but north is not "up" ever. North as a cardinal direction on a map is a relative positioning or direction. If a map is used, north as a direction may be oriented however the map user wishes. Furthermore, if a graticule having curved meridians is used north cannot be considered as having a singular orientation. North arrows are not required with areas on a map that exceed 1° of latitude and longitude in extent as direction is correctly oriented by the geographic grid.

To show this situation consider the necessity of actually pointing toward the north pole. The orientation would be along the chord distance, but in the actual use of a map north is separate from the northerly orientation of the person. North on the map is relative to the map only. A map of the school, village or state drawn on the floor of the classroom and correctly oriented would prevent saying "north is up."

Literature Cited

1. ROTHKOPF, ERNST Z. 1965. Some theoretical and experimental approaches to problems in written instruction. p. 193-221. In JOHN D. KRUMBOLTZ [ed.] Learning and the educational process. Rand McNally and Co., Chicago, Ill. 277 p.