EVALUATION OF STUDENTS' LEARNING OUTCOME II:
Alternative Assessment Techniques of Students' Learning Outcomes

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CHAPTER 30

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Introduction

In the teaching and learning process the teacher’s main task is to promote and facilitate meaningful learning. A teacher would not have completed his task until he has determined the performance of his students. Hence, evaluation of students learning outcomes is imperative in the instructional process. Evaluation is one of the elements of the curriculum without which the latter is not complete. In the classification of educational objectives, evaluation occupies the sixth and highest level of Bloom's Cognitive Taxonomy of Objectives. According to Doran (1980).

Evaluation is a mainstream educational tool which is most valuable and less obtrusive when properly integrated with all phases of the instructional process (p. 2).

Bloom (1971) perceives evaluation as the systematic collection of evidence to determine whether certain changes are taking place in the learner and the extent of the change in individual learner. He further identified two sides to evaluation as: the goals and roles and collection of information (data collection); plus the processing of collected data. Evaluation is therefore, a useful tool in the determination of the worth of a learning programme for the purpose of making alternative decisions.

Three primary types of evaluation are recognised among educators: Diagnostic, Formative and Summative. Diagnostic evaluation often precedes instruction, while formative is carried out and completed during the instructional period. Summative evaluation is the most common and is concluded at the end of the unit or course. In the school systems-evaluation focuses on the students, the teacher, the curriculum and the classroom. However, the student is the primary focus in the evaluation of learning outcomes.

In evaluating students learning, three domains of knowledge are recognised. The cognitive, the affective and the psychomotor. Evaluation in the cognitive domain, which deals with knowledge and the development of intellectual skills and abilities, is often given more attention. The affective and psychomotor domains are seldom as prominent. Inspite of the importance of evaluation, most teachers are unprepared for the role of an evaluator because they have not received adequate training in evaluation techniques. Consequently, evaluation in schools traditionally, tended to be paper-and-pencil testing type. Furthermore, summative evaluation is the most frequently used by teachers.

Novak and Gowin (1984), observed that to most students and teachers, achievement testing (usually true-false, multiple-choice and short answer paper-and-pencil examination), is synonymous with evaluation of learning. Although testing is a significant part of evaluation and has its own value in learning, several problems have been associated with it. Traditional testing practices have been widely criticized as unreliable, subjective, measure low level...
cognitive outcomes and lack validity (Pines, Novak, Posner and Van Kirk, 1978). Unfortunately, these criticisms are true of some standardised and teacher-made tests currently in use in our schools.

In this chapter, evaluation of students' learning outcomes is discussed focusing on three alternatives techniques namely, clinical interview, concept mapping and Vee-Heuristic techniques which most classroom teachers are unfamiliar with but are already being used in developed countries. Each technique is described and guidelines as to how a classroom teacher can make use of it for the assessment of students’ knowledge is given. Some examples are also provided in the chapter. Models and scoring procedures are given in the appendices.

Clinical Interview Technique

The Clinical interview was used and described about five decades ago, hence it is not a totally new method. Piaget (1929) introduced the method for the purpose of studying cognitive development in children Novak (1978) and his associates extensively modified the clinical interview although the basic procedure of the technique remains similar. The clinical interview is a technique or tool by which data can be generated for the purpose of evaluation. The sources of data are verbal human subjects. Once the data has been acquired; if can be used for the purposes of answering several different types of questions about different entities, both processes and products. These are the goals of evaluation which should direct the interview. For example, clinical interview can be used as a technique for evaluating student(s) achievement in the broadest sense and the data obtained may be used to ameliorate certain deficiencies in a specific course.

Clinical interview has three aspects which may elude, of confuse the classroom teacher. These are the “content” the “task(s)” and the “method”. The “content” refers to the subject matter of the interview, while the “task” refers to the particular problem situation presented to the subject(s) or interviewee. The “method” is concerned with the technique by which the teachers or interviewer (I) attempts to elicit information from the subject (S). A relationship exists between the three components. It is important to take note of the relationship because the technique is always designed for the particular task or tasks.

Content and Tasks

The "content" as subject matter of the interview is presented to the interviewee or subject by way of specific problem situations which may be referred to as "tasks". The latter do not constitute subject matter, but rather they are means through which information about a specific content area is presented. The tasks are instrumental, because they are usually a small representation of the set chosen from several possible alternatives. One specific task may be suitable for a number of different content areas. Some tasks are better suited to a particular area of content than others depending on the purpose of the interview and upon the subjects for whom the interview is directed. While some researchers have utilised Piagetian tasks, others have rather constructed task primarily to suit unique research goals (Friedman 1977; Pines. 1977; Rowell, 1978; and Whieman. 1975).
Method

The "method" or format of the clinical interview refers to the techniques of administration. That is, how the interviewer (I) utilises the tasks and manipulates the modes of questioning to collect information in certain content areas from the subject(s). Two formats have been identified: the inflexible format and the flexible format. The former is essentially the presentation of the interview in a rigid standardised format which does not allow any flexibility. The latter that is, the flexible format is similar to that used by "Piaget (1929) and Novak (1984). Below is an interview format continuum to show the two types of format used in the technique.

<table>
<thead>
<tr>
<th>Inflexible</th>
<th>Flexible</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tasks are highly relevant and related to the interview format.</td>
<td>Tasks are only relevant as a stimulus for the initiation of the interview.</td>
</tr>
<tr>
<td>2. Interview is very reliable because the format is not dependent on the interviewer or the interviewee.</td>
<td>The interview is very unreliable and dependent first and foremost on the interviewee. The interview is also dependent to some extent on the interviewer, the context, and the circumstances in which it is administered.</td>
</tr>
<tr>
<td>3. The format of the interview and the resultant data can be anticipated a priori.</td>
<td>Except for the one guiding principle of following upon all student responses, the precise format of the interview and the resultant data cannot be anticipated a priori.</td>
</tr>
</tbody>
</table>

4. The data obtained are precise but contain little information. The data obtained are both amorphous and rich with information.

5. Interpretation of the results is very straightforward. The interpretation of the data is very difficult.

6. Results are categorizable, usually into dichotomous. A total interview cannot be easily categorized in any meaningful way.


Guidelines for the Use of the Clinical Interview Technique As An Evaluation Tool

i. A good knowledge of the subject matter by the teacher (interviewer) is essential as this cannot be acquired during the clinical interview training session.

ii. The teacher's theoretical orientation and focus influences the purposes or goals of each interview.

iii. The format of the interview preferred is largely dependent on the purposes or goals of the interview, e.g. the depth of knowledge being evaluated.

iv. The more rigid the interview (inflexible) format is, the easier it is to prepare in advance and to perfect the technique.

v. It is possible for two independent teachers (interviewers) to use the same tasks to represent the same or different content, while using different methods.
vi. When the student (subject) is presented with a task in an inflexible format, the reason for the student's (subject) response is not often determined. Hence, the type of format influences the type of responses obtained.

vii. The teacher as the interviewer must use a tape recorder to record interview sessions, most importantly the responses of each student (subject).

viii. The responses must be transcribed and analysed carefully at a convenient time. (See appendix I for a model of an interview format).

Concept Mapping Technique

This procedure is based on the notion that the meaning a pupil or student acquires for any concept is manifested not only as all-or-none acquisition of knowledge or failure to acquire, but rather as a growing set of propositional linkages between the concept of a central theme and other related concepts (Novak and Gowin, 1984). Concept mapping emerged as a result of the search for reliable, consistent ways to express the varying degrees of concept understanding.

Changes in the development of meanings of concepts in pupils over a span of years or as a result of instruction, were difficult to determine. Indeed, almost impossible to study until a measurement tool was devised that could identify these changes in pupils and students cognitive structure. One of such tools is the Concept Mapping Technique.

In using this technique for evaluation, teachers must determine their own purpose and meaning of the concepts concerned and assessment as it relates to the subject matter taught. How to construct concept maps during instruction, the identification of concepts and linking words are very important (see appendix II and III). Concept mapping technique is both an instructional and an evaluation tool.

In evaluating students' understanding of concepts using concept maps, the teacher may also score the scheme. Concept maps may be constructed in any subject or discipline provided the subject matter knowledge of whoever is constructing it is adequate. The basis for the latter derives from the cognitive learning theory (Ausbel, 1978). Three ideas in the theory which serve as guiding principles in the use of concept mapping technique for evaluation are as follows:

(a) Cognitive structure is hierarchically organised

(b) Concepts in cognitive structure undergo progressive differentiation and

(c) Integrative reconciliation occurs when two or more concepts are recognised as related or when conflicting meanings of concepts are resolved.

Hierarchical Structure

This principle incorporates the concept of subsumption (Ausbel, 1978). That is, the notion that new information often is relatable to and subsumable under more general main inclusive concepts. It is important to note that a good hierarchical structure for a segment of content to be learned begins with a broad inclusive concept. The latter leads to more specific and less inclusive concepts subsumed by the broad concept. There can be no "right" or "wrong" concept maps but rather they are focused on good ways of
Establishing hierarchy of relationships among concepts. The concept map (Fig. 1) illustrates the hierarchical structure as follows:

(i) Continent is a broad most inclusive super-ordinate and key concept.

(ii) Africa, Asia, Europe, and America are subordinate concepts, less inclusive under the concepts continent. These occupy the first level in the hierarchy of concepts.

(iii) Similarly, Nigeria, South Africa, India, Pakistan, United Kingdom, Germany, and South America are countries and subordinate less inclusive concepts under the five different continents in the second level in the hierarchical structure.

(iv) Abuja, Lagos, Cape Town, Pretoria, Bombay, New Delhi, Bangladesh, Dhaka, London etc are the least inclusive concepts and so on depending on the level in the hierarchical structure and number of steps in the concept map. These concepts constitutes the third level in the hierarchy.

In order to construct a hierarchical concept map, therefore, what is perceived as the most inclusive, less inclusive and least inclusive concepts in any body of knowledge or subject matter must first be identified. Two general patterns in the construction of concept maps have been identified.

(i) One pattern is to first develop smaller submaps combining six to ten concepts together and then integrating these into a larger final map.

(ii) The second is, to begin by ranking the concepts to be mapped in some way and begin constructing a map with six to eight major concepts.

(iii) Gradually adding more subordinate concepts as they proceed. Any of the two methods may...
be used in the construction of a well-hierarchically structured concept map.

Hierarchical structure allows for relative ease in assessment by the teacher, as sections of a concept map that are too general or too specific are readily detected and indicate either lack of understanding of the topic taught or the need for more careful integration of super-ordinate and subordinate concepts. Figure 2 illustrates two examples of concept maps constructed by two students who had attended the same lesson in social studies in the Junior Secondary School. One of the maps illustrates a faulty concept map (Fig 2a) and the other represents a well-structured map (Fig. 2b).

**Progressive Differentiation**

The second principle of progressive differentiation states that "meaningful learning is a continuous process where new concepts gain greater meaning as new relationships (prepositional links are acquired)." (Ausubel 1984). Thus, concepts are never "finally learned" but are always being learned, modified, more explicit and more inclusive. They become more progressively differentiated.
Fig 2 (b) Well constructed concepts map on the same topic by another student by Danmole, B. T. (2000)

Fig 3: A concepts map on the topic "Ecosystem" in biology showing the hierarchical structure and progressive differeriation of the main inclusion concepts by Danmole, B. T. (2000)
Learning is the result of change in the meaning of experience, and concept mapping is one method for showing both teacher and learner that cognitive reorganisation is taking place.

Progressive differentiation of concepts is improved when a concept map for one topic is linked to concept maps for other related topics. If specimen concept maps are posted around the classroom, students would be encouraged to see how the concept map for the current topic of study cross links to one or more concept maps for other topics. It is desirable that a class discussion be conducted on ways to construct a high order concept map to relate several topics of study to show the hierarchical relationships. Progressive differentiation of concepts through concept maps can provide emotional as well as cognitive rewards, both in a short term and, especially, in the long term.

Integrative Reconciliation

The third principle of learning considers that meaningful learning is enhanced when the learner recognises new relationships (concept linkages) between related sets of concepts or propositions. For example, ice turns to liquid when heated not because the molecules have changed but because rigid bonds between molecules break up. Indeed, if more heat is applied, the molecules may move further apart to form a gas that would expand indefinitely if it were not confined in a container.

The example mentioned illustrates that meaningful learning relationships exist between old and new sets of concepts. In addition, misconceptions are consciously exposed and displaced by new prepositional linkages. Concept maps reveal the individuals prepositional frameworks and can therefore be used to check any faulty linkages or to show the relevant concepts that are missing students' knowledge of a particular content area or topic may be determined by scoring individual students concept maps.

Introducing Concept Mapping Techniques to Students: Strategies for Teachers

1. Prepare two lists of words on a sheet of paper prior to the time of your lesson. Copy the two lists of words on the chalkboard or use an overhead projector during the lesson. One of the lists could be a list of objects while the other is on events. Label the two lists as A and B respectively.

List A ----- Table, cat, pressing iron, (objects) flower, spoon and magnet.
List B ----- dancing, singing, (events) reading, lighting, driving, drama

2. Ask the students what they think of the words in the first lists e.g. table, cat and so forth. Assist students to recognise that even when we use the same words, the "meaning we give to them are often slightly different. The mental ideas we have for words are called concepts. At this juncture the teacher should introduce the word "concept" to the students.

3. The teacher should repeat the activities in step 2, this time looking at list B, the events' list. Again, we have our differences in our mental images or concepts of events. This is why it is difficult for us to understand one another sometimes. Words are labels for concepts, but each individual must acquire his own meaning for words.
4) The teacher should now list words such as “are”, “the”, “is”, “then”, “with”, and “where”. Ask students what comes to their minds when each of these words are mentioned to them. The teacher should make students understand that these are not concept words, but linking words and are used in speaking and writing. Linking words are used with concept words to construct sentences that have meaning.

(5) Proper nouns are not concept words but rather names of specific people, events, places or objects. Teacher uses some examples and assist students to distinguish between labels for regularities in events and objects and those for specific events on objects (or proper nouns).

(6) The teacher using two concept words and linking word(s), constructs a few short sentences on the chalk board to illustrate how concept words and linking words are used to convey meaning. Examples:
(a) There is lightning
(b) Those children are dancing
(c) The spoon is hot

(7) The teacher encourages students to construct a few short sentences of their own, identify the concept words, whether each is an object or event, and also identify the linking words.

(8) If there are bilingual students in the class, the teacher asks them to present in their own language equivalent words that label the same objects or events. Assist students in pointing out that language does not make the concept, but only serves as the label used for the concepts.

(9) The teacher introduces some short but unfamiliar words to the class such as Titiapia and Carica. These are words that stand for concepts they already know (i.e., fish and pawpaw), but have some what special meaning. The teacher should assist students to see that meanings of concepts are not rigid and fixed but can grow and change as we learn more about them.

(10) Select a page in a textbook and make duplicate copies for students. Choose a passage that conveys a definite message. As a class, ask the students to read the passage and identify key concepts (often 10-20 relevant concepts) may be found in a single page of textual material. Ask students also to identify linking words and concept words that are less important to the story line.

### Vee Heuristic Technique

This procedure is useful for answering value questions such as "is this topic in the syllabus valuable? Is this article or poem, or mathematical equation of any value? The Vee-heuristic was first developed to assist students and instructors clarify the nature and purpose of laboratory work in science. Since the Vee was introduced to college students and teachers in the United States of America, in 1977, it has been found to be relevant in virtually every discipline represented at the university level.

Gowin (1978), introduced the Vee Heuristic to Junior High School Students to help them "learn how to learn" science. It has since been applied as an aid to learning in many fields of study at both Secondary and College levels in developed countries.

Vee-Heuristic diagram like "concept maps is a way of assisting students and teachers to see the "meaning" of learning materials and to penetrate the "structure" and "meaning" of the knowledge they seek to understand. The following Vee heuristic diagrams as presented by Gowin illustrates the interaction between the conceptual and methodological elements in the construction of knowledge.
An important feature of Vee-heuristic to note by teachers when using this technique is the interplay between the conceptual or theoretical (thinking) elements on the left side and the methodological or procedural (doing) elements on the right side of the diagram. It is crucial that students understand the interplay, or interaction between "thinking" and "doing" in any field of human endeavour before the creation of new knowledge. The two sides are interdependent, the teacher must make students recognise that concepts, principles and theories influence what we see in and do with observations. Similarly, these observations influence the concepts, principles and theories we construct.

![Vee-heuristic diagram](image)

Fig 3: Gowin's Vee heuristic diagram invented to illustrate the conceptual and methodological element that interact in the process of knowledge construction in the analysis of lectures on documents presenting knowledge.

It is important to note that an experiment, a poem and a painting has only the interpretation or quality that our constructs allow us to see. This reciprocal relationship between what we see and our interpretations is the basis of human understanding and obviously have important implications for evaluation. It requires not only interpretation, but also analysis, synthesis, and evaluation of knowledge. Evaluation is the highest levels of Bloom's (1956) Taxonomy of Educational objectives (Gowin, 1978).

In spite of the challenging nature of the Vee Heuristics students have been known to react positively to this task especially when compared with traditional written reports. Vee diagram is a short hand approach to exposing students understanding of the topic or area of study and also helps the students to organise ideas and information. The motivating value of this technique for students is immense and student feel better, more willing to work and more likely to be responsible for their own learning.

In utilising Vee-Heuristic diagram for understanding knowledge and its production, the following five questions are to be applied to any document on exposition presenting knowledge (Gowin 1984). These are:

(i) What is the "telling question"?
(ii) What are the key concepts?
(iii) What methods of inquiry (methodological on procedural commitments) are to be used?
(iv) What are the major knowledge claims? What are the value claims?

In introducing the Vee-heuristic diagram to students, it is advisable to introduce concept mapping before Vee-heuristics. The following steps serve as a guide.

(i) Begin with concepts, objects and events.
(ii) Introduce the idea of records and focus questions.
(iii) Identify knowledge claims and how data from records may be transformed.
(iv) Discuss principles and theories underlying the concept, objects and events.
(v) Identify the value claims.
It is important for teachers to note that a graph is a common form of record transformation in the natural and social sciences.

Examples

(i) Below is a specific example of an experiment in chemistry on the effect of heat on a salt solution using the Vee-heuristic diagram as provided in fig. 5 (i) to explain the events (observations) in the experiment (ii) to illustrate transformation of record data and (iii) to construct a graph or graphs from the transformed data.

Table 2: Observations on Heating a Salt Solution

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10°C</td>
<td>Solute dissolves leaving excess solute undissolved in solution</td>
</tr>
<tr>
<td>20°C</td>
<td>Excess solute begins to dissolve</td>
</tr>
<tr>
<td>50°C</td>
<td>Solubility increases as the temperature rises</td>
</tr>
<tr>
<td>70°C</td>
<td></td>
</tr>
<tr>
<td>90°C</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: A table showing the records of observation of the event of heating a solution of a particular salt (KC103) at varying in a temperatures.

Fig 5: A graph of transformed records for the event of heating a solution of a particular salt (KCI03) at varying in a temperature

A second example is the use of Vee-diagram to teach and evaluate in economics, the Demand and Supply theory. Similarly, the Vee diagram is represented thus:
Implications for Classroom Instruction

(1) The effect of prior knowledge has been confirmed to be significant on subsequent knowledge acquired. Therefore, instruction must endeavour to determine the entry behaviour of students before the introduction of new knowledge. The clinical interview technique is very useful in this regard.

(2) It is known that the depth of students' knowledge as a result of instruction obtained in school can be identified when the analysis of data collected from evaluation has been done. Hence, instruction must be geared towards using the three evaluation techniques discussed in detecting alternative conceptions, misconceptions and inconsistent conceptions among students, which the teacher must correct during subsequent instruction.

(3) Instruction must be to teach students to identify key concepts in any given piece of information in any topic and the relationship between concepts highlighted. The concept map and Vee diagram must therefore be used not only for evaluation but also for instruction.

(4) Research efforts have placed considerable emphasis on subject matter knowledge and conceptual change. The emphasis on acquisition of concepts has become imperative during instruction. The teacher must have a good knowledge of the subject matter of the particular discipline before being able to utilise the concept map and Vee-diagram techniques for both instruction and evaluation.

(5) The use of the three techniques requires that the teacher be resourceful and understand the salient features of each technique. Most importantly, instruction must be accompanied with several illustrations, examples and assignment this is to
provide practice on the use of the concept mapping and Vee heuristic diagram techniques.

Conclusion

Evaluation of learning outcomes is an important component of curriculum, an indispensable part of instruction and the responsibility of the classroom teacher. The classroom assessment is till the foundation of the day-to-day evaluation programme of the school. However, most teachers have little or no formal training in evolution techniques, a situation which is far from the ideal.

In line with the explosion in knowledge, there has been considerable pressure on teachers to examine carefully and likewise place a high premium on the adaptation of a variety of evaluation techniques and instruction that are comprehensive, functional, amenable to change and yet precise (Doran, 1980). The clinical interview, concept mapping and vee heuristic diagrams are alternative evaluation techniques of immense value in assessing cognitive learning outcomes of students. These techniques not only make up for the deficiencies of traditional tests but also provide data of a qualitative type on the depth of knowledge or understanding of the subject matter by students.

Bibliography


APPENDIX I

PHENOMENON = Stimulus or Task to initiate interview

QUESTION

REDIRECTION

RESPONSE

IRRELEVANT

RELEVANT

FOLLOW-UP

IRRELEVANT

RELEVANT

Fig. 8: A Model of an Interview Format adopted from the Clinical Interview Research Report No. 6, September, 1978.

In scoring a concept map the teacher should look for four components in the map. These are (i) Propositions, (ii) hierarchy (iii) Cross-links and (iv) examples.

(i) **Propositions:** The teacher must ascertain that relationship between two concepts are indicated by a connecting line and a linking word (s). The relationship must be found to be valid to merit the score of one (1) point.

(ii) **Hierarchy:** The map must show hierarchy. That is, whether each subordinate concept drawn above it (i.e. the concept under which it is supposed to be subsumed). Each valid level

(iii) **Cross-link:** The map must show meaningful connections between one segment of the concepts hierarchy and another segment. For a significant and valid cross-link shown, ten (10) points may be allocated. However, two (2) points may be awarded for each valid cross-link but which does not illustrate a synthesis between sets of related concepts or propositions. Cross-link can indicate creative ability and special care should be taken in identifying and rewarding its expression. Extra points should be given to such cross-links. Examples: specific events or object that are valid instances of those designated by the concepts label can be scored one (1) point. (These are not supposed to be circled because they are not concepts).

A Criterion Concept Map

The teacher may construct a criterion concept map and score it, for the content to be mapped. The student scores may be divided by the criterion map score and multiplied by (100) to determine the Percentage for comparison. Where students have done better than the criterion, extra points should be given at the teachers discretion. The actual numerical value applied to each of the key scoring criteria is arbitrary, and teachers are encouraged to explore the possibility of assigning different values.
APPENDIX II

Scoring Model for Concepts Maps

APPENDIX III

Scoring Vee Diagram

It is customary to see the term "data" for both the initial records and the transformed records, and that students recognize the differences between raw data (initial records) and the data in transformed records. As students become more experienced with the Vee heuristic diagram they could be same event. This could be a test of their creativity and understanding of concepts.

Scoring key for Vee diagrams, developed for use with students (Adapted from Novak & Gowin 1984)

Score Focus Question

0- No focus question is identified.
1- A question is identified, but does not focus upon the objects and the major event OR the conceptual side of the Vee.
2- A focus question is identified; includes but does not suggest objects or the major event OR the wrong objects and event are identified in relation to the rest of the laboratory exercise.
3- A clear focus question is identified; includes concepts to be used and suggests the major event and accompanying objects.

Score Objects/events

0- No objects or are identified.
1- The major event OR the object are identified and are consistent with the focus questions, OR an event and
objects are identified, but are inconsistent with the focus question.

2- The major event with accompanying objects is identified, and is consistent with the focus question.

3- Same as above, but also suggests what records will be taken.

Score Theory, Principles, and Concepts

0- No conceptual side is identified.
1- A few concepts are identified, but without principles and theory, or a principle written is the knowledge claim sought in the laboratory exercise.
2- Concept and at least one type of principle (conceptual or methodological) OR concepts and relevant theory are identified.
3- Concepts and two types of principle are identified OR concepts one type of principle, and a relevant theory are identified.
4- Concepts, two types of principles, and a relevant theory are identified.

Records/transformations

0- No records or transformations are identified.
1- Records are identified, but are inconsistent with the focus question or the major event.
2- Records OR transformation are identified, but not both.
3- Records are identified, for the major event; transformations are inconsistent with the intent of the focus questions.
4- Records are identified for the major event, transformation are consistent with the focus question and level and ability of the student.

Score Adapted from Learning to Learn (Novak and Gowin 1984) knowledge claim

0- No knowledge claim is identified.
1- Claim is unrelated to the left-hand side of the Vee.
2- Knowledge claim includes a concepts used in an improper context OR a generalization that is inconsistent with the records and transformations.
3- Knowledge claim includes the concepts from the focus question and is derived from the records and transformations.
4- Same as above, but knowledge claim leads to a new focus question.

A simple method for scoring Vee constructed from expository material would be to assign 0 to 10 points for answers to each of the questions given especially when Vee is applied to evaluation of reading materials, e.g. a comprehension or composition in English language and Literature given to students. It is also directly to the critical reading of research papers (in any field) Hence, the Vee is laid on paper and the ten questions asked as follows:

1. What objects and/or event were been observed?
2. What records or record transformations were made?
3. What was/were the focus question?
4. What relevant concepts or principle were cited or implied?
5. Do the records made validly record the main aspects of the events and/or objects observed?