CHAPTER-II

BASIC CONCEPT OF SCIENTIFIC DISCOURSE
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2.1 Scope of Discourse Analysis

2.1.1 Discourse analysis is the most recent trend in ELT. It grew out of heterogeneous disciplines such as Linguistics, Psychology, Anthropology and Sociology in the 1960s and early 1970s. It is now increasingly forming a backdrop to research in Applied Linguistics and hence gaining a key importance in second language learning and teaching.

Discourse analysis is a way of describing and understanding how language is used at different levels. The different levels for the analysis of language, include most specially the elements of grammar and lexis. These two elements, in fact, constitute the basic concept of discourse analysis. Without a command of rich and variable resources of grammar and lexis the study of discourse in any given text will be inadequate.

Grammar deals with the grouping and classification of recurrent elements in the structure of utterances and stretches of writing. The recurrent elements such as sentence, clause, anaphoric and cataphoric reference and cohesive devices are all considered discourse features. These are important means to
analyse the internal features of the language. Grammar, according to McCarthy\(^1\) (1999) deals with closed system choices which carry grammatical meaning such as singular/plural, present/future, this, that, these, those etc. Lexis on the other hand is concerned with open set choices which belong to the major word classes of noun, verb, adjective and adverbs.

Bloomfield\(^2\) (1993) described lexis as an appendix of grammar and a list of basic irregularities. That is to say lexis deals with the part of the functioning of language that cannot be treated under the general categories of grammar. It is, in fact, an important means for linguistic statement which deals with the deepest part of language.

Halliday (1964)\(^3\) has frequently used the term grammar with an enlarged meaning referring to the total system of language and its description. Hence, according to Halliday (1966) grammar is that part of the system of a language which can be described in terms of generalization or rules. On the other hand lexicon has often been characterized as a list of all the particular facts about language which cannot be generalized into rules.

Lexical studies also deal with the formal aspect of vocabulary organization. Lexical description of specialist discourse has always been an exciting area for research. Vocabulary and its various aspect will be discussed at length in chapter V.

2.1.2 Discourse analysis, at the level of lexis is concerned with the study of relationship between language and the context in which it is used. Encoding and decoding the meaning of a word depends almost on the context in which it is used. A word cannot be properly comprehended without taking into account the context in which it has occurred. In fact, no word has implicit meaning. It is the context that determines the meaning of a word. Therefore a word is like a chameleon. As a chameleon changes its colour to match the colour of its surrounding. Similarly a word acquires different meanings in different contexts. As a matter of fact, it is discourse analysis which assists the reader to draw the meaning of a word that does correspond to the context in which it has occurred.

Discourse analysis is not only concerned with discription and analysis of spoken interaction but it is equally concerned with the organization of written language. More particularly in scientific writing discourse analysis has
become a recurrent phenomenon. It focuses on what norms or rules do scientists adhere to when creating scientific texts and on how the progression of the whole text is formed. In addition, the way discourse has been defined in scientific context is most significant because it unravels the entire enigma of scientific writing, such as Widdowson’s (1975) ideas in this regard are invaluable. Widdowson (1975) defines scientific discourse as the verbal and the non-verbal realization of communicative system of science. Both verbal and non-verbal devices, according to him, are equally important. Non-verbal devices are formulae, symbols, line drawing, tables, etc. Apart from verbal devices, these non-verbal devices are also an essential part of technical writing because they enable scientists to communicate their findings effectively. Sometimes these non-verbal devices orient the reader to the topic before he or she begins to read the text. These non-verbal clues are, therefore, an intrinsic part of scientific text because they substantiate communicative value in the text. The second meaning of discourse analysis relates to the study of rhetorical functions in scientific text. These can be exemplified from Todd, Trimble and Trimble (1977) referring to technical manuals, such as:

Thus we find commonly the rhetorical functions of descriptions, definition and classification and the rhetorical techniques of time order, space order and causality. In addition, manuals have two rhetorical features found less commonly in scientific and technical writing: the interpretation of illustrations and the rhetoric of instructions.

Thus, Trimble and Trimble consider rhetorical function, rhetorical technique and rhetoric of instruction as the recurrent features which characterize scientific discourse and thereby constitute a specific format for scientific text. Trimble and Trimble (1977) bring into focus the identification of the rhetorical function in scientific text. They also consider sequencing of functions and analyse grammatical patterns in scientific texts. In addition, their works on the relationship of tense and rhetorical function seem specially useful. The analysis of such discourse patterns in scientific texts has been further substantiated by Trimble's book *English for Science and Technology: A Discourse Approach*. In this book Trimble (1985) presents rhetorical functional approach to EST and outlines the methodology for it. His approach focuses on:

(i) Unit of discourse larger than the sentence.

(ii) The rhetorical functions of units at various levels in EST texts.

(iii) The impact of rhetorical functional considerations on the choice of specific grammatical phanomena.

(iv) The interrelation and conceptual integration of skills needed for both reading and writing.

(v) Pedagogical issues and considerations inherent in a rhetorical functional approach.

Thus, according to Trimble (1985) EST discourse means a collection of connected language units such as sentences and paragraph that together make up a coherent and cohesive text. The basic assumption of EST discourse lies in analyzing the language of science and technology beyond the level of isolated sentences. EST discourse, according to Trimble (1985) is built around three main rhetorical concepts:

1. The nature of EST paragraph

2. The rhetorical technique

3. The rhetorical functions that are frequently employed in written EST discourse.
2.2 Nature of EST Paragraph

A critical analysis of EST paragraph gives a deep insight into the written discourse of scientific English and marks a distinction between EST paragraph and what is usually understood about non-EST paragraphs. The standard definition that a paragraph is a group of sentences which express a complete thought and which are set off on a page of text by indentation or spacing is not sufficient to ascertain the nature of EST paragraph, because it does not fit in well with the way the scientific and technical English is organized. The difficulty in applying this definition to written EST discourse is that it confuses two quite separate factors: the first half of the definition deals with concepts (... a group of sentences which express a complete thought..), while the second one is related to the physical nature such as to (..'set off on a page by spacing or indentation) of the paragraph. Thus, in a sense it contains a dual definition and gives rise to confusion and vagueness in understanding EST paragraph. On the contrary, the way Trimble (1985) defines EST paragraph is worth noting. According to him EST paragraph has distinct characteristics, hence it presents distinct phenomena. He analyses scientific text in terms of conceptual and physical paragraphs. This is really a distinct way of looking at scientific text beyond the
level of isolated sentences. In writing conceptual and physical paragraphs the scientist delineates interrelatedness and touches upon only those points which are relevant.

2.2.1 Conceptual Paragraph

Conceptual paragraph, according to Trimble\(^7\) (1985), consists of all the information chosen by the writer to develop a generalization, whether this is stated or only implied by the content. The physical paragraph in contrast is defined as that amount of information relating to the generalization which is set off from other parts of the discourse by spacing or indentation. The generalization of a conceptual paragraph, according to Trimble, in a written EST discourse is developed by a complex organizational pattern which contains the main idea that is further divided into two or more sub ideas. Each idea is represented in the text by a generalization on a lower level which is more specific than the level of main generalization. By the main generalization Trimble means the ‘core’ generalization that he deals with in abstract information. He calls it the core statement of the paragraph when he discusses a concrete example. In addition, the way of looking at paragraph structure contains the idea of correspondence. When a

\(^7\) Ibid:p.16.
conceptual paragraph is developed by only one physical paragraph, it has a one-to-one correspondence. When it requires two or more physical paragraph for its development it has one- to more than-one correspondence. One conceptual paragraph composed of three physical paragraphs (One-to-more than one correspondence) is given below for further illustration:

The components composing the urban systems can be categorized into two major categories. These are the land use configuration and the transportation system. These two categories interact with each other as well as with themselves. (Core of Conceptual Paragraph)

Land use refers to the special configuration of supply and demand of opportunities for instance, the demand for interaction of opportunities is located in institutional, commercial and industrial areas. The supply side of opportunities is measured in terms of the intensity of attractiveness, which may be expressed by the number of jobs in the specific zone. The special location and quantities of these entities (supply and demand
of opportunities) in relation to others are the major attributes of land use components of the urban system. (Subcore No. 1).

The transportation systems determines the case of interaction between the supply and demand configuration. The transportation system has two attributes. One is the transportation network which determines the special coverage of its service, and the other is the level or service of quality of the transportation system. Both factors have an effect on the interaction between activities. Sub-core No. 8.

The above text has been originally cited by Trimble (1985). It serves as a model for analyzing EST paragraph beyond the level of isolated sentences. The way Trimble (1985) analyses EST paragraph is really concerned with the cohesive progression of the text as a whole. Earlier, paragraphs were analyzed by exploring grammatical patterns in isolated sentences but Trimble’s (1985) analysis of paragraph is based on both the isolated sentences and paragraphs which are knitted together and hence make the scientific text more coherent and cohesive. On the basis of this analysis the above text may be divided into three

physical paragraphs that add up to one conceptual paragraph. The first physical paragraph which presents the major generalization is the core statement of the conceptual paragraph. Therefore 'land use configuration and transportation systems' constitute the two major components of urban system. They are the theme or the core statements which have been further elucidated in the next two physical paragraphs. In the second physical paragraph the writer picks up a key term such as land use configuration from the core statement and elucidates it at some length giving the reader the first sub-core. The second sub-core is found in the third physical paragraph and is an expansion of the second key term that lies in the core statement of the first physical paragraph. Thus the transportation system which is the key term has occurred as the major theme in the first paragraph. This has been further elucidated in the third paragraph. Thus for the core statement to be adequately developed three physical paragraphs are required.

To sum up, the core statements in the preceding paragraph are the components such as land use configuration and transportation systems which compose the urban system. These two categories are the broadest generalization followed by lesser generalizations which are detailed in the second and the third physical paragraphs. Thus
readers find direct support for major generalization (our core) given by the lesser generalization. These two categories interact with each other as well as with themselves. The other two physical paragraphs then develop the core statement and its supporting generalization.

With regard to the placement of the core statement, it is interesting to note that the EST paragraph sometimes has the core statement as the first sentence and sometimes as the second sentence. A paragraph which contains the core statement in the first sentence is given below:

Technology is undoubtedly a mixed package; it has its benefits and its disadvantages. It cannot be denied that advances in technology have had a tremendously beneficial impact on food production, health care, housing, education and other important sectors of life. Human life has been rendered easier and more comfortable by technology. Turning to the other side of picture, we find that technology has led to pollution of environment. The concentration of human and material resources at a few centres has resulted in large scale migration of rural population to urban areas. The import of technology at prohibitive costs has the additional
disadvantages of widening the gap between the rich and the poor.

The organization of the above paragraph is almost of a classic nature. The core statement in this paragraph lies in the first sentence which is supported by other statements. Thus, the sentence ‘technology is a mixed package’ is the core statement with which the paragraph begins. This theme has been further supported by other two statements: it has its benefits and its disadvantages. That too became specific in relation to the major generalization. Thus, in the paragraph ‘technology is a mixed package’ is the topic sentence which is further elaborated by more comprehensive information. The paragraph of this type frequently occurs in scientific texts because the scientist very quickly wants to apprise readers of the central theme that he wants to discuss at length in the paragraph.

Another worth-mentioning point in this context is that the ‘core statement’ can be sometimes, other than the first sentence in a paragraph or the major generalization of that paragraph. Such a paragraph is neatly rounded off by a concluding sentence which also relates to the core statement but less directly than the preceding information. e.g.

Spectacular success of science and technology is based on the overall consumption of chemicals because without it no experiment is possible. On the other hand its adverse effect cannot be denied, such as chemical pollution is changing the structure of the earth's atmosphere resulting in the green house effect and ozone depletion. Several chemicals used in or produced by industry greatly affect the speed at which ozone is broken down. Changes of a few per cent in future ozone levels would be enough to let substantially more ultraviolet radiation reach the earth's surface which is responsible for sun burn, snow blindness, eye damage and skin cancer. Such an adverse effect of science cannot be neglected.

The core statement in the above paragraph is the second sentence, rather than the first one. This can be well perceived by examining the key information given in the second sentence which is concerned with the adverse effect of chemical pollution not with the larger topic of viability of chemicals. Such a structure as this can be very confusing to non-native readers, especially to those who have been

taught that the first sentence is the generalization of the paragraph and that all other information in the paragraph supports this generalization. Hence it can be deduced from the aforesaid examples that the one important characteristic of EST paragraphs is that they are often deductive in nature because most EST paragraphs have their core statements either in the very beginning or near the beginning; that is, the governing generalization precedes most or all of the supporting information.

In addition, Larry Selinker (1974) has explored three other structures which are also found in scientific text. They are the inductive paragraph, the hybrid paragraph and the implicit paragraph.

2.2.2 Inductive Paragraph

The core statement in inductive paragraph is found at or near the end and the supporting information precedes the generalizing following the rules of logical induction. This type of paragraph is usually found in the kinds of peer writing in which the events (physical or mental or both) lead to a discovery or new hypothesis etc). Such events are stated chronologically with the results which are presented

as a kind of climax. An example of such a paragraph is as follows:

Take any field from steel furniture to ship building, railway coaches to space vehicles, cranes, bridges, boilers and atomic reactors, there is hardly any industrial area which does not use welding. In fact, the efficiency and economics of these engineering products depend on the efficiency of welding. Correct and intelligent use of the principles of welding can slash the manufacturing cost of engineering goods. Thus when we look back we can see how much crucial welding is for joining metals. To a country frantically trying to raise its export of engineering products, this is particularly important.12

The last sentence is the core statement in this inductive paragraph. This paragraph has developed inductively various uses of welding discussed throughout the paragraph and hence led to a logical ending. Therefore a conclusion has been drawn after the logical development of the paragraph. If the last sentence 'how much crucial welding is for joining metals' is shifted to the beginning the whole

paragraph will be transformed into a deductive one.

2.2.3 Hybrid Paragraph

The hybrid paragraph contains both inductive and deductive structures. It has some specific information that leads to a core statement following some other information relating to the core. Since the core statement in such a paragraph is found in or near the centre, it has a kind of sandwich, made of specific information with the core in between. The 'core' statement that falls in the centre binds both the information that precedes and the information that follows together. Illustrative of this kind is the following:

Technology is characteristic of all human societies, and it exists even among less developed tribes and communities. Even the Eskimo uses a number of techniques to make life more comfortable for him. He makes clothes; he builds an igloo and a boat, he uses needles and knives; he gets foods by means of fishing lines and harpoons. Above all, though, we must understand that technology is the application of scientific knowledge to human problems. Like all knowledge, it can be applied for good or evil—
it can have evil results. In short every human advance carries with it not only automatic benefits but also inherent dangers. So we must remain constantly aware of the dangers that lie in the possible misuse of enormous skills. Who can forget the automisation of Hiroshima-and later of Nagasaki. But if properly used technology can also lead to the better life.\textsuperscript{13}

It has now become evident that sometimes the scientist uses the core statement in the middle, such as in the above paragraph the topic sentence 'the dangers that lie in the possible misuse of our skills' has occurred in the middle though the paragraph opens and ends with the viability of technology.

\textbf{2.2.4 Implicit Paragraph}

The implicit paragraph has compact information, which calls for the readers' ability to make a generalization. Since the meaning in such a paragraph is not explicit enough to be understood readily the readers had to make meticulous efforts to derive workable meaning and then to apply their own generalization to the details presented in the paragraph. The complete grasp of such a paragraph depends on how

much knowledge and ability the readers possess to correlate the things for reaching a reasonable generalization. A paragraph with an implicit core is illustrated below:

When the Kings Bridge in Melbourne, Australia, collapsed in 1962, it stirred the engineering world. It was a welded steel bridge and a span had given away. Earlier, in 1935, the Hassett bridge in Belgium had similarly collapsed on a cold winter day. And between 1942 and 1945, six of the 2,700 welded liberty ships mass-produced in the US to meet the emergencies of the war broke completely in the sea. These are some major instances that have been recorded. But they stress how crucial is the technique of welding, the art and science of joining metals.  

Several examples of welding failure have been given in the above paragraph which are clear pointer to the fact that several bridges have collapsed due to some defect in welding system. Therefore the writer implicitly proposes that a new method of welding should be adopted to prevent such welding failure.

2.3 Rhetorical Techniques

Rhetorical Techniques are the rhetorical elements that bind together the information in a piece of EST text. They may also be called as cohesive ties or the semantic elements both explicit or implicit that forge the items of information within the units of discourse and show the relationships of these items to the core idea. The most frequently used rhetorical techniques, according to Trimble (1985)¹⁵ are time order, space order, causality and result. The other patterns we call 'logical' patterns which are treated below in the following order: order of importance, causality and result, comparison and contrast, analogy, exemplification and visual illustration.

The term logical patterns refer to those sets patterns employed by the writers when they select one or more as the frame for their materials and choose a certain pattern for a particular kind of information. Such use of the specific pattern gives a distinct colour to the written scientific discourse. In this regard Trimble (1985) holds the idea that there are some semantic patterns that frequently occur in scientific writing and hence give a specific format to EST texts. They are given below in details:

ORDERS (Natural Patterns)

Time Order
Chronology: dates and clock times
Process: first, second, finally, last, now, then, after

Space order:
General: in, out, above, below, to the left, in the centre
Specific: directly above, at a 450 angle, normal

Causality and result:

Both natural and logical patterns use the same terms such as thus, hence, therefore, as a result, causing, so that, such that as, since, as a consequence of

Patterns (Logical Patterns) Order of importance:
First, second, third, most important, least important

Comparison and Contrast:
Comparison (relates similarities): in comparison, similarly, in a like fashion as does X so does Y
Contrast (relates differences): in contrast, on the other hand, however, nevertheless, by way of difference

Analogy (compares things basically dissimilar): by way of analogy, analogically, by analogy, in much the same fashion.

Exemplification: for example, by way of example, for instance, as can be seen

Illustration: Reference to a visual aid.

2.4 Time Order (Chronology):

Both chronological time and process time which determine the chronological occurrence of things are found commonly in written EST discourse. Chronological time occurs whenever the writer uses a framework of dates, clock times, etc. It is found in historical accounts and in reports of time controlled experiment. An illustration of a paragraph that has its chronological time framework determined by the nature of the materials is given below:

Even when there is an apparently linear series of fossils, the true course of evolution is for more complex. The oldest fossils of modern humans (Homo sapiens) found in a cave in
Qafzeh in Israel are about 92,000 years old. Pataeontologists had asserted, without sufficient evidence that modern apes had separated from Man about 20 million years ago (MYA). But in 1967 Vincent Sarich and Allan Wilson of California university, Berkeley, USA showed that the many similarities between Man and the living apes could be explained if we and they had shared a common ancestor no longer than 5 MYA.

The most celebrated of these fossils was a female, found in 1974 in the Afar region of Ethiopia by Maurice Taieb. Lucy was given the name Australopithecus afarensis. Since 1990, 53 new A. afarensis individuals have been found at Hadar. In 1992, Morris Goodman (USA) proved by comparing human serum with serum from apes. The man, chimp and gorilla are closer to one another than previously imagined.16

The evolution of humans is the major theme of the above paragraph. The findings that have been brought up by the scientists on the evolution have been discussed

chronologically. Here the chronological framework is shown by the markers: 92,000 years old, about 20 million years ago, findings of Vincent Sarich in 1967, female fossils in 1974, findings of 1990 and again of 1992. The chronological markers are indicative of the steady development of Man. The paragraph also contains the latest findings about Man in the concluding line.

**Time Order: Process (Descriptive)**

The first man to produce a practical steam engine was Thomas Savery, an English engineer (1650 – 1715), who obtained a patent in 1698 for a machine designed to drain water from mines. The machine contained no moving parts except hand-operated steam valves and automatic check valves, and in principle it worked as follows: Steam was generated in a spherical boiler and then admitted to a separate vessel where it expelled much of the air. The steam valve was then closed and cold water allowed to flow over the vessel, causing the steam to condense and thus creating a partial vacuum. This vacuum pulled water from the area to be drained into the vessel. Then by a further
operation of the valves, steam was readmitted to the vessel to force water through a vertical pipe to the discharge elevation.¹⁷

In this paragraph the process time markers are 'then and Juxtaposition of sentences describing the activities that make up the process. Along with the process time we have six sentences of causality and result which are marked either by Juxtaposition (for example, steam... admitted to separate vessel, where it expelled much of the air) or by lexical indications: for example, causing, thus, then and 'to'.

In addition, process time is also found in instructional discourse and occurs most often in technical manuals. The text usually consists of a series of numbered steps, such as:

**Loggin on the vax**

1. Flip on the power switch. It is on the back of the terminal to the left.

2. Press the return key until ENTER CLASS appears on the screen.

3. Type in "3". The VAX is a class 3 option.

4. Press the return key. The computer will respond with GO.

5. Press the return key once or twice until the computer displays WELCOME TO THE UW-STOUT VAX 11/18. The computer will then display USER NAME on the screen.

6. Type in TS 1112220304. This is the training session user name.

7. Press the return key. The word PASSWORD will be displayed on the screen.\textsuperscript{18}

The core idea is indicated by the heading which is followed by instructions. Here the instructions are put serially, with each instruction as brief as is consistent with clarity.

2.5 Space Order

By space order Larry Selinker (1975)\textsuperscript{19} means the precise and exact description of a technical instrument. He takes into account ‘under this heading’ the description and function of an instrument. Larry Selinker (1974) divides space order into two categories: ‘general space order and ‘specific-space order.

In using general-space order writers try to give general information about how the instrument is made.

In case of specific space order the writers provide specific information about the instrument, such as:

**Space order General:**

The boomerang is a thin piece of hard tough wood which is left flat on one side but rounded on the other. It has sharpened edges, rounded ends and is bent in the middle. It can be steamed and bent to the required angle, or made from two pieces of wood joined together. This boomerang is held in one hand and thrown horizontally in such a way that it rotates rapidly.\(^{20}\)

In contrast to ‘Space Order General’ we have specific order in which the descriptive information is almost as precise as any reader could wish. Specific order is a good basis for precise visual representation. e.g.

**Space-Order Specific:**

The frame of the paper micrometer is a cast piece of steel that provides a surface to which all the other parts are attached. The frame painted gray, looks like the letter C with a large flat disk on the bottom and a round calibrated

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dial on top. The disk is $4'/2$ inches in diameter and resembles a flat hockey pack. The frame is $5'/8$ inches high and $7'/2$ inches long. Excluding the bottom disk, the frame is approximately $1'/2$ inches wide. The micrometer weighs 8 pounds.\textsuperscript{21}

It follows from the above two paragraphs that in space order general the writer does not include any specific details, aiming instead at a reader who needs only a general understanding of the part. On the contrary, in specific space order, the writer uses very specific details to show the exact physical description of an instrument. The specific details in above example are $4'/2$ inches in diameter, $5'/8$ inches high, $7'/2$ inches long and $1'/2$ inches wide. These details enhance the description of an instrument thereby making it easier to understand.

2.6 Logical Pattern

In organizing a paragraph a technical writer adopts logical patterns. This makes the description more logical and hence appealing. The writer starts with the first action or step and continues in order until the last. He thus follows the obvious sequences of steps to communicate the things effectively. The most commonly occurring logical patterns

\textsuperscript{21} Ibid., p 74.
of a paragraph development are: 1. Order of importance 2. Comparison and contrast 3. Analogy and visual illustration.

The examples of the above logical patterns are given below:

**Order of importance**

In the design phase, the developer designs a software system based on the requirement specifications and produces a software design document. This phase consists of three major steps: defining data flow, decomposing the system and constructing an algorithm description. First, the developer constructs data flow diagrams to document the way the system handles these documents. Secondly, the developer divides it into separate executable units. Thirdly to construct an algorithm description, the developer uses PDL/Ada, a design language that specifies a formal structure for algorithm.\(^{22}\)

In this paragraph the logical pattern is represented through the order of importance. The coherence in ideas has been developed on priority basis. The explicit words that

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refer to sequential order are as follows. e.g. first, second and third.

**Logical Patterns: Comparison and contrast.**

Communication satellites can be classified into two types: Passive satellites and active satellites. A passive satellite works just like a reflector. Another advantage of such a satellite is that it has no orientation problem because it is like a balloon whose surface reflects the incoming signals from ground. The biggest disadvantage of a passive satellite is the requirement of extremely powerful transmitter on ground. On the contrary active satellites donot need extremely high power ground transmitters as required in the case of passive satellites.

A comparison-contrast definition shows both similarities and contrast between two similar or dissimilar objects. The technical writer, in order to simplify his objects, chooses other similar objects for reference so that the objects he intends to explain can become crystal clear.

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If the writer compares two things he does so on the basis of features or parameters applicable to both. In the above example the writer has compared ‘passive satellite’ with ‘reflector’. While similizing one thing with another, the writer should also take into account the audience’s level of understanding, otherwise the use of simile will not assist readers’ understanding. In addition, the writer has also put a contrast between passive satellite and active satellite. Passive satellite requires extremely powerful transmitter on ground. On the contrary active satellite does not need high power ground transmitters. This pattern particularly characterizes scientific writing because a scientist or a technical writer needs more to explain in scientific texts.

**Logical Patterns: Analogy**

Sound waves are created by the comparison of the molecules of air, this compression generated by the origin of the sound. The resulting wave motion is analogous to that created in water when a rock, is thrown in a pond. By studying the properties exhibited by water waves, we can become familiar with the properties of all wave motion.  

In this paragraph the writer has elucidated his points through analogy by using the term analogous in the second sentence. Thus, the creation of sound waves has been well defined by the wave motion created in water when a rock is thrown in a pond.

Three times, the writer describes events connected with water waves. He defines a term associated with a sound wave. Thus the readers are presumed to apply the marker and follow the analogy each time. In addition to this, we have two instances by causality and result, the first and third analogies. The first is marked only by Juxtaposition (a rock striking the water produces waves) and the third by ‘cause’ (waves moving past a given point cause an up and down motion at this point). It is also interesting to note that the supporting information in this paragraph consists of lower level generalizations rather than specific statements.

The last logical pattern is visual illustration which simplifies the information that is tedious to read in solid text or impossible to describe accurately in words alone. Some of the common visuals frequently used in scientific and technical discourse are tables, graphs, schematics, and flow charts. All of these visual details used by the writers facilitate the understanding of the students of science. The
details about scientific and technical equipments cannot be fully comprehended unless they are illustrated with visual forms.

In addition, visual aids reinforce major points and clarify complex ideas in scientific texts. The use of good visual aids often makes the presentation more effective. Therefore if a technical writer wants to familiarize the readers with machine, he should project first a photography and drawing of machine and discuss each part in details. If a section of writing contains a complicated expansion of a process or mechanism or an abstract relationship, the use of visual aids will always make them easier to understand. Thus, visual aids in scientific writing have proved to be substantially effective.