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THE LANGUAGE OF SCIENCE: A STUDY OF NON-VERBAL MATERIALS IN COMPUTER SCIENCE TEXTS

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Abstract
The study examined the codes peculiar to the sub-registers of Computer Science for learners' communicative competence. The data was collected through a textual analysis of forty Computer Science texts covering eight sub-registers of Computer Science. The researchers used the Systemic Functional Linguistics as a model to examine the alphanumeric codes in the texts. The study reveals that four sub-registers of Computer Science namely; computer architecture, database management system, Programming language and computer security contained more codes than the other sub-texts. It was discovered that the texts contained different codes in the forms of mathematical symbols, illustrative symbols, flowchart symbols, pictures and icons. A significant number of sentences contained both verbal and non-verbal materials. Also, the codes had their verbal interpretations. The researcher also highlighted the functions of the codes as used in the texts. There, these codes are relevant for discipline Specific English (ESP) and for the communicative competence of learners.

1.0 Introduction

Scientists employ language to produce different texts which are informative and objective. Therefore, language is crucial in understanding scientific ideas and concepts. Ahmad (2012) asserts that scientific language is accurate, precise and detached from individual impulse. The author sees scientific language as an objective interpretation of facts and findings which contains such components that need external and experimental evidence to consolidate their validity. Li & Li (2013) assert that scientific writings state facts, processes and features, most of which are of universality, frequency and particularity. The authors posit that science and technology documents do not use

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rhetorical devices such as metaphor, personification and hyperbole. Rather, scientists adopt simple formational style of writing for the sake of objectivity.

Awofala, Awofala, Nneji and Fatade (2012) state that language of science, technology and mathematics involves logical chains of arguments, couched in abstract and specialized language.

In view of these notions, scientific language is formal, specialized, technical, and informative. Explaining the language of science further, Ahmad (2012) states that in order to evolve a scientific terminology, the scientists coin new words best suited for their purposes or take the words from the ordinary native speech and give them 'speech dresses' for scientific use. Also Crystal (1995) explains that the main birthplace for new words is in the field of science. It is also crucial to note that scientists use a lot of non-verbal materials in writing. Sionis (1997)asserts that all non-verbal materials explicitly or implicitly carry varying amount of verbalism. Therefore, an empirical study of the form, structure and codes in scientific writing leads to proper understanding of the concepts in science. Also the knowledge and explanation of different codes used in scientific texts are also pivotal in the comprehension of scientific texts (Anigbogu, 2017). Sometimes, the codes, symbols, pictures and icons employed in scientific texts appear highly technical and complex and difficult to understand in a second language situation. This complexity has an impact on the understanding of scientific texts. Therefore, scholars need to grasp and understand the technical codes for competence in their field. It is the intention of the researchers to examine the salient codes found in Computer Science texts, their corresponding verbal interpretations and their functions. The study will be of great relevance to scholars as it will reveal the codes used in Computer Science texts. Pedagogically, the study will provide a framework for learning English in the specialized field of Computer Science and will assist learners in using the codes effectively in different situations.

Hyland (2014) also state that ESP genre based framework of academic literacy offers learners an understanding of how target texts are structured and why they are written the way they are.So genre analysis facilitates scholars' engagement with texts. Hence Cheng

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(2006) state that it is one of the effective approaches to learning discipline specific writing.

Dudley Evans (2014) also reiterates that in the same way as the teaching procedures of ESP are linked to a view of language learning all ESP activities are linked to a new text. Therefore genre analysis of Compute Science texts is imperative since it would reveal the patterns of organization of the text and the language and symbols used in expressing the patterns. The study particularly sought to answer the following questions:

What are the codes employed in Computer Science texts?

What are the functions of the codes used in Computer Science texts?

2.0 Literature Review

Sionis (1997:3) has explored the characteristics of scientific discourse and asserts that one unique feature of the scientific discourse is the inclusion of non-verbal materials. The author posits that:

> One of the characteristics of science discourse is not to speak in words only. Each individual researcher's style and discourse appeared to be personal and located as it were, on a scale going from a purely symbolic mode of representation, resting exclusively on non-verbal material to an exclusively verbal mode with all the possible in-between combination and proportioning of verbal material and non-verbal material. The result was a hybrid type of written discourse which may prompt the question of knowing whether scientific and technological facts are conceived mentally on a hybrid way too.

Therefore, the author states that in written scientific discourse, all non-verbal materials explicitly or implicitly carry varying amount of verbalism. The study addresses the problem of the integration of dissimilar modes of representation (verbal, partially-verbal and visual) found in some written scientific discourse. By examining thirty scientific papers in the field of mechanical engineering and computer-aided design and

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manufacturing, the scholar revealed the types of lexico-syntactic pragmatic and rhetorical devices used in achieving cohesion in the discourse. The author states that lexico-syntactic cohesion really exists between general language and the mathematical language of equations and formulae even though traditional markers (and, but, however, so etc) do not appear within equations. In the same vein, the source maintains that well known mathematical symbols like:

= = (is approximately equal to)

= > (Entails)

≤(less than or equal to)

≥(greater than or equal to)

∞ (is proportional to) and others

are found everywhere within equations either to act as deictic and /or predicative elements or to introduce cohesive relations. Thus, according to the author, "lexico-syntactic markers are found in the verbal/non verbal materials which are comparable to those occurring between verbal passages. In other words, the source affirms that the writers of the scientific discourse consciously and unconsciously recognise these materials as texts to be integrated with other texts in a conventional textual way. Furthermore, Sionis (1997:13) asserts that as far as integration is concerned, the dividing line between verbal and non-verbal materials is not much. Verbal and non-verbal materials have verbal overlap which makes it possible for them to be integrated by lexico-syntactic makers.

Thus, the author contends that "when lexico-syntactic cohesion is not possible, various pragmatic/rhetorical devices are used. The rhetorical markers have referential measuring but act as instructors and participate in the procedurally encoding of sentences. Sionis (1997:13) attests that semantic cohesion affects verbal and non-verbal materials which are recurrent organisational patterns similar in their purpose to the cognitive frames of reference existing in strictly verbal discourse.

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Chase and Argamon (2006:43) have explored the stylistic distinctions between articles in different fields of science and have related them to methodological differences. Their corpus is a collection of recent articles drawn from twelve peer-revived journals in six fields namely geology, paleontology, physics, chemistry, and biology. Chase and Argamon (2006:44)'s focus is on the use of expansion, modality and comments on the articles. According to the authors, expansion describes features linking clauses casually or logically. The authors state that expansion is of three types: extension (linking different pieces of information), elaboration (deepening a given meaning via clarification and exemplification) enhancement (qualifying previous information by spatial, temporal or other circumstance). Also, the scholars affirm that modality relates to how likelihood, typicality or necessity are indicated usually by a modal auxiliary verb or an adverbial group. Furthermore, the authors assert that comment is an assessment comprising a variety of types of comments on a message and assessing the writer's attitude towards its validity or its evidential status.

The field of sciences is divided into historical and experimental writing. The authors disclose an opposition in extension and enhancement for historical and experimental science respectively. They point out the differences: more independent information in historical science and more focused storylines with experimental science. Furthermore, the source attests that historical scientists show a preference for contrasting information (adversative) and contextualization while experimental scientists show preference for supplementary information (additive and time-space relations) As regards the comments, Chase and Argamon (2006:47) stress that the experimental sciences prefer predicative comments which follow directly from their focus on predicative accuracy and historical sciences prefer admissive comments which indicate opinions.

They state that there are interesting contrasted features in the use of modality by historical and experimental scientists. Historical sciences speak of what is likely while experimental sciences state 'what' 'must' or is able to happen.

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Bagheri, Biria, and Shafiee (2013:1) have explored the textual meta-discourse markers in scientific texts. They reveal that the textual meta-discourse markers are significant features of professional rhetorical writing in English and they are used by writers to persuade their readers. The authors assert that logical markers occupy the first place, code glosses the second and sequencers, the third. Thus, the scientific writers employ the additive and adversative markers, the consecutive and conclusive markers in their writing. For the code glosses, they employ exemplifiers and parenthesis. The authors state that writers of material engineering texts employ code glosses because they are aware of the broad audience they are addressing. Therefore, the presence of these markers is believed to show a writer responsible attitude. Furthermore, the authors stress that material engineering text writers use logical makers to establish more coherent texts in order to provide more guidance for the reader to comprehend the purpose of the text. The code glosses explain, rephrase, expand or exemplify propositional content. They also reflect the writers expectations about the audience's knowledge or ability to follow the argument (that is, in other words, for instance). Thus, they present information clearly, explicitly and persuasively. The source posits that sequencers are used to organise the texts and the writers of material engineering texts use sequencers to create more organised texts and to assist the readers through the texts. Also Bagheri, Biria and Shafiee (2013:6) report that non-verbal signals such as underlining, capitalisation and italics are the visual meta-discourse used in the texts to highlight importance in the analysis of the text. The authors reveal that the variations in the use of meta-discourse markers are attributed to the writer's preferences and their idiosyncrasies. Hence, the authors state that the analysis in the field of material engineering can offer learners tools with which to engage in any of the structural aspects of their professional life.

3.0 Theoretical Framework

This study employed the Systemic Functional Linguistics as an analytical model to examine the non-verbal materials and their verbal interpretations in Computer Science

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texts. Language, according to Systemic Functional Linguistics, is a symbolic instrument used for communicative purposes (Malmkjan and Anderson, 1991:10).Systemic Functional Linguistics focuses on the forms and functions of language.Since, Systemic Functional linguistics lays emphasis on functions, functions are,therefore, taken to have left their mark on the structure and organisation of language at all levels, which is said to be achieved via metafunctions.

3.1 The Meta-Functions

In SFL, language has three meta-functions which are ideational, interpersonal and textual. The ideational function refers to the way language is used in expressing the realities of human experience. Ajayi (2009) states that the ideational meanings relate to what is going on in the world, that is, how people use language to articulate experiences. They relate to how words are used to express actions, objects, places, events, people, things and ideas.

The interpersonal meta-function gives individuals the opportunity to express their attitudes and establish personal and social relationship. The function equally deals on how people express their judgment and how they use language to influence others. Matthiessen and Halliday (1997) stress that ideational and interpersonal meta-functions orient towards two ‘extra-linguistic’ phenomenon, the social world and the natural world. Thus, the source posits that we construe the natural world in the ideation mode and to enact the social world in the interpersonal mode. The textual meta-function expresses the structure of information or how language is organised to achieve goals and to produce a cohesive text (Opara, 2009:10). Also the textual meta-function is concerned with the creation of text with the presentation of ideational and interpersonal meaning as information that can be shared by the speaker and listener in text unfolding in context (Matthiessen and Halliday, 1997:8). Matthiessen and Halliday (1997:8) assert that:

> One of the major textual systems is theme; a resource for setting up a local context for a clause by selecting a local point of departure in the flow of information.

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The theme is the element which serves as a point of departure of the message; it locates and orients the clause within its context (Halliday and Matthiessen 2004). The remaining part of the message in which the theme is developed is called the Rheme. The scholars posit that a clause consists of a theme accompanied by a Rheme; and the structure is expressed by the order: whatever is chosen as the theme is put first.

Halliday and Mathiessen's analysis of theme and Rheme shows that the theme always starts from the beginning of the clause. It is what sets the scene for the clause itself and positions it in relation to the unfolding text. The authors use the term 'unmarked Theme' to refer to the mapping of Theme onto the subject. Therefore, 'unmarked theme' is the logical subject of a verb while the 'unmarked Theme' is any linguistic device other than the subject in a declarative clause. Thus, a 'marked theme' can be 'an adverbial group, prepositional phrase, adjunct or a complement. Opara (2009:50) posits that a clause is marked if it has an unusual form or unmarked if it has the usual form and anything other than the subject in a declarative clause is marked.

Furthermore, Forey (2015:50) states that the Theme gives a special status to a chosen part of the clause; it helps to organise the message and plays a vital role in the success of a text. It helps to construe the intended interpretation of the clause and the text as a whole.Halliday and Matthiessen (2004:105) further state that:

> In the theme-Rheme structure, it is theme that is the prominent element… by analysing the thematic structure of a text clause by clause, we can gain an insight into its texture and understand how the writer made clear to us the nature of his underlying concerns.

Therefore, Theme and Rheme show how messages are organised to achieve goals, to produce cohesive units and to achieve generic conventions. The study employed the Theme and Rheme structure in the textual analysis of Computer texts to show the sentence/clause structures with alphanumeric codes in the texts. Also, the three meta-functions in SFL are directly relevant to the present study because the research examined the use of codes and their verbal interpretations in academic writing or professional

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settings in the field of Computer Science. Furthermore, the study portrayed how codes and their meanings depicted different uses/usage in professional settings. Similarly, it showed the functions of the codes used in the context of academic writing. The analyses of the codes were geared towards bringing out the underlying meanings of the non-verbal materials employed in the discourse.

Furthermore, the study articulated how non-verbal materials were used to express different concepts, ideas and technological concepts in Computer Science. In addition to these, the study explored the functions of the non-verbal materials under study.

3.2 Methodology

The purposive sampling technique was used to select forty texts from journals and textbooks in the field of computer science. These textbooks and journals were of various sub-branches of Computer Science namely: database management system, computer security, computer architecture, artificial intelligence ,information technology , programming languages, networking, introduction to computers and appreciation. So these branches accommodated representatives of different sub-registers of computer science. Five texts were selected from each of the eight sub-branches of computer science.The texts were analysed for Computer Science codes and their corresponding verbal interpretation.The researchers employed the qualitative descriptions of data for the study. . The qualitative analysis described the peculiarities of the non-verbal materials.

4.0 Results and Discussions

4.1 The Coding of Computer Science Texts

The researchers discovered a significant number of non- verbal materials in the Computer Science texts. These codes were in the forms of mathematical symbols, illustrative symbols, flow chart symbols, diagrams, icons and pictures. It was also discovered that the linguistic and non- linguistic materials interact with one another. A significant number of sentences contained verbal and non- verbal materials. Also, the non-verbal materials had their different shades of verbalism. The codes had their corresponding verbal

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interpretations. The researchers discovered that the following sub-texts in Computer Science contained more non-verbal materials than the other sub-texts:

i. Computer architecture

ii. Database management system

iii. Programming language

iv. Computer security

Thus, these texts contained sentences with alphanumeric codes.

Table 1: The Mathematical Symbols Found in the Sub-Texts

Symbols	**Meanings**
=	Equal to
+	Plus
:=	Assignment statement symbol
>=	Greater than or equal to
=>	Entails
-	Minus
( )	Brackets
X	Times
= =	Is approximately equal to
≤	Less than or equal to
≥	Greater than or equal to
∞	Is proportionate to
*	Asterix
Ɵ	Theta
<>	Less than and greater than
Σ	Summation
$\square^{2}$	Pi square
[ ]	Square brackets

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Table 1 show that mathematical symbols in Computer Science have their corresponding verbal interpretations. The researchers discovered that they served as cohesive devices in Computer Science texts by connecting ideas together.

Excerpts of Some Sentences with Mathematic Formulas in the Sub-Texts

These excerpts show how the linguistic and non-linguistic codes interact.

1. Another useful definition is the trapdoor. Many cryptographic algorithms apply the trapdoor concept. A trapdoor one-way function is a one-way function f: X-Y with the additional property that give some extra information. It becomes feasible to find for any given E im (f), an x EX such that f (x) =y
2. The we have to join the system, divulging the enciphering key, which is a pair of positive intergers (n,e), where n is the product of two large prime numbers p and q, and e must be relatively prime with (n) = (p-1) (q-1) that is gcd (e,Q (n)= 1, or gcd (e, p-1) = gcd (e, q-1) =1. This pair of integers (n,e) we divulge is kept in a publicly accessible directory.
3. To produce, for instance 100 decimal digits, we generate a random 100-digit odd number m. apply next to m is primality text. If m passes it, then we have found a prime.

   Otherwise, we apply the primality text to m +2. If m +2 is not prime either, we test m + 4 and so on, until a prime number is found.
4. A probalistic rephrasing of the same theorem states that the frequency with which prime numbers appear near m is 1/10gms. We may expect to have to perform o (10gm) primality tests before finding the first prime number larger than m.
5. Consider B delivering a message m to A in an unsecure internet. To eliminate the man in the middle from intercepting the content of the message, B must encrypt it for the recipient A to decrypt. The encryption process satisfies the following computational procedures:

   i. Encryption: B would do the following:

   a) Obtain A's authentic public key (p,a, a^a) .

   b) Represent the message as an integer M in the sent range (O,, I,…, P-1).

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c) Select a random integer K, $1 \leq K \leq P-2$

d) Compute y = ak modp

e) Sent the cipher text c= (y,δ) to A

Decryption: To recover the plain m from B, A should do the following:

a) Use the private key a" to computer y^{p-1-a} modp

b) Recover m by computing (y-a. δmodp)

(Source: Techniques for curbing crime in developing countries by W.V. Onomza)

6. In our system, each 16 x 16 macro-block is a task, which results in a diagonal- major ordering of tasks. They also compute scores for all 4 x 4 sub-bocks. The task then chooses whether to use the 16 x 16 or 4 x 4 block size, performs the encoding and reconstructs the macro-block.

   (Source: A GPU task-parallel model with dependency resolution by Tzeng,S.,Llyod,B.,and Owens,J. D.)

7. The encryption public key is KE = (n, ε) and the decryption private key is K^D = (n,d).

   The encryption function is $E(m) = M^2$ mod n

   The decryption function is $D(M) = M^d$ nodn

   These functions as above satisfy DCE (M) = M and E(D(M)= MVO $\leq$ M $\leq$ n

   (Source:Techniques for curbing cyber crime in developing countries by W. V. Onomza)

8. Require: Ready Queue Qin

   Require: Output Queue Quota

   Require: Depedency counter DCounter while tasks remaining > O do if /Qin/ = O then (if there are no available tasks, then wait for dependencies to get resolved…) continue

   Else Acquire Qin, head lock tasks – pop (Q in. Head) release lock

   end if

   Process task into out

   go through dependencies.

   for all d in d (task)m do

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atomic Dec (d) = O then

acquire Qin. head lock

d push (Qin head)

release lock

end if

Out ⟶ push (Q out. Tail)

Update task remaining

9. N-tier refers to the number of layers in which a whole package or application can be classified into better still, it can also be referred to as Client-Server model wherein > = 2. A client is a system that accesses resources while a server provides resources over a network.(Source:Design and implementation of a distributed web by Adeyeye,O. M.)
10. One student's solution was to assign the value true or false to a Boolean quantity equal as follows:

    Equal: = (string 1 length = string 1 : length);

    if equal

    the for i: = 1 to string 1; length do

    equal: = string character (i) = string 2 character (i)(Source:A science of computing by Polya, G.)

The researchers discovered that the Computer Science language examined in the corpus contained a lot of formulas and symbols. These formulas and symbols were integrated with words. It was also discovered that in Computer Science discourse, all non –verbal materials like the formulas had varying amounts of verbalism, that is, the formulas had their corresponding verbal interpretations. The authors of Computer Science discourse resorted to formulas especially when writing algorithms. For example, in order to achieve cyber security, algorithms were employed. The writers called it 'cyber security algorithms'.

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It was discovered that the Computer Science language is a fine blend of words, symbols and formulas. A lot of processes were described mathematically. The processes described mathematically have their verbal explanations or verbal equivalent.

Table 2: Illustrative Symbols

Illustrative Symbols	**Meaning**
$\downarrow$	Flowchart directional symbol
$\uparrow$	Flowchart directional symbol
$\longrightarrow$	Flowchart symbol
&	Ampersand
3	Curley bracket
з//	Curley bracket and double slash
( )	Bracket
@	At
<>	Not equal to used as relational operators
//	Double slash
)))ε	Bracket and Curley bracket

Table 2 shows that illustrative symbols have their verbal interpretations. The researcher discovered that the Computer Scientists employed illustrative symbol to explain the diagrams and ideas in flow charts symbols. Also, the illustrative symbols interwove with words, flowcharts and formulas to give further clarification of ideas.

Some of the Excerpts from the Computer Science Texts
Application Logical Layer

```
// Application Logic Layer Begins
function query (){
        $query_string = "insert member.
```

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```
set str_name=-'$this->narne',
str_email = '$this->email',
str_sex='$this->sex'
str_category='$this->category'";
..$this->query_string := 
$query_string;
$this->result = $result;
if(!($this->result =
@mysql_query($this->query_string,
$this->db_link->conx))){
trigger_error("Error executing query");}{return true;}
}/,/close of query ft notion

// Application Logic Layer ends

}//end of class
```

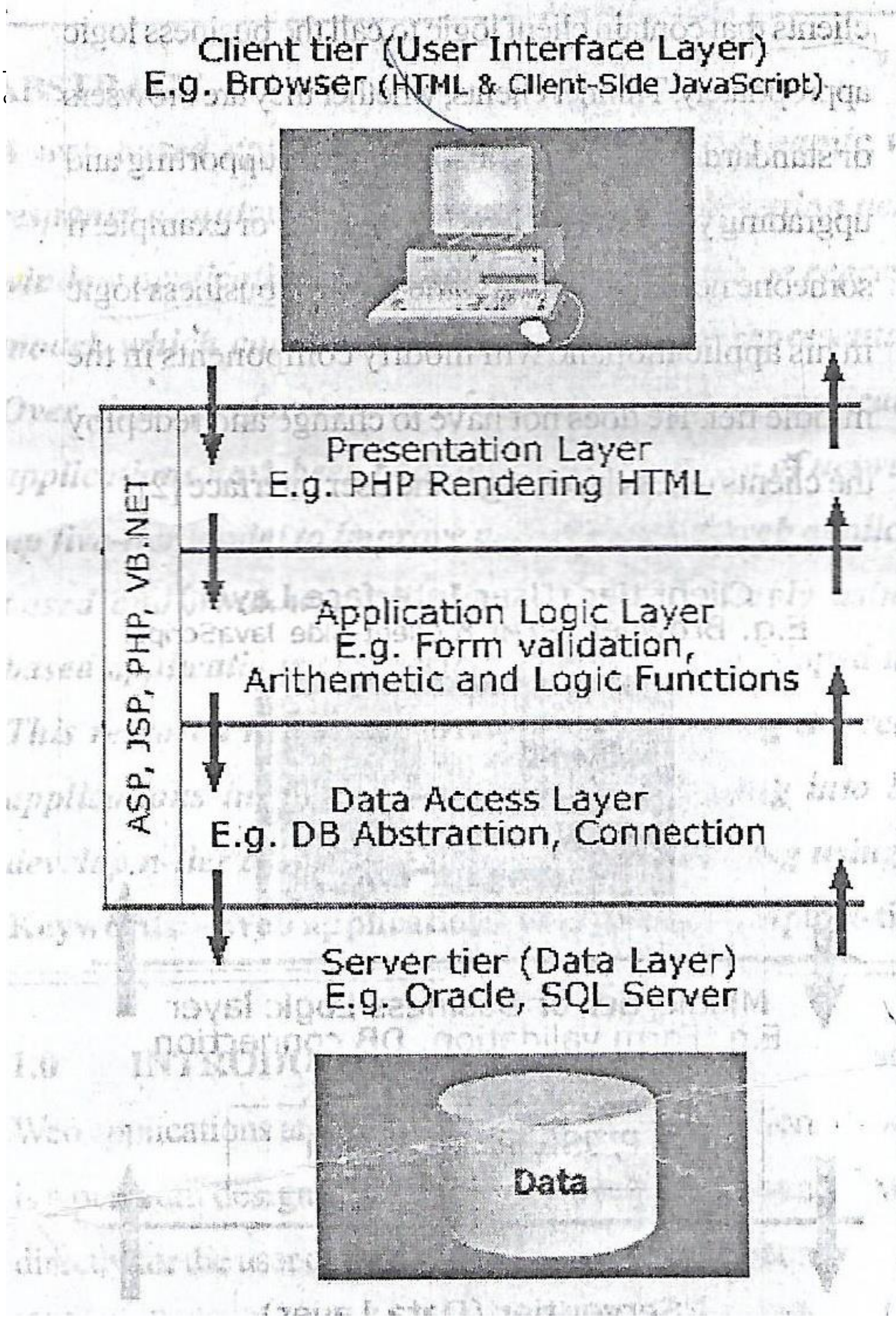
Client tier (User Interface Layer)
E.g. Browser (HTML & Client-Side JavaScript)
Presentation Layer
E.g. PHP Rendering HTML
Application Logic Layer
E.g. Form validation,
Arithemetic and Logic Functions
Data Access Layer
E.g. DB Abstraction, Connection
ASP, JSP, PHP, VB.NET
Server tier (Data Layer)
E.g. Oracle, SQL Server
Data

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Figure 1: Five-tier Model

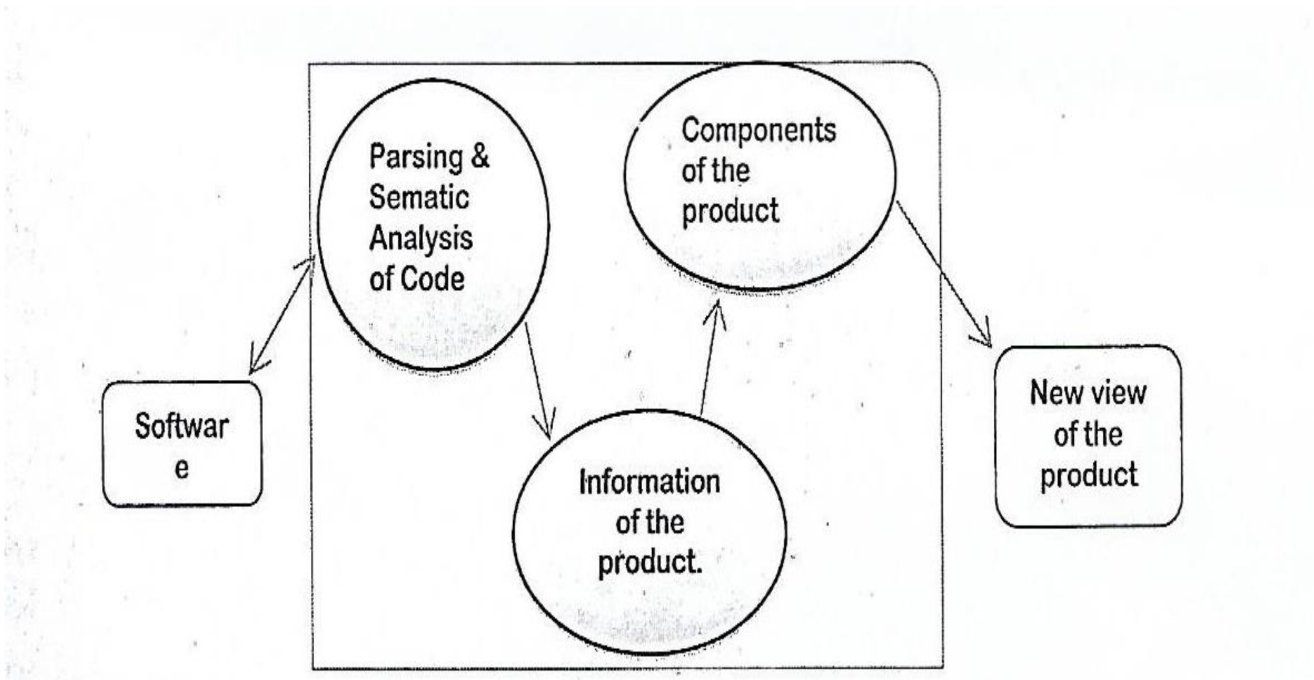

Figure 2: Reverse Engineering Process

The illustrative symbols portrayed ideas and flowcharts in a concrete manner and without any abstraction.

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Table 3: Flow Chart Symbols

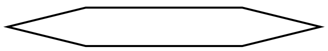
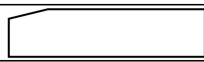
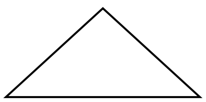
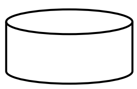
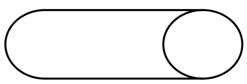
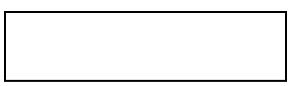
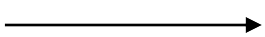
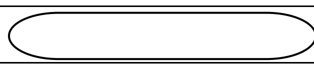
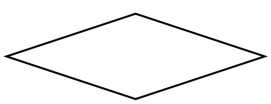
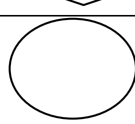
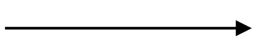
Flow Chart Symbol	Meaning
	Keyboard input
	Source document
	Manual operation
	Alternate process
	Display
	Extract
	Magnetic storage
	Direct access storage
	General output
	Direction of flow of data
	Start or stop
	Input or output
	Decision
	Connection
	Direction of flow of data

Table 3 shows that the flow charts symbols found in the corpus have their verbal interpretations. The flow charts are meaningful and are used in the presentation of ideas.

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The researcher discovered that they made presentations of ideas very succinct. The flow chart symbols interwove with illustrative symbols, words, and icons in the texts

Examples of Some Excerpts of Flowchart Symbols in Computer Science Texts

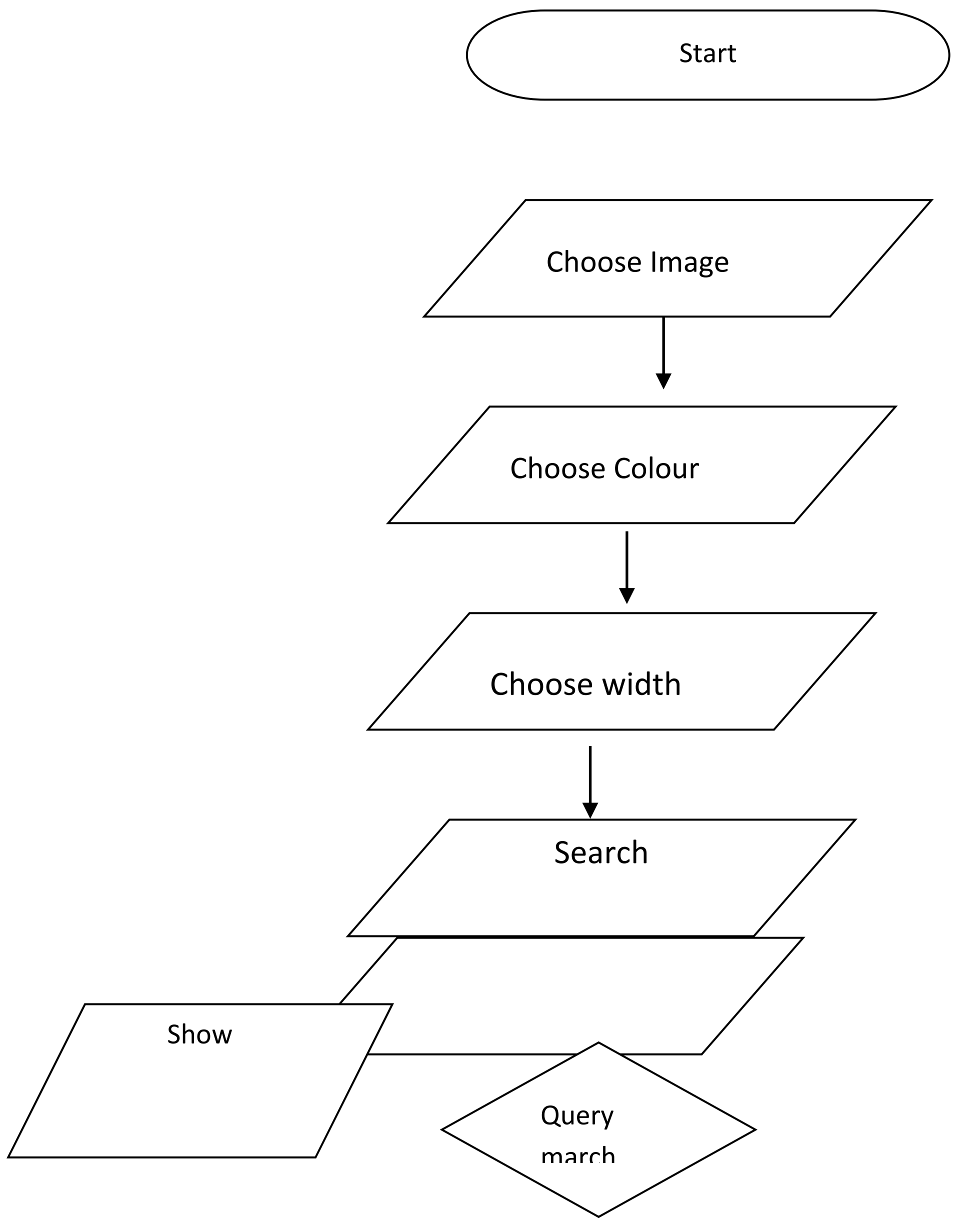

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Figure 5: A Flowchart

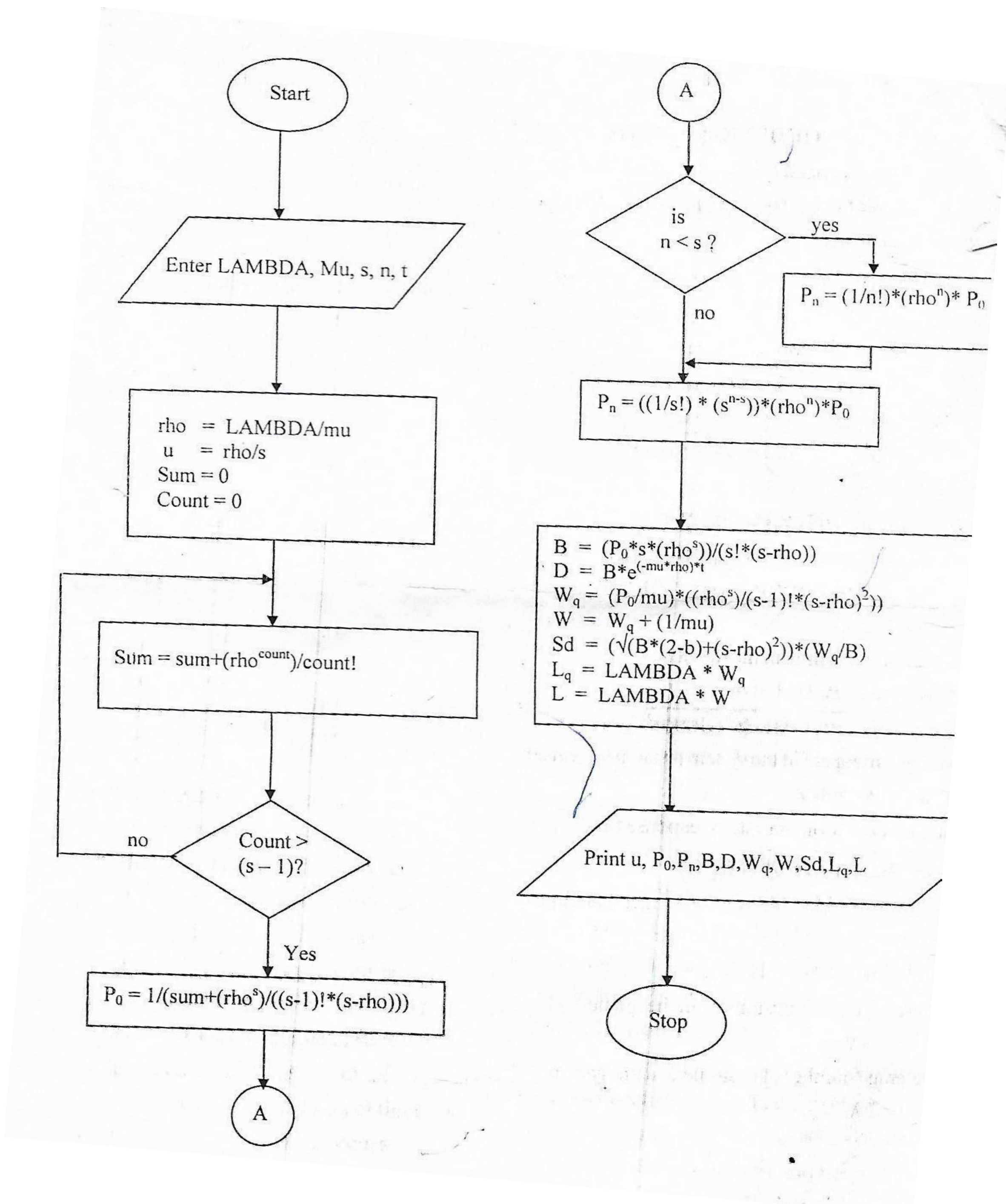

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Figure 6:**A Flowchart Implementing a Model**

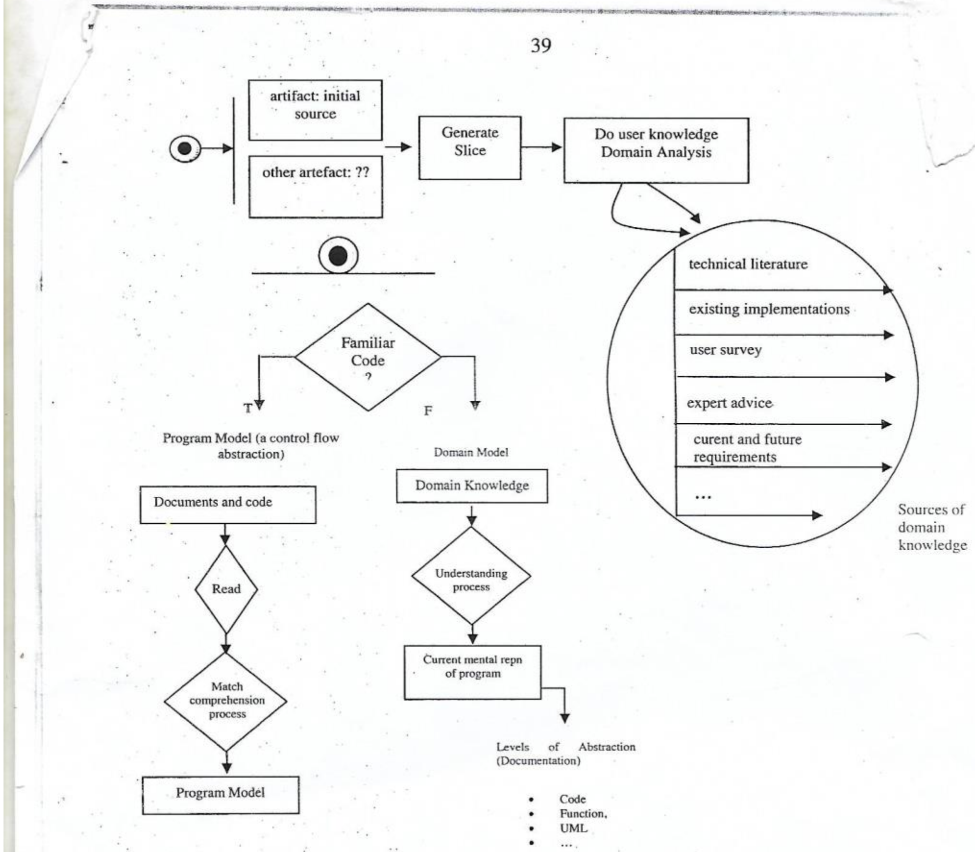

Figure 2: The user knowledge comprehension Model.

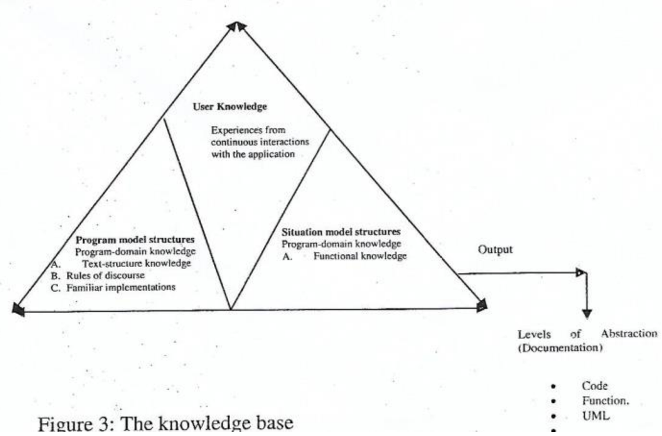

Figure 3: The knowledge base

Figure 7: The Knowledge Base

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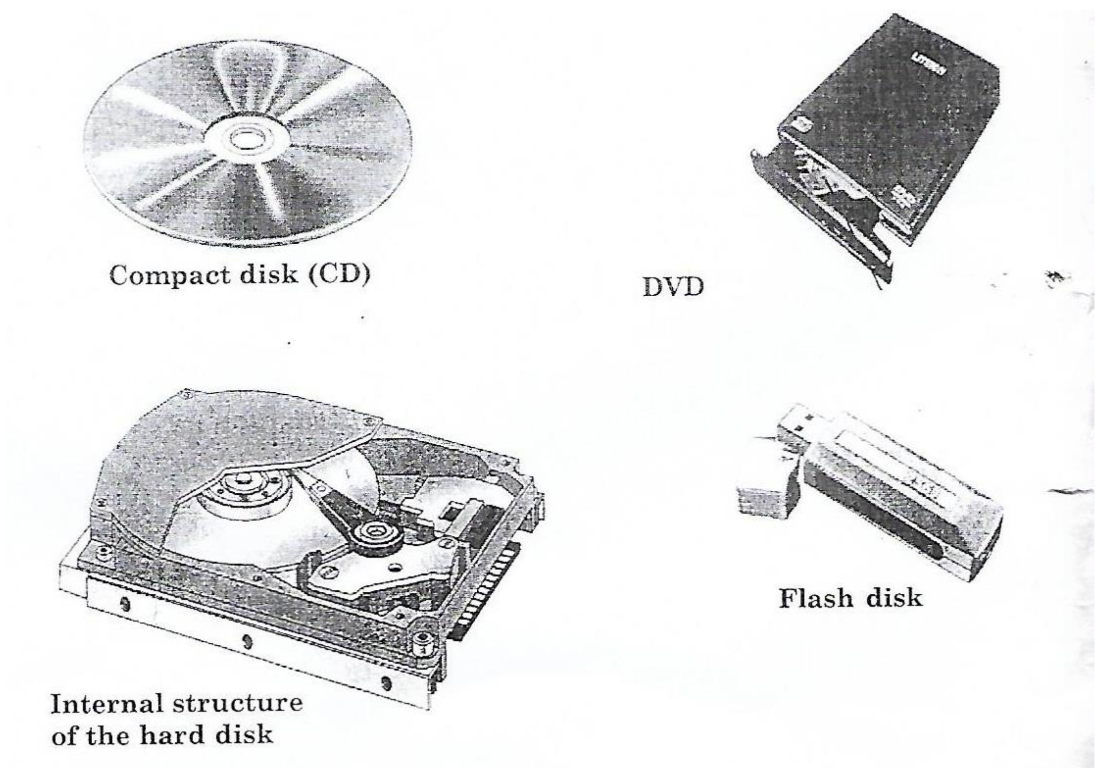
The researchers discovered that the flowchart symbol enabled writers to present complex programmes and give visual pictures of well defined rules to be followed in order to obtained solution to problems. The flowchart symbols had their corresponding verbal interpretation. They also interwove with words, formulas, illustrative symbols and numbers.

Pictures and Icons

The researchers discovered the use of pictures and icon in the texts examined. The computer scientist employed the icons and pictures for clear illustration of ideas.

Figure9: Internal Structure of the Hard Disk



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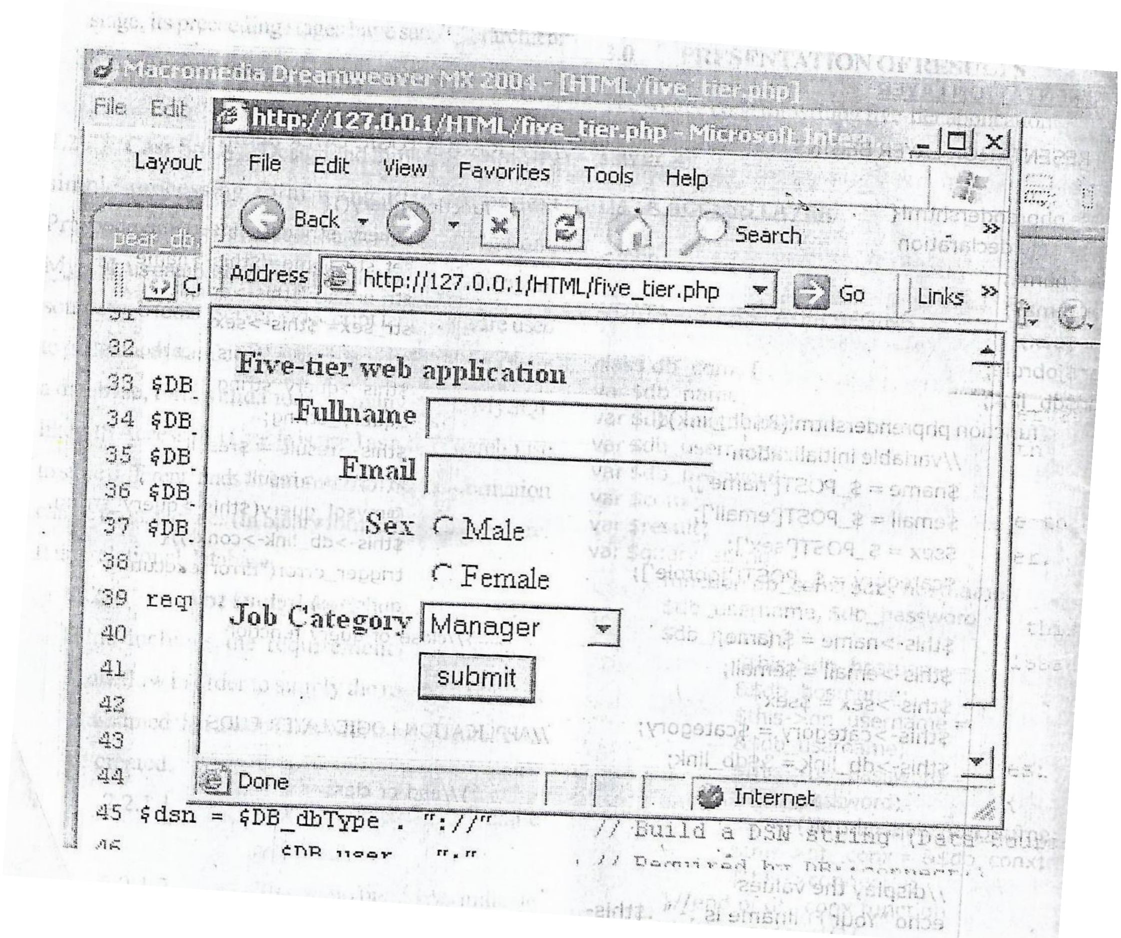

Figure 10: The Web Form before Data Entry and Submission

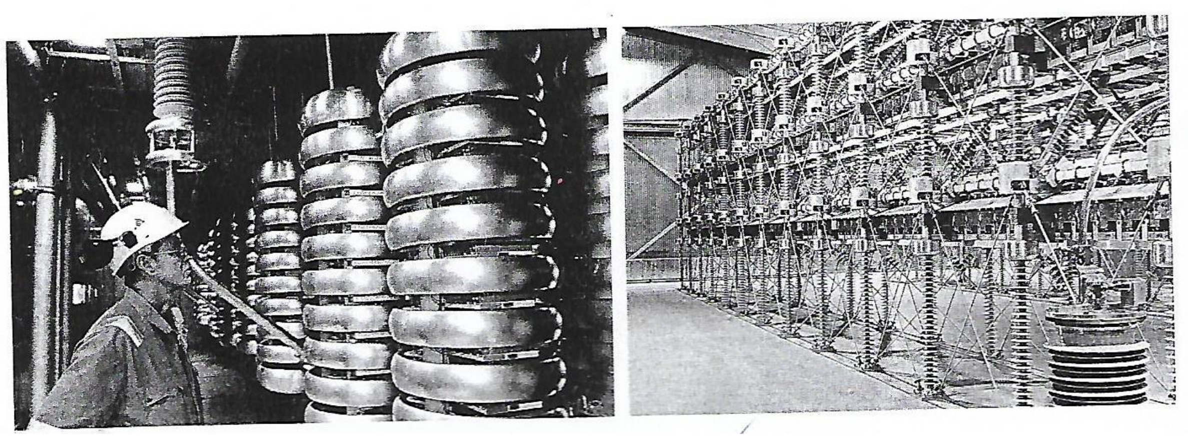

Figure11:IGBT Power

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The computer science employed pictures and icons to clarify ideas and make them more succinct. It was also discovered that the texts that carried pictures, icons and images were very illustrative. Sionis (1997:13) sums up the integration of non-verbal material into scientific writing by asserting that:

> As far as integration is concerned, the dividing line between verbal and non-verbal materials is not much. Verbal and non-verbal materials have verbal overlap which makes it possible for them to be integrated.

4.2 Syntactic Analysis of Some Clauses with Alphanumeric Codes

The researchers employed the Theme –Rheme structure in the syntactic analysis using the classification by Halliday and Matthiesen (2004:65-69)

Unmarked Theme

1

A trapdoor one way function	is a one-way function f: x $\rightarrow$ y with the additional property that gives some extra information
Theme	Rheme

2

The encryption function	is E(m) = M^{ε} $mod^{1}n$ $\rightarrow$
Theme	Rheme

3

These functions as above	satisfy D (D(M)) = M
Theme	Rheme

4

The expression INT(1+N* RND)	will yield a random integer between1 and n
Theme	Rheme

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5

Our aim	is to write hef (a, b) = ɼn
Theme	Rheme

Marked Theme

1

To produce, for instance 100 decimal digits,	we generate a random 100-digit odd number m
Theme	Rheme

2

Otherwise	we apply the primality test to m +2
Theme	Rheme

3

To eliminate the man in the middle from intercepting the content of the message	B must encrypt it for the recipient A to decrypt
Theme	Rheme

4

In our system each 16 x 16 macro-block	is a task	Which	results in a diagonal-major ordering of tasks
a)Theme	Rheme	Theme	Rheme
b) Theme	Rheme		

5

If m +2, is not prime either	we Test m + 4
Theme	Rheme

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In these examples, Theme + Rheme is speaker oriented. The Theme is what the speaker chooses to say as his point of departure. The unmarked Themes refer to the mapping of themes on to subjects. Therefore, in the sentences, the unmarked Themes are the logical subjects of verbs. The marked Themes in the sentences are phrases and an adjunct. Thus, it is marked because it has the unusual form as the subject in a declarative clause. In sentence 4 under the marked theme, (a) shows the local thematic structure while (b) shows the thematic structure of the whole clause as a predicated theme.

4.3 Rhetorical Functions of Non-Verbal Materials

From the corpus, it was discovered there were lots of complex programmes, information, words and ideas in computer science texts. So the flow chart assisted computer scientists to plan, design and structure the programmes and salient ideas.Uzoma (2005:74) posits that the use of flow charts give visual pictures of the steps of an algorithm with the direction of flowcharts between the various steps in programming. The source asserts that each instruction or series of instructions are enclosed in different shaped symbols/boxes and the flow of control is indicated by direct arrow- line between the boxes.The pictures, icons, images and graphics illustrated ideas in very succinct manner. The mathematical signs had verbal meanings which served as kinds of cohesive devices. So, the mathematical signs connected ideas together in their own way.

Conclusion & Recommendations

Based on the research findings, the following conclusions have been reached. The Computer Science English is coded in verbal and non verbal materials. The codes are in the forms of mathematical symbols, illustrative symbols, flow chart symbols,icons and pictures. The codes have meanings and some are used as cohesive devices to link ideas together. Some of the codes are used in presenting ideas in succinct ways.Computer Science writing is rooted in words, mathematics, engineering and national science. The research has therefore provided a rich store for discipline specific English (Anigbogu, 2017). The genre convention of Computer Science will facilitate the learning of English

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in the specialized field .Learners of English as a second language require drills both in verbal and non-verbal materials found in Computer Science texts.(Anigbogu,2017)

Against these conclusions, it is therefore recommended that further research be carried out in genre analysis of texts especially in other fields of study. To achieve the important objective of communicative competence in the field of language learning, learners should be conversant with technical codes in their field of study.

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