

ENGLISH FOR SCIENCE AND TECHNOLOGY: A STUDY OF COHESIVE DEVICES IN COMPUTER SCIENCE TEXTS

Ngozi C. Anigbogu

Directorate of General Studies, Federal University of Technology, Owerri, Nigeria

ABSTRACT: *The study examined the grammatical cohesive devices in Computer Science texts through a comprehensive genre analysis. The texts were from eight sub registers of Computer Science. The data was collected through the corpus culled from Computer Science texts. The Systematic Functional Linguistics was used as a model of analysis for the grammatical cohesive devices found in the texts. It was discovered that the texts contained grammatical cohesive in the forms of conjunctions and reference expressions. The study also revealed that absence of ellipsis and substitution in the texts. It was equally discovered that the cohesive devices enabled the Computer Science authors to hang stretches of language together and they signaled relations between sentences. The study further highlighted the functions of the cohesive devices in giving coherence to academic writing. Therefore, the grammatical cohesive devices, is an integral part of any form of writing which connected the ideas logically.*

KEYWORDS: English, science and technology, cohesive devices, computer science, texts

INTRODUCTION

Scholars employ English for Science and Technology (EST) to realize the universal communicative functions associated with science genre. Thus, understanding the forms and functions of science discourse is important to learners of English as a second language. Trimble (1986:6) asserts that “EST covers the areas of English written for academic and professional purposes and of English written for occupational/and vocational purposes, including the often informally written discourse found in trade journals and in scientific and technical materials written for the layman”. It is crucial not only in scientific and technological endeavours but also in institutions where provision of EST related skills are essential to the population of science & technology scholars (Chiujo, Utiyamo and Nakamuro, 2005). Furthermore, Remache (2013) posits that learning science and technology entails the acquisition of knowledge of some universal concepts peculiar to scientific and technological texts. So, all EST activities are linked to texts. Cheng (2008) states that genre can support learners by facilitating their engagements with texts and he sees genre analysis as one of the uniquely effective approaches to learning discipline specific English. Thus, genre analysis is an important aspect in the study of texts. Dudley-Evans and John (1982) state that genre analysis helps learners to build a repertoire of the organization of essential language forms of different genres. Furthermore, Umera–Okeke (2011:220) asserts that:

The intent of genre analysis is to help learners to use language more effectively in academic and professional settings and to bring the needed psychological reality and relevance to the learning task. In other words, learners need to develop the understanding of the code, the acquisition of

genre knowledge associated with the specialist culture, sensitivity. Then, and only then, can they hope to exploit generic knowledge of a repertoire of specialist genres by becoming informed users of the discourse of their chosen field.

Therefore, second language learners of English in the field of science should be familiar with the specialized language in their field of study as this would facilitate their scholarly understanding of texts (Anigbogu, 2017). In the field of Computer Science, scientific language poses problems to some second language learners of English. Some do not understand the use of grammatical cohesive devices in Computer Science text. Arya, Herbert, Pearson (2011) state that the challenge may come when the reader needs to construct a cohesion model of meaning from a series of short statements. Thus, students need skills covered in English speech and technical writing in order to achieve success as Computer Science professionals (Beaubouef, 2003). Another problem that arises is that some learners of English in the sciences are not given the opportunity to learn specialized English: EST. Furthermore, Okoh (1988) laments that in some Nigerian Universities, ESP is not given the attention it requires. Learners of English as a second language should not study English in isolation from specialized contexts. There should be a relevant connection between their use of language and the purpose of their communication.

Therefore, it is the intention of the study to analyze and interpret the grammatical cohesive devices in Computer Science texts. The researcher has also examined their functions and the relevance of EST in the study of the English language. The following research questions served as guidelines for the study:

What are the grammatical cohesive devices in computer science texts? What are their functions?
What is the relevant of EST in the study of the English language?

LITERATURE REVIEW

Different scholars have explored the distinctiveness of scientific English. Tarone, Dwyer, Gillette and Icke (1988:191) have refuted the idea that most research work in science and technology portrays the frequent use of the passive verbs. The authors posit that active verbs occur at least as frequently as the passive verbs.

Examining the frequency of the verbs used in two journal papers in astrophysics and the rhetorical functions of the verbs, Tarone, Dwyer, Gillette and Icke (1988:201) have discovered that the active verb forms greatly outnumber passive verbs. Therefore, the authors assert that in professional journal papers of astrophysics, the passive verb form occurs much less frequently than the active verbs. Similarly, the active first person plural 'we' seems to be regularly used at strategic points of the publications. Their investigation into the functions performed by the active and passive verbs yielded four generalisations. First, writers of astrophysics journal paper normally use the first person plural active 'we' form to indicate points in the logical development of the agreement where a procedural choice has been made. The passive is used when the authors are just following established or standard procedure that is using accepted quotation or describing what logically follows from their earlier procedural choice. Second, when the writers of astrophysics journals

contrast their own research with other contemporary research, they use the first person active for the work being contrasted. Third, when the authors quote other contemporary research works which do not contrast with their own, they use the active form of the verb; when the writers refer to their own proposed future work, they use the passive voice. Fourth, Tarone, Dwyer, Gillette and Icke (1988:201) assert that the use of active as opposed to passive forms of the verb appears to be conditioned by discursual functions of focus or by the excessive length of certain sentence elements.

Susinkiene(2012:134) has explored the use of nominalisation as a lexico-grammatical cohesive device in science texts. The writer sees nominalisation as a feature of written scientific English. The source posits that in the scientific discourse, nominalisation is used in creating taxonomies and serves as a complex encodings of processes into nouns. Thus, these encodings contribute to the complexity in scientific texts. The author has examined a corpus of one hundred and fifty articles drawn from the on-line English magazine “Popular Science” and has discovered that nominalisation has many aspects of usage which are summary of information, language economy, conciseness and packing of information, back grounding and forwarding of information. The source also reveals that the condensing of information and the dynamism nominalisation adds to the structure of a sentence are the most salient features of the science texts examined. The scholar also discloses the idea that the text is not a simple collection of sentences rather the sentences used in the text are integrated logically and semantically which bring about the coherence in the text. Thus, the coherence is realised by cohesion. In the same vein, the study, also, shows that nominalisation functions in two patterns of cohesive relations: implicitly and explicitly. Thus, according to the author, the use of the two patterns of cohesion significantly contributes to the general coherence of the popular science discourse. Therefore, Susinkiene (2012:133) presents cohesion as one of the text properties that contribute to the organisation of science discourse, that is, cohesion is related to the connectedness of the surface element in the texts.

Furthermore, the scholar stresses that whether the stretches of a text includes or does not include underlying propositions, the presence of a nominalisation is conceived of as a text – unifying factor: the reader automatically establishes a link between the nominalisation (that is an element of the surface structure) and the underlying proposition (that is a deep structure of the nominalization).

Esterez and Llacer (2005) observe that 20% of technical words occur in the Health Science articles and that some of the lexical items discovered are compound words with two or more items. The resulting statistical information from the study shows that the vocabulary in Health Science articles contains a significant percentage of core key lexical items relating to the health domain as well as others used in L2 general English and EAP/ESP learning contexts. Thus, the writers regard the lexical items as being important and constituting a very useful learning tool for L2 Health Science students. They attest that the variety of vocabulary found in the health science articles warrant due consideration as one of the basic English language tools to be applied in ESP courses. Furthermore, the source affirms that the Health Science lexical items provide excellent linguistic material in terms of expansion of a learned vocabulary which is a rewarding experience for ESP learner.

Li and Chun-Ge (2009:93) report that the medical research articles have its conventional structure, being a specific genre. From a corpus based genre analysis of the structural and linguistic evolution of medical research articles, they discovered a total of seven verbs tenses used in the selected research articles. These verb tenses are the simple past, the simple present, the present perfect, the past perfect, the simple future, the past progressive and the present progressive. They stress that the genre convention of medical research articles contributes to the understanding of English for Medical Purposes. Li and Chun-Ge's study has debunked the idea that the passive voice is predominantly used in the sciences. Writing conventions show that authors freely use the voice that appeals to them.

Ngonebu (2001:106) has identified significant discourse features that characterise engineering texts. In her study of textual cohesion, she discovered the use of twenty five cohesive strategies in engineering discourse which are of immense significance in writing pedagogy. These cohesive devices are anaphora, homophora, cataphora, deixis, coordinators, additives, enumeratives, sequencers, expectation deniers, result injectors, condition indicators, casual markers, compromisers, diminishers, maximisers, emphasizers, exemplifiers, illustrative indicators, reformulators, time relators, place relators, contrastive makers, adversative makers, comparatives and analogy .

Ngonebu's study provides an invaluable data for the language teacher of science and engineering particularly in organising and coordinating the discourse patterns of their learners. Thus, she posits that the research has equally provided a rich store for discipline - specific writing course.

Li and Li (2015:161) posit that "English for Science and Technology has developed into an important variety of modern English with its unique characteristics that contribute to the style of science and technology materials". They have examined the characteristics of EST through various examples at such language levels as the lexical, syntactic and rhetorical levels. As regards the lexical characteristics of EST, science and technology words fall into four categories according to different ways of formation, meaning and use. These are pure ST words which are of Latin and Greek morphemes; semi ST words which are monosemic but more commonly and frequently used in fields of different professions; common ST words which are specialised common words with different meanings in fields of different professions; built ST words which are built through different ways of word building such as a affixation, compounding, blending, acronyms. Li and Li (2015:162) also comment on the extensive use of abstract nouns and descriptive adjectives which are used to indicate means, existence, tools well as the result states of action, behaviour and movements. They assert that the abstract nouns mostly have the same roots with general verbs or adjectives from which they are derived.

Furthermore, the descriptive adjectives are used to describe the state, feature, degree, size and shape of natural phenomena and matters. These adjectives are mostly derived from verbs and nouns using suffixes. Also, abstract nouns and descriptive adjectives are collocated to indicate highly professional existence. The authors note that a large number of English verbs and their corresponding verb phrases share the same meaning in a certain language context. Comparatively, single verbs of limited use are more monosemous and more formal (Li and Li, 2015:162).

In the area of syntactic characteristics of EST, the authors posit that the accuracy, conciseness and objectivity of EST documents are also achieved by the extensive use of post-positive attributive, non-predicative verbs, passive voice as well as long and complicated sentences. The use of post-positive attributes in EST can be realised through the following five structures:

- i. Pre-positional phrases
- ii. Adjective or adjective phrases
- iii. Adverbs
- iv. Participles
- v. Attributive clauses

The extensive use of passive sentences meets the requirement of science and technology materials for objectivity, compactness and coherence. Non-predicative verbs are far more frequently used in EST than in general English to serve the purpose of explaining ideas impersonally, concisely and precisely. Similarly, to present the complicated relationships among the existence, EST documents depend on the logic thinking that resort to the use of long and complicated sentences (Li and Li, 2015).

The rhetoric characteristics of EST is expressed through the limited use of tenses, the simple rhetorical choices, the common use of abnormal sentences and the deliberate use of subjunctive mood and imperatives. Particularly, EST writings use simple present tense to create timeless notions.

These writings state the facts, processes, and features, most of which are of universality, frequency and particularity. The authors posit that science and technology documents seldom employ such rhetorical devices as metaphor, personification and hyperbole. Rather, the writings adopt simple formational style of writing for the sake of objectivity. The use of inversion helps to make ideas more eye catching, prominent and vivid. The description of proposition of ideas, discussion of problems, and the deduction of formulas often involve a variety of prerequisites and conditions. Thus, Li and Li (2015:164) state that in order to avoid ambiguity, the use of subjunctive is prevalent. This usage avoids ambiguity in meaning and is usually a smooth tone for expressing the result of a supposed condition. Furthermore, imperatives are used in operation specifications, work procedures and precaution matters to provide instructions, suggestions, advice and commands. Also the use of comparatives helps to refine and express the author's friendly suggestions to the reader. The writers conclude that EST displays its own unique features in its evolution and development process.

THEORETICAL FRAMEWORK

The study employed the Systematic Functional Linguistics to examine the grammatical cohesive devices found in Computer Science texts. Systematic functional theory focuses on what people do with language and how language is used purposefully. Opara (2009) states that functionalists focus on the possible connection between forms and functions of language. Also, Chappel (1998:1)

remarks that language is a social semiotic; a resource people use to accomplish their purpose by expressing meanings in context. Norguist (2014) explains that SFL insists on the inter-relation between the form and meaning. Therefore, Chappel (1998:1) states that the Systematic Functional theory is based on the view that language is a system for making meaning. Systematic refers to the fact that when we use language, we make choices from sets of available options ... Functional assumes that every time we make a choice from the available options, we are doing so in order to fulfill a communicative purpose.

Bawarshi and Reiff (2015) assert that Systematic Functional approaches to genre have contributed richly to how genre is understood and applied in textual analysis and language teaching. Language structure is integrally related to social function and context. The authors state that the theory is functional because it refers to the work that language does within particular contexts and systematic because it focuses on the structure or organization of language which is used to get things done. In SFL, language has three meta-functions which are ideational, interpersonal and textual. The ideational focuses on the use of language to express the realities of human experience. The interpersonal meta-function gives individuals the opportunity to express their attitudes and establish personal and social relationship.

According to Opara (2009:7) the textual meta-function “expresses the structure of information or how language is organized to achieve goals and to produce a cohesive texts”. Furthermore, Halliday and Hassan (1985:71) state that through the textual meta-function language is imbued with the potential not just to create text, but to relate itself both to the context of situation and to the preceding or succeeding texts. The authors posit that cohesion is a typical example of this textual phenomenon because of its text forming potentials; it makes provision for texture: a configuration of meaning relations.

The three meta-functions are directly relevant to the present study because it examined how language is employed in academic texts and in the professional discourse: Computer Science. The study examined the use of language to portray the realities of research experience and research ideologies. The study also captured how stretches of language words were organized to achieve goals and produce cohesive texts. In addition, the study explained the functions of the cohesive devices studied. Thus forms and functions of language were studied in the Computer Science texts.

METHODOLOGY

The purposive sampling technique was used to select 40 excerpts from forty texts and journals in the field of Computer Science. The texts covered different sub-branches of Computer Science which were: database management system, computer security, computer architecture, artificial intelligence, informative technology, programming languages, networkers, introduction to computers and appreciation. Five excerpts were selected from each of the eight sub-branches of Computer Science. Excerpts which contained 120 to 200 words were analyzed. The researcher employed the quantitative and qualitative descriptions of data for the study. The quantitative description employed frequency count for the cohesive devices in the presentation of data. The qualitative analysis described the peculiarities in the use of the cohesive devices.

The excerpts of the Computer Science texts were analyzed and different grammatical cohesive devices were written out and categorized according to types. Simple percentages were used to categorize them into types and in the tables. The functions of the cohesive devices were also discussed.

RESULTS AND DISCUSSIONS

The Cohesive Devices Found in the Computer Science Texts

The study focused on grammatical cohesion using Halliday and Matthiessen's model of analysis. Grammatical cohesion is the structural linking of sentences in a text which holds the text together and gives it meaning. For Halliday and Matthiessen (2004:533), grammatical cohesion is created in three ways in the English language: conjunction, reference and ellipsis/substitution. Again, Halliday and Mathiessen (2004:540) posit that in the system of conjunctions, the logico-semantic relations that are manifested fall into three: elaboration, extension and enhancement. Thus, the source posits that conjunctions mark relations where spans of texts elaborate, extend or enhance earlier spans of texts. Under the nature of reference, Halliday and Matthiessen (2004:533) have pointed out two types of reference expressions :co-reference and comparative references. The co-reference is of two types :personal and demonstrative pronouns while the comparative reference is also of two types: general and specific. The comparative references comprise adjectives such as post-deictic (same, similar, other etc) and comparative adverbs (more, fewer, less and so on). In ellipsis, certain parts of the structure of a sentence which can be presumed from the context are left out. In substitution, certain parts are substituted with other structures. Hence, the study categorised the grammatical cohesion found in the texts using paragraphs containing 100-200 words in each of the 40 excerpts.

Table 1: Summary of Types of Grammatical Cohesion in Forty Computer Science Excerpts

Total Number of Words	Total Number of Conjunctions	%	Total Number of References	%	Total Number of Ellipsis	%	Total Number of substitution	%
6749	280	4.32	382	5.66	0	0	0	0

Table 1 also shows the absence of ellipsis and substitution in Computer Science texts. The language of science including Computer Science puts a lot of premium on objectivity and as such the use of ellipsis and substitution is scarce. The table also shows that writers of Computer Science texts employ the systems of conjunctions and references in writing their articles. The use of references was more prevalent in the texts examined. Out of a total number of 6749 words analysed, 382 (5.66%) were examples of references while 280 (3.32%) were examples of conjunctions.

Table 2 Summary of Types of Conjunctions in Forty Computer Science Excerpts

Types of conjunction	Number	Percentage
Elaborating	88	31.4%
Extending	157	56.07%
Enhancing	35	12.5%
Total	280	100%

Table 2 shows that Computer Scientists employ the elaborating , extending and enhancing conjunctions in academic articles. 31.4% of the total conjunctions were elaborating; 56.07% was extending while 12.5% was enhancing conjunctions. The conjunctions used in the texts marked the logico semantic relations in the clauses and sentences. Also, the conjunctions contributed to the internal organisation of the Computer Science discourse and the connectedness in sentences and paragraphs. Following the mode of analysis by Halliday and Matthiessen (2004:54), the elaborating conjunctions are of two types: appositive and clarifying .The appositive shows how an idea is restated or exemplified .The clarifying shows the clarification and summary of an idea. Some examples found in the excerpts are:

1. Figure 5-1 illustrates the various types of object technologies (OOT). (appositive)
2. For instance, when you depress a key on the keyboard, it is shown on the monitor screen. (appositive)
3. Numerous examples of technological advances health care; professional service and education have been central to industry wide growth and the creation of new markets. For example, Ernest and young offers continuing education to its national workforce through a private satellite network. (appositive)
4. The analysis can be subdivided into four t asks, as illustrated in Figure 2.4 below. (appositive)
5. Figure 2a illustrates Novo Ad’s advertising display (ww.novad.com) which appears to be a standard mirror like that found in a public. (appositive)
6. In sum, the distinction among inputs, conversion, and outputs is muddled in the service produced. (clarifying)

The appositive conjunctions show the elaboration of information already stated. The clarifying conjunction clarifies and summaries issues presented in the course of the discourse.

For extending conjunctions, Halliday and Matthiessen (2004:541) state that they are three in number: additive, adversative and varying .The additive shows addition of ideas; the adversative expresses contrast of ideas and varying shows variation of ideas. Some of the examples found in the excerpts are:

7. However, existing memory metric- miss rate (MR) and average miss penalty (AMP) as calculations of average memory access time (AMAT)- still measure hits and misses based primarily on sequential single-access activity.(adversative)
8. In addition, concurrency effectiveness is application and implementation dependent: accurate data storage and access measurement can vary. (additive)

9. These studies focus on how technology affects society and culture, and also how they interact .(additive)
10. On the contrary, technological decisions on different levels are often not made because of characteristics of technology, but also because of economic, political, ideological or cultural motivation. (adversative)(additive)
11. However, says Dale Hartzell of Sandchery, Inc., a software company specializing in speech products. (adversative)
12. Again, it is a two-way procedure involving synthesis and identification. (additive)
13. With synthesis, the techniques or methods available to test the vulnerabilities are joined and, the result is documented. (additive).
14. For each technique that we describe, we implemented a version of at least one of the Parboil benchmarks that lacked that technique but, was otherwise well optimized. (adversative).
15. Alternatively, the data so captured can be stored in some intermediate form. (varying). The extending conjunctions found in the texts showed extension of ideas in the forms of additive , adversative and varying.
The enhancing conjunctions are four: matter (respective), manner, spatio- temporal and casual-conditional. These are further divided into types as shown in the examples .Some of the examples found in the excerpts are:
16. Therefore, content-based image retrieval system is desirable taking into consideration the quantity and quality of the image. (casual-general)
17. Finally, we outline the utility of existing frameworks of services and present the argument for the new perspective as an effective means of managing technologies in services. (Spatio-temporal, conclusive)

18. There are other technological designs not mentioned here. (Matter: positive)
19. Similarly, one can argue that the probability of n such pairs showing up the error is less than 1-(25/26). (manner-comparative)
20. Then, the probability the any two randomly generated strings of equal length have unequal last characters is 25/26. (causal-general)
21. Otherwise, the original deck should be left intact. (conditional-negative)
22. When presented with a problem like this, the first step should be do ensure that you have a clear understanding of the problem. (spatio-temporal ,following)
23. Today's modular multi level HVDC can't help, because of a design quirk that actually feeds DC faults. (spatio-temporal-specific)
24. Next, it sets up a synchronize to keep the copy and the original file consistent. (spatio-temporal, following)
25. The question of what is a worm and what is a virus is hardly settled, though. (conditional, concessive).
26. So, the flow graphs produced from Java programs are always reducible, while those from Java bytecode may express non-reducible flow graphs. (casual, general)

Table 3: Summary of Types of References in Forty Computer Science Excerpts

Types of References	Number	Percentage
Personal	133	34.81%
Demonstrative	247	64.65%
Comparative	02	0.52%
Total	382	100%

Table 3 shows that Computer Scientists employ both co-references and comparative references in their writing. The co-reference is of two types: personal and demonstrative while the comparative is of two types too: general and specific. Table 3 shows that the writers employ more demonstrative references than that of the other types of references. 64.65% of the references were demonstrative: 34.81% was personal and 0.52% was comparative. For personal references, the writers mainly used anaphoric references. Also, for demonstrative references, the authors used anaphoric ones. Table 3 shows that there are few comparative references used in the Computer Science texts examined.

The comparison, as Halliday and Mathiessen (2004:560) point out, is made with reference either to general features of identity, similarity and difference or to particular features of quality and quantity. Some of the examples found in the excerpts are:

Personal Reference Items

1. KM is a set of techniques and procedures supporting the establishment and maintenance of Keying relationships between authorised parties. It involves the initialization of systems users within a domain, generation, distribution and installation of keying material. (Anaphora).
2. Task parallelism is a natural model for expressing dependencies. It can have a different execution path per unit of parallel work (Anaphora)
3. The monitor is the TV-like device that enables the computer to display the data or information it has in its memory. It is also called the visual display Unit (VDU) of the computer. (Anaphora).
4. Tiling and privatization are obviously familiar terms but they have been around long enough to become slightly ambiguous. (Anaphora).
5. The application bins the atom data (technique 5) to efficiently find the atoms near a point in space. It partitions the atoms-filled volume into a 3D uniform grid of cells. (Anaphora)
6. Hackers are predominantly male folk in their mid-twenties. They lack social skills and a good proportion of them are under-achievers... (Anaphora)

The sentences above contain typical examples of anaphora: ‘it’, ‘they’ and them.

The pronouns substitute their antecedents ‘km’, task parallelism, the monitor, tiling and privatization, hackers, and application beings. They are all endophoric expressions. The computer scientists used them as textual references, that is, the references being made to entities within a text. These endophoric expressions are also called anaphoric references.

The computer scientists employed them to point backwards to already existing entities in the text. Also, they were used as a means of referencing and as a type of cohesion too. In view of this,

Cornish (1999:38) asserts that the anaphora serves as inter-defining and inter-dependent discourse procedure involving both speakers and addressee in shifting, or maintaining their joint focus of attention at different points in the unfolding discourse.

Some of the Demonstrative References Found in the Excerpts:

1. The terminal was essentially used to assess the mainframe computer often far away in some of the way computer rooms. This concept gave rise to the ‘dumb terminal’ expression that the reader may have heard of.
2. Electrical contacts brushed the cards and made contact through holes in the cards as the cards passed through the device. These devices were called tabulators.
3. Lee de Forest invented the thermionic valve. This resembles a squat cylindrical light bulb, glowing dimly into which has been inserted a number of additional wires and metallic plates.
4. The database design is the creation of a conceptual model of a database that is structured for the insertion and retrieval of images. This consists of the image retrieval table and the image insertion table.
5. There is a concern that developers of affective computing system fail to recognize this complexity. This could lead to people being judged on an incorrect interpretation of their emotions.
6. User queries must match when retrieving an image. This has become imperative due to the fast development of digital cameras and computer technology.
7. For their distinctive operational differences, clear functional trade-off exists among these synchronization mechanisms. This is problematic for building general purpose and reusable Java systems.
8. Concurrent components communicate by altering the content of shared memory locations. This style of concurrent programming usually requires the application of some form of locking.
9. Teleconferencing facilities enable one to participate in a conference without being physically present. In this arrangement, one computer sends a message and all other participants can receive the message simultaneously.
10. The information obtained is stored in an information base and then this information is used to understand the basic functionality and algorithms of the software.

These demonstratives are anaphoric in nature. Thus, the demonstratives in the ten sentences: this, ‘these’, that point backwards to already existing entities and set up a relation of co-reference.

Comparative References

Comparative references set up a relation of contrast. The researcher discovered that there were very few used in the Computer Science texts examined. The comparison, as Halliday and Mathiesen (2004:560) point out, is made with reference either to general features of identity, similarity and difference or to particular features of quality and quantity. Some examples found in the excerpts are:

Emerging IT are broad categories for an ecosystem of devices and systems that go together to create new classes of digital capability. They are emerging in the sense that the first generation of products are just now appearing in the market. Typically such technologies take 10-15 years to change society: think about where smart phones were in 2004.(General features of quality).

When a process calls a monitor procedure, the first few instructions of the procedure will check to see if any other process is currently active within the monitor. Such a calling process will be suspended if the answer to the check is yes.(Particular features of quality).

The reference items are all good sources of linking devices that are used to hang sentences together in the Computer Science texts. The references used in the excerpts established relationship between the various language forms used in organising the information presented in the excerpts. They served as a means of retrieving the identity of issues, being talked about in the excerpts. The reference items helped in the building of textures in the Computer Science excerpts.

Rhetorical Functions of Cohesive Devices

Cohesive devices form an integral part of any form of academic writing and they give coherence to the writing and help connect ideas logically. Thus Arthur (1996:2) calls them the language forms used to indicate semantic relations between elements in a discourse. From the excerpts, it was discovered that the cohesive devices enabled the Computer Science authors to hang stretches of language together. The cohesive devices in the texts signaled relations between sentences. They created a kind of continuity in the clauses and sentences examined and the continuity gave room for proper interpretation of the Computer Science texts.

In view of this, Moreno (2013:14) asserts that most models of cohesion explain the principles that govern the well formedness, the unity and connectivity of texts by examining the different ties established within texts and the relations they express. Halliday and Matthiessen(2004:540) assert that lexico-grammatical systems originate in the textual meta-function and are collectively known as the system of cohesion.

The Relevance of EST in the Study of the English language

English for Science and Technology is a sub category of a larger field of English for Specific Purposes (ESP). This is a learner-centered approach for the learning of the English language. In the science field, this approach facilitates learning because it enables the language instructors to include the scientific grammar which learners need in their teaching. It gives learners the opportunity to use the grammar found in their texts well and to relate language instructors to real life situations. Thus, Remache (2013) stresses that EST offers learners and teachers different methods of dealing with science in terms of communication purposes. The author sees EST as a further development of the knowledge that actually exists at the disposal of the learner. Remache(2013) also asserts that the main aim of EST is to develop the learner's communicative competence by focusing their attention on the relationship between usage, science and use.

From these assertions, one fact is obvious from the study carried out; the second language learners of English as a second language in the field of Computer Sciences need the specialized English: English for Science and Technology. Therefore, this onus lies on the EST instructor to help the learners to develop the essential skills in approaching the various types of the rhetorical functions in a scientific text, the ability to interpret scientific terminology and to evaluate and comprehend English language functions for the production of information (Remache,2013)

It is therefore, crucial to adopt EST especially English for Computer Science for learning and studying English in advanced academic settings. For instance, students in this field would have

ample opportunity to learn the use of cohesive devices in real life texts (Anigbogu,2017). Rao (2014) reiterates that EST emphasizes purposeful and utilitarian learning of English and that in EST, the communicative needs of the learners are important consideration of course design. He also stresses that the responsibility of the EST teacher is to provide meaningful impact through context and provide an opportunity to put grammar to use and relate grammar instruction to real life situation.

Hence, language instructors need to be aware of their learners' need in the English language. Therefore English for Science and Technology programme would help the Computer Science students to perform the work-related communication tasks. So, it is critical to adopt EST approach in tertiary institutions as it would contribute to maximum success in language use.

CONCLUSION AND RECOMMENDATIONS

The language of Computer Science is peculiar and students studying Computer Science should be conversant with its peculiarities (Anigbogu, 2017). When students are familiar with the distinctiveness of Computer Science English, it would facilitate the learning of the discipline specific English and their professional communication. EST is very vital for learners of English as a second language. To achieve the crucial objective of communicative competence in the field Computer Science, EST approach to learning/teaching should be adopted in higher institutions. Emphasis should be laid on cohesive devices in language classes. Students should be made to realize the significant contribution cohesive devices make to texts (Anigbogu,2017). So, it is essential that the EST approach to language learning should be adopted for communicative competence.

REFERENCES

- Anigbogu, N.C. (2017). A lexico-syntactic study of academic writing in computer science. Unpublished PhD dissertation, Imo State University, Owerri.
- Arthur, T. (1996). *The Oxford companion of the English language*. New York: Oxford University Press.
- Arya, D. J., Hiebert, E.H., Pearson, P.D (2011). The effects of syntactic and lexical complexity on the comprehension of science texts. *International Electric Journal of Elementary Education*, 4(1), 107-125.
- Beaubouef, I. (2003) Why computer science students need language. *In road The SIGCSE Bulletin*, 35 (4), 20-25.
- Bwarshi, A.S. & Reiff , M. (2005).*Systemic functional linguistics and genre analysis*. Retrieved September 11th, 2015 from https://wac.colostate.edu/books.bawarshir_reiff/chapter3pdf.
- Chapelle C. (1988) *Some notes on systemic functional Linguistics*. Retrieved 6th June 2014 from www.Public.iastate.edu/carolc/sfl.html.
- Cheng, A. (2008). Analyzing genre examples in preparation for writing. The case of an L2 graduate students in the ESP genre-based instructional framework of academic literacy. *Applied Linguistics*, 29 (1), 50-71.

- Chiujo, K. Utiyama, M. & Nakamura, T. (2005). Extracting level-specific science and technology vocabulary from the corpus of professional English. *English for Specific Purposes*, 2, 3-10.
- Cornish, F. (1996) "Antecedentless" anaphors: deixis, anaphora, or what? Some evidences from English and French. *Linguistics* 32, 19-41.
- Dudley-Evans, T & St. John, M. (1998) *Development in English for specific purposes: A multi disciplinary approach*. Cambridge: CUP.
- Esterez, N. and Llacer, E. (2005). Lexical analysis of Health Science mass circulation articles (HSMCA). *Quaderns de filologia Estudis Linguistics*, 10, 67-80.
- Halliday, M. & Hassan, R. (1985). *Language context: Aspects of language in a social semiotic perspective*. Deakin: Deakin University Press.
- Halliday, M. and Matthiesen, M. (1997). *Systemic functional grammar: A first step into the theory*. Retrieved 6th June, 2014 from www. Alvinle.org. info/sfg.
- Li, J. & Chun-Ge, G. (2009). Genre analysis: structural and linguistic evolution of the English-medium medical research articles (1985-2004). *English for Specific Purposes*, 28, 93-104.
- Li, X., & L., I. (2015). Characteristics of English for science and technology. *International Conference and Social Science Research*, 161-165.
- Moreno, A. (2003) The role of cohesive devices as textual constraints on relevance: A discourse-as-process view. *International Journal of English Studies*, 31(1), 111-165.
- Ngonebu, C.L. (2002). The structure of English in science and technology: A study of the discourse features in expository writing of engineering students. In E. Otagburugu and P. Anyanwu (Eds.), *Concepts and Issues in language studies*. (106-120). Owerri: Cel Bez and Co-Publishers.
- Okoh, N. (1998) Managing and Marketing ESP in Nigeria.. In E.J. Otagburagu (Ed.). *Common Frontiers in communication skill: Focus on the Nigerian university system*. Abuja, National Universities Commission.
- Opara, S. (2009). *Aspects of functional grammar. A systemic approach*. Enugu: Victojo Production Services.
- Remache, A. (2013). The universality of scientific discourse. *International Journal of English Language Teaching* 1.(2),37-52.
- Rao, V.C. (2014). English for science and technology: A learner centered approach. *English for Specific Purposes World* 42 (15), 1-10.
- Susinkiene, (2012). Nominalization as a lexico-grammatical cohesive device in science popular texts. *Fiologiga*, 17,133-142.
- Tarone, E. , Dwyer, S., Gillette S., & Icke V.. (1981). On the use of passive in two Astrophysics journal papers. In J. Swales (Ed.), *Episodes in ESP. A source and reference book on the development of EST*, (pp:191-202). New York: Prentice Hall.
- Trimble, L. (1985). *English for science and Technology: A discourse approach*. Cambridge: Cambridge University Press.
- Umera-Okeke (2011). *Eng 411 Course Material, National Open University Retrieved from <http://www.nov.ed.ng/NOUN-OCL/pdf>*.