THE LANGUAGE OF SCIENCE TEXTS (COMPARISON BETWEEN BIOLOGY TEXT AND CHEMISTRY TEXT)

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ABSTRAK

Penelitian ini adalah Kekhasan bahasa pada teks ilmu alam. Tujuan penelitian ini adalah untuk menemukan ciri khas bahasa pada teks ilmu alam. Penelitian ini dilakukan dengan penelitian kualitatif. Data penelitian ini adalah kata-kata pada teks ilmu alam yaitu pada teks Biologi dan Kimia. Berdasarkan analisis yang dilakukan ditemukan bahwa pada teks Biologi ciri khas bahasanya terdapat pada struktur teks, kata penghubung, bahasa teknis, bahasa akademik, bahasa yang padat, fakta dan objektif, kata kerja penghubung. Sedangkan pada teks Kimia, ciri khas bahasanya terdapat pada struktur teks, kata penghubung, bahasa teknis, bahasa akademik, bahasa yang padat, dan kalimat pasif.

Kata Kunci : Bahasa, teks, ilmu alam, ciri khas bahasa

A. INTRODUCTION

It is obvious that scientific English is somehow different to ordinary English, but attempts to state precisely where these differences are, have largely failed. Stevens' generalizations are useful guidelines, but are not applicable to all scientific writing. Ewer's lists are a step in the right direction but are as much based on educated guesses as hard experimental data that are widely applicable. Widdowson's argument that scientific language uses impersonal forms is an over-generalisation: some styles do, but not all require the use of the passive, for it is sometimes important to state who is doing the action, because the person can affect the results.

Part of the problem is the sheer complexity and variety of language. Another part is the broadness of the question which may need breaking down into smaller components. The world of science is vast. What part of this scientific world is being analysed? Once the answers start arriving for small clearly defined areas, the evidence can be put together and wider conclusions made with a higher level of confidence. A

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comparable question is what distinguishes the language of history from normal English, and on what evidence. Therefore what is special about science, and is science more than any other specialised subject of enquiry.

In learning the language of science, students need to learn not only a specialised vocabulary but how words go together and when to use this way of communicating. The challenge is to teach these "rules of the game" whilst still valuing the ways of using language that the students bring to the classroom. The role for teachers is to help students build bridges between their known and familiar ways of using language, and academic ways of using language.

What is the nature of scientific discourse and what is different about it compared with the rest of 'normal' language. (He says that scientific discourse uses a lot of words, roots and affixes of Greek and Latin origin, and uses, or has access to, symbols, numbers, names of chemicals etc, which are largely international in character.[2] In many respects scientific language is normal in that a scientist functions in a host language using the same system of pronunciation, the same accent, the same common grammar, rules of spelling and orthography, and even a lot of the common non-specialised vocabulary as anyone else. ie, all the parts are there, but the proportions in the mixture are different. For Strevens scientific discourse is like a different style, therefore the differences can be explained not in terms of the basic components of the language, but in terms of, the statistical properties of the mixture in which they occur, and the intention, the purpose, behind their selection and use. In this case, the writer compare the linguistics features between Biology text and Chemistry text.

B. CONCEPT OF SCIENTIFIC TEXTS

There are some aspects of language features found in the texts of science. However, science texts, like all others, come in many forms; the genre is diverse and constantly changing and evolving. Some experts stated about the feature of scientific text.

[2] Strevens P., *problems of learning and teaching science through a foreign language. Studies in Science Education. 3*, (1976), p. 153-154.

1. **The Features of Scientific Text According to Strevens**

What is the nature of scientific discourse and what is different about it compared with the rest of 'normal' language? He says that scientific discourse uses a lot of words, roots and affixes of Greek and Latin origin, and uses, or has access to, symbols, numbers, names of chemicals etc. which are largely international in character. In many respects, scientific language is normal in that a scientist functions in a host language using the same system of pronunciation, the same accent, the same common grammar, rules of spelling and orthography, and even a lot of the common non-specialized vocabulary as anyone else. i.e., all the parts are there, but the proportions in the mixture are different.

For Stevens, scientific discourse is like a different style, therefore the differences can be explained not in terms of the basic components of the language, but in terms of the statistical properties of the mixture in which they occur, and the intention, the purpose, behind their selection and use.

The features of scientific prose[3]

a. rather long sentences containing many clauses, often in complex degrees of dependency and with much embedding;
b. long nominal groups containing strings of adjectives or nouns acting as adjectives, each providing the greater specificity that comes from modification upon modification,
c. frequent passives which have the effect of putting important ideas in initial position where in English they carry salience of meaning.

'Scientific English' is simply 'English used by scientists or for the purposes of those engaged in science'. It has the same grammar, pronunciation and spelling as are found in all kinds of English; it includes much of the general vocabulary of English, though with a large number of specialized items or of familiar words used in specialized ways; it also carries an array of linked symbols and visual symbolizations which nevertheless can be verbalized by those who know the rules for doing so.[4] What then is different or special about 'scientific English'? A brief and oversimplified answer

[3] Ibid, p. 155
[4] Ibid, p. 156

is that the particular mixture of grammatical and vocabulary items typically found in 'scientific English' may display some or all of an array of features, including e.g.: long and complicated noun-phrases . . .;
a higher proportion of passive constructions . . .;
the frequent use of logico-grammatical items . . .;
a high proportion of items of specialized vocabulary. . ..

2. **The Features of Scientific Text according to Ewer**

Characteristics of the language of science[5]

a. -ing forms replacing a relative
b. Infinitive as substitute for longer phrases
c. Words similar in form but with different meaning for the same function
d. Most prefixes and suffixes.
e. Most structural and qualifying words and phrases
f. two out of the three courses or dealt with inadequately:
g. Compound nouns, Passives, Conditionals, Anomolous infinitives
h. Cause-and-result constructions
i. Words similar in form but with different functions
j. Past participle usage
k. The prepositional (two part) verbs common in scientific English.

3. **The Feature of Scientific Text according to Widdowson[6]**

Scientific language avoids the first and second person, thus detaching a message from its sender and receiver. The passive is used. 'We' is also used, but in a special way, to refer to both the person communicating and the person being addressed. It is important to recognize that the 'depersonalized' statement of the scientist represents a way of referring to phenomena in a 'non-ordinary' manner which is as much an essential part of science as is the 'subject matter'. [7]

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[5] Ewer JR., *further notes on developing an English programme for students of science and technology* (English Language Teaching Journal,1971), p. 65-70.
[6] Widdowson HG., *Literary and scientific uses of English*. English Language Teaching Journal. 28:3, 1974, p. 288
[7] Ibid, p.289

New terms in literature are complex (<wind> can be inanimate and human) in science they are compound such as "copper electrode".[8] This to Widdowson is not a point of grammar. The example given of a compound, "copper electrode", while grammatically equivalent to "the electrode which is made of copper" does not have the same value. The compound term is a name of something already viewed as having a distinct separate entity, and the stress is on this name, not on describing the electrode.

To summarise. Scientific English then to Widdowson is characterised in communicative terms by for instance the impersonal passive, the use of 'we' to refer to writer and reader, and compound rather than complex terms.

Table. 1 The Linguistic Feature of Scientific Text[9]

Text Organization	Example
Text structure Information is presented in a logical order where meaning is built up step by step.	The gecko uses its detachable tail in two ways. It drops its tail if a predator grabs it, and it may also drop its tail if a predator is approaching. Evaporation occurs when water is heated. This involves...
Connectives Connectives link ideas so that claims about knowledge can be formed and justified. The place of connectives within a sentence varies.	The gecko uses its detachable tail in two ways. It drops its tail if a predator grabs it, and it may also drop its tail if a predator is approaching. Evaporation occurs when water is heated. This involves... Other connectives include those used to clarify, sequence ideas, and present a condition or concession.

[8] Ibid2, p. 290
[9] Ibid, p. 291

Language Feature	Example
Technical language Technical words are specific to a particular topic, field, or academic discipline. These words, i.e., their scientific meanings, are usually uncommon elsewhere. General words that also have different scientific meanings.	Indigenous, podocarp, regeneration; endangered, database, DNA samples, dorsal fin, habitats, Hector's dolphin, species, run-off pollution; Co_2; solution, periodic table. Potential, wastes, solution.
Academic language: Academic words are common to the range of academic disciplines.	Affect, analyze, assess, concept, conclude, consequent, define, design, estimate, formula, identify, indicate, interpret, major, method, process, resource, relevant, select, similar, specific, theory, transfer, vary. Averill Coxhead's full list of academic words: language.massey.ac.nz/staff/awl/awlinfo.shtml
Condensed language: Information is densely packed, i.e., several ideas are packed into just a small amount of text. Nominalisation condenses information by removing the person and sometimes other details such as time. It is a process by which verbs, and sometimes adjectives, become nouns.	"Heavy rain causes the water to rise up high and spill over the banks" (an example of a child's use of everyday language to explain a process) is turned into "Heavy rain causes flooding" (an example of a more condensed form of language). ("…water to rise up high and spill over the banks" is written using mainly verb phrases – "to rise up high" and "spill over"; "flooding" is written as a noun). In this example, a lengthy explanation is turned into a single noun – "flooding".

Factual and objective: The focus is on things and processes. People's thoughts, feelings and opinions are not usually of interest. Personal pronouns such as "it" and "they" are reasonably common, especially in scientific reports, but "she", "he", "we", "I", and "you", are not.	Southern right whales do not have teeth. Instead they have filters, called baleen or whalebone, which...
Passive voice: The passive voice focuses attention on the action, not who did it. The subject of a clause receives the action (or state) of the verb, i.e., the subject is the target of the action. In contrast, the active voice is where the subject is the agent or actor of the verb.	Baking soda and vinegar [subject] were mixed [verb]. I.e., the baking soda and vinegar receive the action of the verb in that they *were mixed*. We [subject] mixed the baking soda and vinegar [verb]. I.e., "We" (the students) is the agent or actor of the verb in that the students *mixed* the baking soda and vinegar.
"Doing" and "linking" verbs "Doing" verbs express the action and happenings in a text. "Linking" verbs link pieces of information. These types of verbs are common in science texts. The verbs of inner consciousness such as feeling, thinking, believing, and seeing, are not.	"Doing" verbs, e.g., Geckos speed away whenever an enemy comes near. ("speed away" and "comes near" are verb groups.) "Linking" verbs, e.g., Hooker's sea lions are native to New Zealand ("are" links "Hooker's sea lions" with "native to New Zealand") and, e.g., Ants have six legs ("have" links "Ants" with "legs").

C. METHOD OF RESEARCH

The design of this study was qualitative design. Text analysis was used in this design which tries to find out the features in the science text.

D. DATA AND DATA ANALYSIS

The data were the words in the science texts.

1. Text of Biology

Rats Induced into Hibernation-Like State

Rats spent hours in a state of chilly suspended animation after researchers injected a compound into the animals in a cold room. The animals' heart rates slowed, brain activity became sluggish and body temperature plummeted.

The research joins a small number of studies that attempt to induce the metabolically lethargic state known as torpor in animals that can't normally slow their metabolism. "It's a breakthrough" in understanding aspects of torpor, says neuroscientist Kelly Drew of the University of Alaska Fairbanks.

Lowering the body temperature of a no hibernating mammal is really hard, says Domenico Tupone of Oregon Health & Science University in Portland. As temperatures inside the body fall, several failsafe systems springs into action. Blood vessels near the skin squeeze tight to hold warmth in, the body starts to shiver and brown fat, a tissue that's especially plentiful in newborns, starts to produce heat.

But Tupone and colleagues bypassed the rats' defenses against the cold with a compound that's similar to adenosine, a molecule in the body that signals sleepiness. After about an hour in a room chilled to 15° Celsius, the rats grew lethargic. Their brain waves slowed, their blood pressure dropped and their heart grew sluggish, occasionally skipping beats.

The rats' core temperature dropped from about 38° to about 30° C, or 80° Fahrenheit, the authors report in the Sept. 4 Journal of Neuroscience. Tupone and his colleagues measured even lower temperatures in further experiments — rats' core body temperature reached 15° C or about 57° F. "That is a pretty amazing temperature. No one has done this before," he says.

The rats weren't in a coma, nor were they asleep or truly hibernating. Hibernating animals' metabolisms plummet and their temperatures sink much lower; an Arctic ground squirrel, for instance, cools to about —3° C when it hibernates. "It's a new state," Tupone says. "We don't really know what it is."

In the experiment, loud noises and tail pinches failed to arouse the rats. They didn't eat or drink. Occasionally, one would slither into a corner, but for the most part, the animals stayed still for up to 6 hours. In unpublished experiments, Tupone has kept the animals in the unresponsive state for 24 hours, he says.

Warming the room coaxed the rats out of their torpor. The recovery process takes about 12 hours, during which the animals ate and drank voraciously. After recovering, the animals were alert, moved around their cages normally and slept when tired.

The rat experiment could one day have implications for another non-hibernating mammal, humans. A safe and reversible way to allow people to lower their temperatures would be an important tool for doctors, says neurologist Midori Yenari of the University of California, San Francisco.

When people have heart attacks or strokes, clinicians can use ice packs or frigid water to chill people and prevent further tissue damage. But those methods of cooling take time and can have dangerous side effects. The compound "looks like another lead," Yenari says.

A safe way to induce torpor in humans is also the fanciful dream of people with interstellar intentions: Humans would be able to travel much farther in space in a suspended animation state.

Table 2. Analysis of Biology Text

Text Organization	**Analysis**
Text structure Information is presented in a logical order where meaning is built up step by step.	Rats spent hours in a state of chilly suspended animation after researchers injected a compound into the animals in a cold room. The animals' heart rates slowed, brain activity became sluggish and body temperature plummeted.
Connectives Connectives link ideas so that claims about knowledge can be formed and justified. The place of connectives within a sentence varies.	Rats spent hours in a state of chilly suspended animation after researchers injected a compound into the animals in a cold room The research joins a small number of studies that attempt to induce the metabolically lethargic state known as torpor in animals that can't normally slow their metabolism. Lowering the body temperature of a no hibernating mammal …
Language Feature	**Example**
Technical language Technical words are specific to a particular topic, field, or academic discipline. These	injected, metabolically lethargic, blood vessels, Celsius, hibernating,

words, i.e., their scientific meanings, are usually uncommon elsewhere. General words that also have different scientific meanings.	metabolism, mammals, clinicians, frigid water, 30° C, or 80° Fahrenheit
Academic language: Academic words are common to the range of academic disciplines.	experiment, induce, process, methods, etc.
Condensed language: Information is densely packed, i.e., several ideas are packed into just a small amount of text. <u>Nominalisation</u> condenses information by removing the person and sometimes other details such as time. It is a process by which verbs, and sometimes adjectives, become nouns.	Hibernating animals' metabolisms plummet and their temperatures sink much lower; an Arctic ground squirrel, for instance, cools to about —3° C when it hibernates. "Hibernating" , "Cooling", "lowering"
Factual and objective: The focus is on things and processes. People's thoughts, feelings and opinions are not usually of interest. Personal pronouns such as "it" and "they" are reasonably common, especially in scientific reports, but "she", "he", "we", "I", and "you", are not.	In the experiment, loud noises and tail pinches failed to arouse the rats. They didn't eat or drink. Warming the room coaxed the rats out of their torpor.
Passive voice: The passive voice focuses attention on the action, not who did it. The subject of a clause receives the action (or state) of the verb, i.e., the subject is the target of the action. In contrast, the active voice is where the subject is the agent or actor of the verb.	- . The recovery process takes about 12 hours, during which the animals ate and drank voraciously

"Doing" and "linking" verbs "Doing" verbs express the action and happenings in a text. "Linking" verbs link pieces of information. These types of verbs are common in science texts. The verbs of inner consciousness such as feeling, thinking, believing, and seeing, are not.	But Tupone and colleagues bypassed the rats' defenses against the cold… When people have heart attacks or strokes, clinicians can use ice packs… The rat experiment could one day have implications for another non-hibernating…

2. Text of Chemistry

A chemical compound is a chemical substance consisting of two or more different chemically bonded chemical elements, with a fixed ratio determining the composition. The ratio of each element is usually expressed by chemical formula. For example, water (H2O) is a compound consisting of two hydrogen atoms bonded to an oxygen atom.

The atoms within a compound can be held together by a variety of interactions, ranging from covalent bonds to electrostatic forces in ionic bonds. A continuum of bond polarities exist between the purely covalent bond (as in H2) and ionic bonds. For example H2O is held together by polar covalent bonds.

Sodium chloride is an example of an ionic compound.

Table.3 Analysis of Chemistry Text

Text Organization	Analysis
Text structure Information is presented in a logical order where meaning is built up step by step.	A chemical compound is a chemical substance consisting of two or more different chemically bonded chemical elements is….
Connectives Connectives link ideas so that claims about knowledge can be formed and justified. The	A chemical compound is a chemical substance consisting of two or more different chemically bonded chemical

place of connectives within a sentence varies.	elements, with a fixed ratio determining the composition. The atoms within a compound can be held together by a variety of interactions, ranging from covalent bonds to electrostatic forces in ionic bonds.
Language Feature	**Example**
Technical language Technical words are specific to a particular topic, field, or academic discipline. These words, i.e., their scientific meanings, are usually uncommon elsewhere. General words that also have different scientific meanings.	chemical compound, chemical substance, chemical formula,
Academic language: Academic words are common to the range of academic disciplines.	Ratio.
Condensed language: Information is densely packed, i.e., several ideas are packed into just a small amount of text. Nominalisation condenses information by removing the person and sometimes other details such as time. It is a process by which verbs, and sometimes adjectives, become nouns.	ranging
Factual and objective: The focus is on things and processes. People's thoughts, feelings and opinions are not usually of interest. Personal pronouns such as "it" and "they" are reasonably common, especially in scientific reports, but "she", "he", "we", "I", and "you", are not.	–
Passive voice: The passive voice focuses attention on the action, not who did it. The subject of a clause receives the action	The atoms within a compound can be held together by a variety of interactions, ranging from covalent bonds to electrostatic forces in ionic bonds.

(or state) of the verb, i.e., the subject is the target of the action. In contrast, the active voice is where the subject is the agent or actor of the verb.	– –
"Doing" and "linking" verbs "Doing" verbs express the action and happenings in a text. "Linking" verbs link pieces of information. These types of verbs are common in science texts. The verbs of inner consciousness such as feeling, thinking, believing, and seeing, are not.	–

D. FINDINGS

After doing the analysis based on the theory of Stevens, the findings are drawn as follow:

Text Organization	Analysis of Biology Text	Analysis of Chemistry Text
Text structure Information is presented in a logical order where meaning is built up step by step.	√	√
Connectives Connectives link ideas so that claims about knowledge can be formed and justified. The place of connectives within a sentence varies.	√	√

Language Feature		
Technical language Technical words are specific to a particular topic, field, or academic discipline. These words, i.e., their scientific meanings, are usually uncommon elsewhere. General words that also have different scientific meanings.	√	√
Academic language: Academic words are common to the range of academic disciplines.	√	√
Condensed language: Information is densely packed, i.e., several ideas are packed into just a small amount of text. <u>Nominalisation</u> condenses information by removing the person and sometimes other details such as time. It is a process by which verbs, and	√ √	√ –

sometimes adjectives, become nouns.		
Factual and objective: The focus is on things and processes. People's thoughts, feelings and opinions are not usually of interest. Personal pronouns such as "it" and "they" are reasonably common, especially in scientific reports, but "she", "he", "we", "I", and "you", are not.	√	–
Passive voice: The passive voice focuses attention on the action, not who did it. The subject of a clause receives the action (or state) of the verb, i.e., the subject is the target of the action. In contrast, the active voice is where the subject is the agent or actor of the verb.	-	√

"Doing" and "linking" verbs "Doing" verbs express the action and happenings in a text. "Linking" verbs link pieces of information. These types of verbs are common in science texts. The verbs of inner consciousness such as feeling, thinking, believing, and seeing, are not.	√	–

E. DISCUSSIONS

From the findings, almost the criteria of language of science referred by Stevens exist. There is one criterion which does not exist in Biology text. that in this article, Passive voice is not appropriate as one of the criterion as Stevens'. It can happen as Stevens's theory that a Stevens' generalizations are useful guidelines, but are not applicable to all scientific writing. Also, it is strengthened by Widdowson's argument that scientific language uses impersonal forms is an over-generalization: some styles do, but not all journals require the use of the passive, for it is sometimes important to state who is doing the action, because the person can affect the results. In the Chemistry text, Factual and objective feature does not exist, and also linking verb does not exist. According to Stevens, not all the terms exist. But almost the terms exist.

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