Teaching expressions of cause, effect, purpose and function in English to students of science and technology

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Definitions of scientific terms, descriptions of scientific and technological processes and procedures, and the like have a pride of place in most of the scientific writings. As a result, the students who pursue their undergraduate or masters program in science and technology in various universities across the world require using several expressions in their writing tasks intended to define, describe and discuss certain concepts pertaining to their respective domains of knowledge. Among them, expressions to explain causes and effects, purposes and functions are more frequently used than others in the writing tasks carried out by the students of science and technology. This article discusses the strategies and the practical exercises that can be used by the teachers of ESP (English for Specific Purposes) to teach the expressions of cause, effect, purpose and function in their ESP classes.

Key words: English, writing, science and technology, teachers, classroom.

INTRODUCTION

Students of science and technology are required to express a variety of intent in their writing. They may have to define, describe and discuss some concepts. They may require expressing the relations between two entities, the function of a particular machine or equipment, the significance of a reaction and so on (Weissberg and Biker, 1978) Among all these intents, the expressions of cause and effect and purpose and function assume a significant place in ESP. For instance, while describing or defining certain objects or processes the students may require spelling out their purpose or function. Similarly, the cause and effect relationships between various entities in science and technology can be expressed in a number of ways using appropriate words or phrases such as on account of, because of, because, since, lead to, caused by, due to, etc.

This article discusses the use of cause, effect, purpose and function in the English language used for science and technology. It then presents sample tasks or exercises designed to teach such expressions in writing to the students of science and technology. The examples discussed would provide a clear idea to the teachers of ESP about the method of teaching the aforesaid important expressions to their students.

Strategies

Relative clauses and adverbial clauses are commonly used in the expressions of cause, effect, purpose and function (Quirk and Greenbaum, 2003) These expressions which are elaborated in the sections that follow can be taught to the learners of ESP by adopting the following strategies:

(i) teaching signal words that show the cause and effect relationships and the purpose and function of a system, object etc. in science and technology through examples
from the relevant texts.
(ii) training the students to identify the above mentioned expressions while reading their texts in science and technology.
(iii) providing adequate drill in these expressions through carefully designed, context-based practice exercises (EDC 2002).

The sections that follow elaborate these strategies in two categories: (i) cause and effect expressions, (ii) indicators of purpose and function.

Cause (C) and effect (E) expressions

*Cause and effect* refers to the relationship between two entities when one of them makes the other to happen (Raman and Sharma, 2009). For instance, the sentence “Because of the reaction of nitrate with Iron sulphate and concentrated sulphuric acid, the brown ring appears” reflects the relationship between the cause (reaction of nitrate with Iron sulphate and sulphuric acid) and the effect (appearance of brown ring). Hence, clauses that explain the reason for something to happen are known as cause and effect expressions. It may be observed that there are two clauses: main and subordinate. In fact, the adverbial clauses of cause and effect expressions (subordinate clause) explain the reasons for what happens in the main clause.

When a *cause and effect* clause appears in the beginning of a sentence, it is necessary to use a comma to separate the two clauses (as shown above). But when this clause appears in the later part of the sentence no comma is required (The brown ring appears because of the reaction of nitrate with Iron sulphate and sulphuric acid). The main clause indicates the result or consequence of the cause or reason clause. Many a time, there may be multiple/a chain of effects (E) arising out of one cause (C) as in “The *inefficiency* (E) resulting from consumers’ confusion (C) today may be costing the U.S. economy as much as $1 trillion per year (E)”.

Signal words

*Because, because of, on account of, as a result of, out of, since, as, as long as, inasmuch as, due to, due to the fact that, consequently, is caused by, lead to, if...then, so, so that, thus, for, for this reason, therefore, this is how, nevertheless and accordingly are the words/expressions used to signal the cause and effect expressed in a sentence. These expressions can be introduced to the students through some examples shown as follows:

1. The accident occurred *because* the machine was not properly maintained.

2. *Because of* its high radioactivity, radium gives out dangerous and penetrative radiation.
3. Many fatal accidents occurred *on account of* icy road conditions.
4. Bulliform cells become flaccid *due to* water stress.
5. *On account of* the difference in chemical binding energies of atoms and molecules on the two sides of a reaction, energy is released.
6. Increase in Ca**++** level *leads to* the binding of calcium with a subunit of troponin on action filaments and thereby removing the masking of active sites for myosin.
7. *As a result of* the movements of the basilar membrane, nerve impulses are generated in the associated afferent neurons.
8. High temperature destroys enzymatic activity *because* proteins are denatured by heat.
9. Coronary Artery Disease is *caused by* deposits of calcium, fat, cholesterol and fibrous tissues.
10. Optical rotation or optical activity is *caused by* rotating the direction of linear polarization in transverse plane.

11. *If* a charged plastic rod is brought close to the sphere, *then* the free electrons move away due to repulsion and start pulling up at the farther end.
12. A reduction in the number of platelets can *lead to* clotting disorders.
13. Atoms and non-polar molecules are electrically symmetrical and have no dipole moment *inasmuch as* their electronic charge cloud is symmetrically distributed. After thoroughly explaining the examples, the teacher may give an assignment to the students on bringing more examples for all the signal expressions given in the list.

IDENTIFYING CAUSE AND EFFECT RELATIONSHIP IN THE TEXT

This task is the reverse of the preceding one. In other words, the text in the form of sentences or paragraphs as shown below will be given to the students and they will be asked to identify and underline the expressions that signal cause and effect relationship within the text.

*Example*

Particles of a gas are always in constant and random motion. If the particles were at rest and occupied fixed positions, then a gas would have had a fixed shape which is not observed. They move in all possible directions in straight lines. During their random motion, they collide with each other and with the walls of the container. Pressure is exerted by the gas as a result of collision of the particles with the walls of the container (Chemistry Part I, NCERT, India, 2006).

Students of science and technology should be able to identify the expressions such as *if...then, and as a result*
of in this text. They should also be taught through appropriate examples as in the sample given below to read between lines to identify the *cause and effect* relationships not explicitly stated.

**Example**

*Initial studies on people who are struck by a mysterious, crippling attack of arthritis (effect) in Karnataka indicate that the people switched to eating crabs from fields sprayed by pesticides (cause).*

Such interesting exercises would enable them become familiar with *cause and effect* expressions. This familiarity would in turn make them confident in constructing texts containing such expressions which are abundant in their texts.

**CONTENT-BASED PRACTICAL EXERCISES**

The teachers that teach science and technology students English should always look for content from the science and engineering / technology textbooks for designing practical exercises. These exercises enable their students to review and reinforce what they had learnt in the ESP classes. Exercises such as the one given below would assist the ESP learners to practice their skills in writing sentences reflecting cause and effect expressions.

**Exercise**

Directions: Select the most appropriate connecting word to show the cause-effect relationship from the list given below and fill in each blank:

Because, since, as, therefore, consequently, as a result, cause, result, due to, on account of, if, when, leads to, produces

1. The people of Cochin petitioned the Government --------- the elephant killed four people.
2. --------- the traffic is heavy, the air gets polluted.
3. Pollutants --------- primary damage with direct identifiable impact on the environment.
4. Chlorofluorocarbons --------- depletion of the ozone layer which may --------- to the increase in the ultraviolet ray intensity at the surface of the Earth.
5. Silicosis is the --------- of inhaling of silica dust.
6. A coal-based thermal plant emits sulphurous gases --------- acid rain.
7. Most of the coal-based thermal power plants are located in some of the large coalfields; --------- it is more economical to generate power at the mine head.
8. Lead poisoning--------- permanent brain damage.
9. --------- of soil erosion by poor agricultural practices, the lands are stripped of valuable nutrients.
10. Our frequent use of numbers in all types of communication is mainly --------- the effect of technology.

**INDICATORS OF PURPOSE AND FUNCTION IN ADVERB CLAUSES**

The intended result or purpose of an action is described by an adverbial clause of purpose, usually a to-infinitive (e.g., to identify, to catch) clause. Purpose and function are inter-related. We perform a function or use an object in order to achieve a purpose. For instance, in the sentence *Scientists use telescopes to observe distant objects,* we may see that scientists perform the function of using the telescope so that they can achieve their purpose of observing the distant objects. Similarly in the sentence *A few flowering plants have evolved a special mechanism to produce seeds without fertilization,* we see that the purpose or function of the special mechanism is to produce seeds. The same sentence can be modified as,

*To / In order to produce seeds without fertilization, a few flowering plants have evolved a special mechanism.*

*A few flowering plants have evolved a special mechanism so that seeds can be produced without fertilization.*

**SIGNAL WORDS**

Besides the most commonly used *to-infinitives*, there are other expressions such as *so that*, *in order to*, *in case* (*in case* is used to indicate negative purpose) that can also be used as indicators of *purpose and function*. In case of sentences in passive voice, expressions such as *are meant for, are involved in, is responsible for*, etc., can be used (the structure will be: *is / are /were/ have, has, had been + verb + preposition*). These expressions can be taught to the students of science and technology through examples as shown below.

**Signal words of purpose and function**

**Examples**

1. Litmus tests are used *to identify* acids and alkalines.
2. *In order to observe* the mice under varied climatic conditions, the scientists prepared a chart.
3. The scientists prepared a chart *so that* they could observe the mice under varied climatic conditions.
4. The generator should run continuously **in case** the researcher loses the data.
5. The generator should run continuously **so that** the researcher loses not the data.
6. Glass bottles are used in the laboratories **to store** acids.
7. Underground cables are used **to carry** electricity to towns.
8. A camera is used **to take** photographs.
9. The students need **to develop** their personality **in order to get** good jobs.
10. Torsion balance is used **to measure** the force between two charged metallic spheres.
11. The electrons are embedded into it **in such a manner as to give** the most stable electrostatic arrangement.
12. Locomotion is generally exercised by animals **to escape** from predators.
13. **In order to explain** the distributions of these charges particles in an atom, different atomic models were proposed.
14. The main function of root system is **to absorb** water and minerals from the soil.
15. Roots in some plants change their shape and structure and become modified **in order to perform** functions other than absorption and conduction of water and minerals.
16. Cathode rays are passed through anode **so that they can strike** zinc sulphate coating.
17. Skeletal muscles **are primarily involved** in locomotory actions and change body postures.
18. The root system of a plant **is mainly responsible for** absorbing water and minerals from the soil.
19. The cellular thickenings at the molecular tip **are meant for** guiding the pollen tubes into the synergid.

**IDENTIFYING INDICATORS OF PURPOSE AND FUNCTION**

Once the students are familiar with the purpose / function signal words and phrases, the teachers of ESP can use short or long passages from science texts to provide adequate practice in identifying those signal words. One sample passage is discussed as follows.

**Example**

The cyclotron is a machine for **accelerating** charged particles or ions to high energies. It was invented by E.O. Lawrence and M.S. Livingston in 1934 **to investigate** nuclear structure. The cyclotron uses both electric and magnetic fields in combination **so as to increase** the energy of charged particles. In addition, the cyclotron is used **to bombard** nuclei with energetic particles. It is used in hospitals **to produce** radioactive substances which **are meant for** diagnosis and treatment (Physics, Part I, Textbook for class XII, NCERT, Delhi, 2006). The ESP learners will be able to identify the highlighted expressions that indicate the various purposes or functions of cyclotron if they are familiar with the signal words that they have learnt earlier. Sentences can also be used instead of passages. To have a variety in the teaching tools, the ESP teacher can display the exercises on the overhead transparencies or power point slides and discuss with students by posing questions.

**CONTENT-BASED PRACTICAL EXERCISES**

Review exercises as shown in the sample given below will be able to reinforce the students’ learning of the indicators of purpose and function:

**Exercise**

Make sentences expressing purpose using the hints given below. Use different expressions that you’ve learnt to construct your sentences.

*Example: Aerial-receive broadcast signals*  
*Answer : An aerial is used to receive broadcast signals.*

i. A litmus test: identify acids and alkalis  
ii. Carbon paper: make copies while typing  
iii. Factories: manufacture products  
iv. A hammer: fix nails  
v. A flashlight: objects in dark  
vi. An ice axe: cut ice, climb mountain  
vii. A compass: find direction  
viii. Ropes: tie things  
ix. A map: locate a country  
x. A lever: operate a piece of machinery

**CONCLUSION**

It is necessary for the students of science and technology to understand English expressions in order to bring out in their writing the cause, effect, purpose and function involved in various scientific and technological concepts. English teachers teaching the students of science and technology may find the three strategies, namely, teaching signal words, identifying them in scientific texts and providing practice through content-based exercises discussed in this article useful in their classes. Specifically, they may find the examples provided in this paper very helpful in their teaching.

**NOTES**

The examples have been taken from the textbooks adopted in Indian schools at grade XI and grade XII...
because immediately after passing these grades, the students enter the universities offering science programs or technology (engineering) programs. However, these examples may provide adequate insight into the teaching of various expressions related to cause, effect, etc., to the ESL students. As the branches of science, namely, Physics and Chemistry are invariably taught to both science and engineering students, the examples have been chosen from these fields. Teachers across the world can use similar examples and strategies in their classes for ESL students.

REFERENCES
