2nd International Conference on Terminology, Standardization and Technology Transfer, pp. 177-185, August 3 - 8, 1997, Beijing, China

Problems in the Standardization of Terminology for Computer Education and for Multiple Cultures

*Zhi-Liang Zhang*a, *Kimio Ibuki*aa* *and Jin-Hua She*aaa

a Department of Computer Science, Shanghai Normal University
Guilin Road 100, Shanghai, 200234 China
Tel: +86(21)64700700ext.2741
Fax: +86(21)64701453

aa Information Technology Department, Tokyo Engineering University
Katakura 1404-1, Hachioji, Tokyo, 192 Japan
Tel: +81(426)372111ext.2206
Fax: +81(426)372118

aaa Mechatronics Department, Tokyo Engineering University
Katakura 1404-1, Hachioji, Tokyo, 192 Japan
Tel: +81(426)372111ext.2314
Fax: +81(426)372118

*: corresponding author.

Abstract: Nowadays, basic education in computers cannot keep pace with the rapid changes in computer technology and terminology. The gap between them is becoming wider and wider. To solve this problem, this paper introduces a new concept called *logic-based technology* and a structural model based on a division of information technology into two parts: physical technology and logic-based technology, and a further division of the logic-based technology into two parts: the slowly changing or unchanging fundamentals and the rapidly changing complex part. This paper suggests that compulsory education in computers should aim at the fundamentals of logic-based technology. Next, based on this new concept, this paper discusses a problem in the standardization of terminology across cultures. A suggestion is put forth to make an attempt at solving the problem.

Keywords: terminology, standardization, computer education, plurality of cultures, Chinese

character.

1. Introduction

Along with the rapid growth of computer technology, digital computers have come into wide use in every field. Compulsory education in related science and technology, which is provided starting in elementary or junior high school, is promoted everywhere in the world. On the other hand, over the last few decades, computer technology has been changing rapidly with the progress in hardware, software and networks. In particular, the rate at which the terminology changes is accelerated by intense commercial competition. At universities, curriculums for computer education have been developed by ACM that successfully track all of the latest changes. However, the situation in primary and secondary schools is totally different. Teachers there need to prepare various lessons on different subjects and cannot spend much time on computer. Consequently, the rapid changes in computer technology and terminology cause serious problems in current compulsory education.

Moreover, a multi-cultural aspect is added to advanced technology in regions where non-English and non-French cultures are predominant. For example, the character ordering system used in Japan is totally different from that used in China even though almost all of the characters are the same.

There are probably two main reasons for this situation. The first is that the technology is too young to have achieved even the standardization of terminology. Even in academia, different societies use different technical terms for the same thing. For example, the term ‘computing machinery’, which is used by ACM, has almost the same meaning as the IFIP term ‘information processing’. The second is that the terminology is not well coordinated between countries and regions during the process of the dissemination of new technology.

To fill the gap between education and technology, it is urgent and important to establish a new theoretical system in order to make a systematic exposition of computer technology and facilitate the standardization of terminology. Necessarily, this system can be applied to all hierarchical levels, e.g. machine, program, and network levels, and is independent of vendors’ technologies.

This paper introduces a new concept called *logic-based technology*. It will be shown that the problems in compulsory education in computers can easily be solved by using an approach involving the division of logic-based technology into two parts: the slowly changing or unchanging fundamentals and the rapidly changing complex part. This paper also considers the problem of the standardization of terminology across cultures. A suggestion is put forth in an attempt to solve the problem.

2. Problems in education

2 .1 Problems with terminology

Recent progress in computer technology has produced both a wide range of applications and an abundance of information for us. On the other hand, the rapid pace of change in computer technology has also produced confusion and problems in education. Moreover, new technical terms have intentionally been created with the same meaning as more commonly used terms to obtain exclusive rights in the market place and gain an advantage in commercial competition. This simply fosters terminological confusion.

A computer teacher is asked to track all the progress in his field, and there are demands that computer curricula are designed to cover all the latest technological changes. This is successfully accomplished at colleges and universities. However, it is impossible to do it in primary and secondary schools because the responsibilities of teachers there cover a wide range of subjects besides information technology and are not confined to a single academic discipline.

If a terminological standard could resolve this problem, clearly, it should be used in education. However, the existing standardization procedures followed by the information technology committees of ISO/IEC and other similar organizations are not a great deal of help in establishing such a standard because the committees are strongly influenced by the industrial world and commercial competition, and are accomplices in producing the current state of confusion. Consequently, the rapid change in terminology is having serious repercussions in compulsory education in computers.

2.2 Gap between industry and education

While one of the authors was participating in a government-supported work group on the standardization of terminology in computer education, he heard different opinions from the industry and education sides. They are as follows.

The industry side says ‘The terminology adopted should be what is currently in wide use in the industrial world. In addition, commercial competition is also essential to the stimulation of technical progress in industrial development. So, standards should be revised every five years.'

The education side says 'In compulsory education, great deliberation is required in the preparation of textbooks, and it takes a considerable amount of time to train teachers. So, standards should only be revised every ten years or more.'

Both opinions are reasonable and are based on common sense. Thus, in spite of the curriculum activities of ACM, the problem still remains unsolved at the level of compulsory education. Now, there is a pressing need to solve it.

To fill this gap, it is necessary to develop a new theoretical system. A division of the problem into two different levels is proposed in this paper in order to solve the problem systematically.

By introducing a new concept called *logic-based technology*, we can divide technology into two parts: physical technology and logic-based technology. Each part can be divided again into two parts: the slowly changing or unchanging fundamentals and the rapidly changing complex part. Physical technology covers on the analog technology that has already been developed. On the other hand, logic-based technology deals with the structural view of technology and its basis can be handled by mathematical logic. Work needs to begin now on establishing the basic principles of logic-based technology. We think that the principles should be a complex combination of mathematical logic and other things including the solution to the problems discussed in this paper. A look at history can help us find a key to the settlement of the problems.

2.3 History in some other scientific fields

During the Renaissance in Europe, many scientific discoveries poured forth in various fields. However, there was no general framework for science at that time, so the discoveries could not be integrated into a comprehensive scheme and remained isolated, seemingly unrelated to each other. It was only later that theoretical work, such as Newton's law of gravitation, established classical physics based on calculus. On the other hand, a couple of centuries later, complex subjects and phenomena beyond calculus were comprehended by introducing a hierarchical structured model, such as an atomic structural model that goes beyond Schrödinger's analysis.

Computer technology is taking the same path as classical physics and chemistry. Now, we have reached the stage of constructing a theoretical system, namely logic-based technology, to expound the complex subjects and phenomena of computer technology. There is much in developed methodology that we can make use of in logic-based technology.

2.4 Logic-based technology

Nowadays, a huge number of scientific discoveries are constantly emerging in physical technology, and related industries are developing in accordance with them. In spite of that, common basic education is stable for a period of over ten years and satisfies all the needs of both industry and education. The actual learning sequence in education is: phenomena in elementary school, general principles in junior and/or high school, and applications in college or university.

Computer education should use the same system. The concept of logic-based technology is aimed at establishing some common principles by which the structure of computer technology can be analyzed.

Figure 1 illustrates the scope and interface of physical and logic-based technology. An analog object can be converted into binary information through the procedure of sampling, quantizing and coding. Thus, the object of logic-based technology can be considered to be information processing that employing logical and timing devices, as shown in Figure 2.

Logic-based technology consists of two parts: the fundamentals and the complex part. The fundamentals are analyzed by mathematical logic, rather than the mathematical analysis of physical technology. The complex part beyond direct mathematical treatment is comprehended by means of the hierarchical structured model shown in Figure 3, as well as the hierarchical structured molecular model of chemical elements.

As summarized in the appendix, the conversion principle between each hierarchical levels is common throughout. This model starts with a logically complete set of elements, wired logic for machines and stored logic for programs, and goes up to combining wired and stored logic for computer systems and/or networks. It is clear that this model is independent of vendors. This principle not only reduces the number of things to be learned and makes computer science easier to understand, but also easily yields new applications by means of mapping directly from existing technology to the related hierarchical level and changing other levels in accordance with it.

Therefore, if compulsory education is directed toward the fundamentals of logic-based technology, the problems in compulsory education in computers can be solved.

By analogy with *chemistry*, which starts with chemical elements, we can name the methodology that starts with logical elements *logistry*.

3. Standardization of terminology across cultures

3.1 General issues in polyglot standardization of terminology

Polyglot standardization in terminology arises from today's actual multilingual world. National standards are translated from international standards. To clarify the notion of terms, two different languages, English and French, are usually used in international organizations concerned with terminology.

The main issues in the representation of terminology are discussed in detail below, and related comments are provided.

Issue 1) Native speaker's principle: International terminology should be the same as that in the national standard for a giving language. Consequently, the representation should follow the norm that native speakers use. To prevent abnormal terminology from appearing in international standards, such as 'Mechatronics', the international standard should be made before a defacto standard gains wide acceptance in the world.
Comments: If the original language of a functional field was not popular, it would be difficult to call enough members (five) of participating countries together for the purpose of international standardization. But it is important to translate a defacto standard into an international pre-standard. That should be done by a group of countries even though it violates the above principle.

Issue 2) International standard language: The international representation should be easily translated. In particularly, it should be translated word-for-word into all national languages even though some of the expressions in the language used by international standard are unnatural to native speakers.
Comments: Totally different sentence structures in different languages in the world render this

idea impractical.

Issue 3) Polyglot database: A database including all national standards offered by all participating countries.

Comments: That has already started in the West. To extend the database and include other cultures, some technical problems need to be resolved. For example, in the area of Chinese characters, we need to make standards for methods of inputting and ordering characters, and take harmonization with the West into account.

3.2 Problems in standardization of terminology across cultures

Issues 2 and 3 are problems of grammar and character-input, respectively. Both depend on culture and history. For instance, an advanced technology for inputting sentences requires the phonetic input of Chinese characters with automatic conversion through syntactical analysis, though the phonetic input of Latin characters does not involve this kind of problem since the method of direct spelling can be used. Logic-based technology can be used to handle this. Generally speaking, logic-based technology depends on culture much more than physical technology .

Issue 1 was not a matter of concern when science and technology were primarily created in the West. However, the recent progress in science and technology in East Asia has been spectacular. Many scientific and technical documents are published in Chinese characters. And some scientific and technical terms, e.g. *mechatronics* and *logistry*, were first introduced in the region where Chinese characters prevail.

3.3 Standard in the region where Chinese characters are used

It is important to establish a uniform standard to solve the standardization problem for different countries and areas where Chinese characters are commonly used. The example in Table 1 shows the difficulty of this problem. So, an investigation should be conducted by a study group consisting of experts and scholars in all of the related countries and areas, and the group should keep in touch with groups in other cultural regions to promote standardization.

3.4 The present responsibility

Though the ultimate aim of the study group is the handling of general items, it is better to start from the standardization of terminology of logic-based technology and its applications for the following reasons.

First, this field has an urgent need for extensive standardization in the region where Chinese characters are used.

Secondly, the process of the standardization of purely scientific terminology is essentially out of the scope of industrial technological organizations. Thus, the organization responsible for standardization should be divided into two parts: an academic group and an application group. The period of revision of standards for the academic group should be more than ten years. These standards cover the slowly changing or unchanging fundamentals of logic-based technology. This group is mainly concerned with the education side. On the other hand, the period of revision of standards for the application group should be much shorter than that for the academic group to maintain stable growth in the industry. These standards are concerned with the rapidly changing complex part of logic-based technology. Clearly, this group is mainly organized to meet industrial requirements.

We think that the structured model shown in Fig. 3 is helpful in dividing up the responsibilities of the two groups. In Fig. 3, the structure of every level is unchanged, but the contents of '*P*' at each level and the number of levels are variable. So, the academic and application groups should mainly deal with structure and content, respectively.

4. Conclusions

This paper introduced the new concept of *logic-based technology*. By dividing logic-based technology into the slowly changing or unchanging fundamentals and the rapidly changing complex part, the problems arising in compulsory education in computers can be solved without difficulty. This concept can also be applied to the standardization of terminology across cultures. A study group for the standardization of the terminology of logic-based technology and its applications need to be organized in every cultural region so that they can develop standards for terminology in their related culture and maintain harmony with each other. In particular, an especially pressing need is the organization of a workshop in East Asia.

References

[1] K. Ibuki : *General Software Science - Fundamentals of Computer System*, Ohm, 1987. (in Japanese)
[2] K. Ibuki : *Logistry*, Morikita Publishing, 1990. (in Japanese)
[3] K. Ibuki : *Introduction to the Operating System*, Kyoritsu Publishing, 1991. (in Japanese)
[4] T. Uehara and K. Ibuki : *Logical Design*, Morikita Publishing, 1997. (in Japanese)

Appendix

An outline of logic-based technology and some examples of its applications are given below. More detailed information can be found in [1] ~ [4].

1. Scope of logic-based technology (cf [1] and [2], also see Fig. 1) .
2. Logical functions and their complete sets (cf [1] and [2], also see Fig. A1).
3. Mathematical composition of logical functions based on complete sets (Mathematical logic) (cf [1] and [4]).
4. Structured hierarchical organization (cf [1] ~ [4], also see Fig. 3) .
5. Conversion of classes of hierarchical levels (cf [1] ~ [3], also see Fig. A2).
6. Library at every hierarchical level and generation of system from generic structure (cf [1] ~ [4], also see Fig. A2 for generic model).
7. Preparation methodology for generic structure (cf [2], also see Fig. A3 for life cycle).
8. Quantitative measure of information and processing media for evaluation and ethics of system (cf [1] ~ [3], also see Fig. 2 for measurement model).

Figure Captions

Table Captions

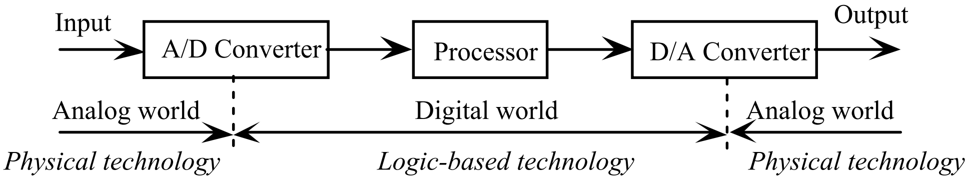

Fig. 1. Scope of logic-based technology.

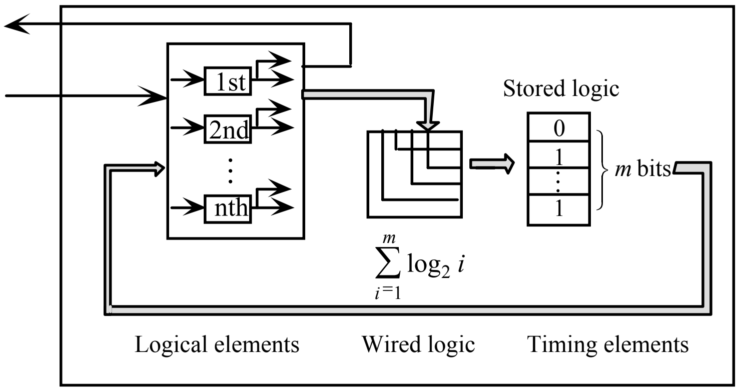

Fig. 2. Measurement model of object of logic-based technology.

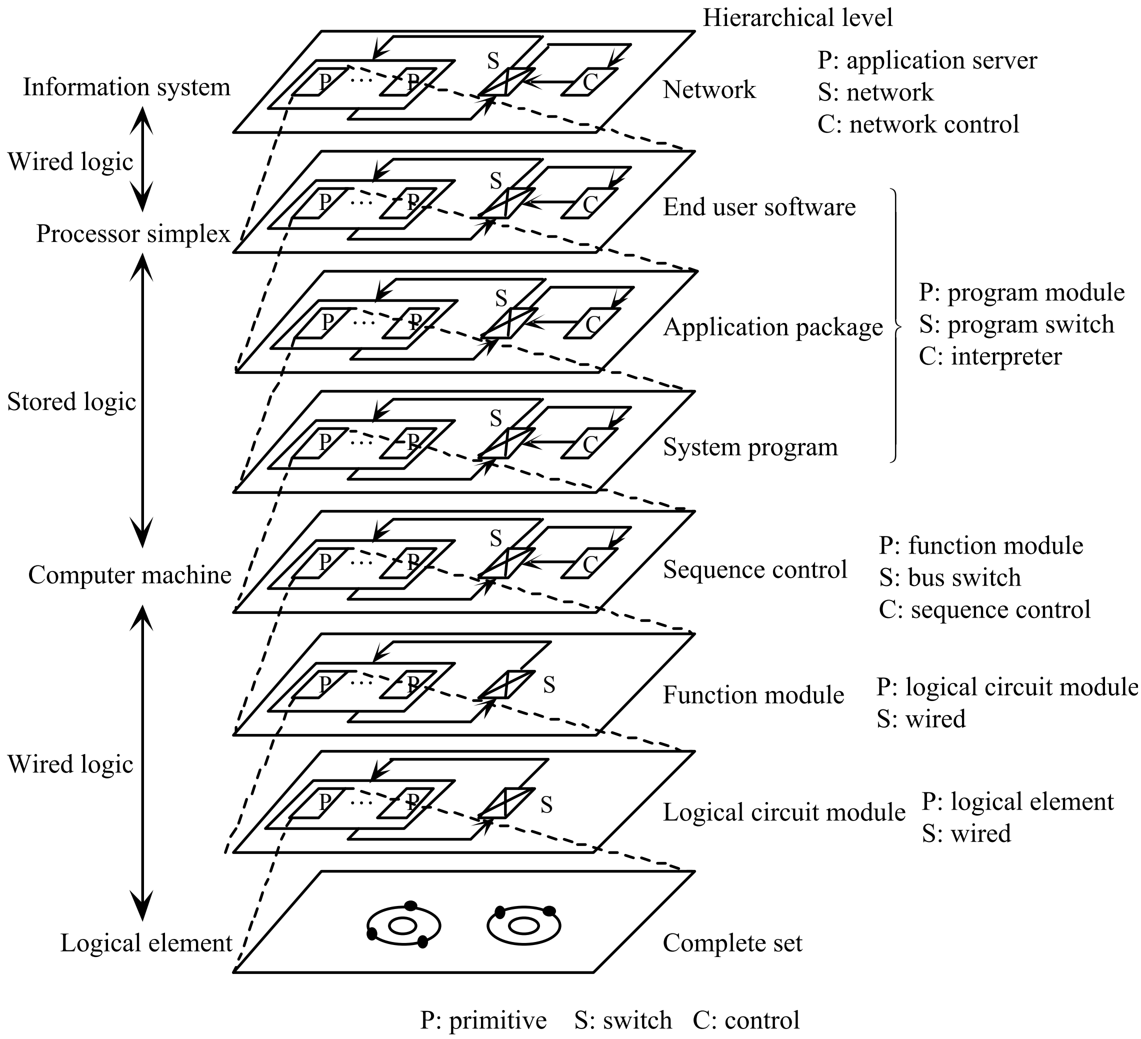

Figure 3. Structured model.

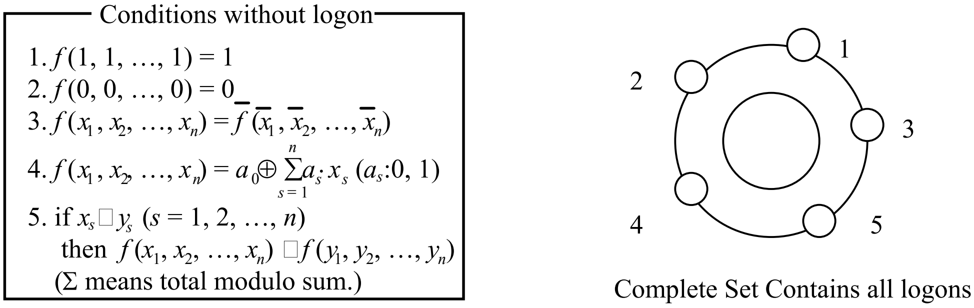

Figure A1. Logon model for logically complete sets.

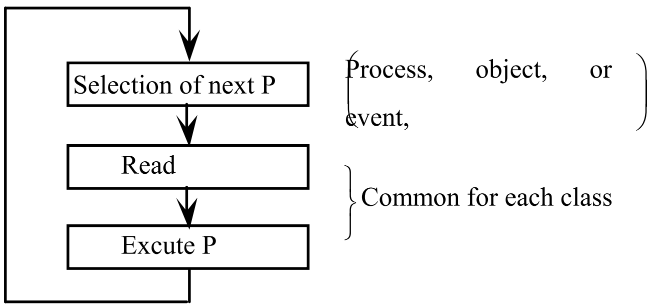

Figure A2. Conversion principle and classification for selection mechanisms.

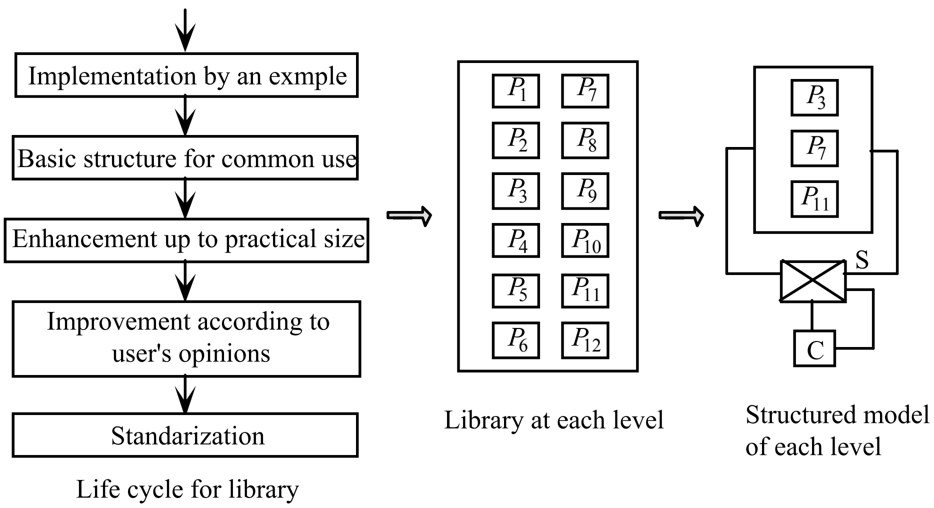

Figure A3. Generic model and life cycle of library.

Table 1. Example of the regional aspects of a Chinese character.

Word: 'to press'	Beijing	Taipei	Tokyo
Pronunciation	Ya	I Y	アツ
Modern character	压	壓	圧
Original character	壓	壓	壓
Code order	Pronunciation order	Pronunciation order	Pronunciation order