Incommensurable but Explicable

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ABSTRACT: This paper focuses on the significance of metalanguage, which is expression of language, in science education in non-Western nation states. Each of them normally assumes its national language(s) in science education. There, science teachers have to think out explanation of scientific concepts by using the non-Western language; consequently, science teachers are inevitably confronted with incommensurability between science, i.e., a Western language, and the non-Western language. In the explanation, science teachers are led to deal with the metalanguage to explain the incommensurability, but the universality of science prevents them realizing their use of the metalanguage. In this perspective, the present paper proposes a general way to distinguish the metalanguage with the aid of the axiomatics model, of which essence is the distinction among the axiom, postulate and theorem stages of cognition. On the basis of this model, the possible axioms about the metalanguage are: 1) A [METALANGUAGE] is an expression about a [CONCEPT], and 2) A [CONCEPT] is negatively articulated in a [LANGUAGE]. These axioms involve three indefinable terms: [METALANGUAGE], [CONCEPT] and [LANGUAGE]. At the postulate stage, an actual way to articulate concepts or objects for consideration is transcendentally postulated in a language-culture community. The postulate makes the concepts or objects for consideration substantial, and is identical with a worldview concerned. This model will remind science teachers of the significance of the metalanguage in science education, and will assure them of pupils' right understanding of scientific concepts. At the same time, pupils will establish their sound language-culture identity.

INTRODUCTION

At the present time, science education is worldwide conducted in various language-culture settings. This societal phenomenon depends entirely on formation of nation-states, a way of organizing people. This way originated in the West Europe in the late eighteenth century historically. Till then, people had been organized into "dynastic or religious states, tribal agglomerations or supranational empires" (Kohn, 1973, p. 324). Nation-states had a new manner of organizing people, and now almost all states regard themselves as nation-states regardless of "Kingdom" or "Republic." There, the people cease to be more passive objects of history.

Nation-sates share the following three characteristics:

1. self-determination of the life of the group.
2. introduction of modern science and technology in the service of the nation.
3. exaltation of the national language and traditions above the formerly frequent use of universal languages (in Europe Latin and later French) and universal traditions (Christianity or Islam). (Kohn, 1973, p. 324)

The first characteristic is not directly related to the issue the present paper discusses. The second one explains the reason why each nation-state bears responsibility for conducting science education, i.e., teaching modern science. In the following, the present article also abbreviates modern science to "W-science" as my previous articles did (Kawasaki, 1996; 2002; 2006). In addition to the second character, the third one also seems to make a natural and persuasive argument about national language.

However, a language-culture conflict results from the combination of the second and the third characteristics in non-Western[1)] nation-states. In order to understand the conflict, it is convenient to classify the conflict according to languages used in science education: 1) Standard Average European (SAE) languages (see Note 1), which are not the national language(s), and 2) pupils' first language, which is (one of) the non-SAE language(s). Clearly, the first case disagrees with the third characteristic requested by non-Western nation-states. In contrast, the second case agrees with the third characteristic, and seems to be normal. However, since the W-scientific worldview is not entailed by pupils' first

language, language-culture conflict is caused in pupils' mind (Kawasaki, 2002). In the following, this paper will focus only on the second case.

In the second case, pupils are forced to face two different worldviews. One is the W-scientific worldview and the other is a worldview entailed by the non-SAE language used in the science classroom. Thus, the exaltation of the national language leads pupils to the language-culture conflict in non-Western nation-states. In order to introduce W-science, however, non-Western nation-states have usually accepted the universality. The acceptance of the universality inclines science educators to deny the national language and traditions in greater or less degree. Then, this denies the third characteristics of nation-states at the same time.

Focusing on a quality of metalanguage, the present paper will show how to resolve the language-culture conflict: the conflict between the W-scientific and a non-Western worldviews. In other words, a general way to develop science teachers' deliberate use of metalanguage is discussed. The way will make it possible for science educators to cope with the conflict between the second and the third characteristics nation-states should share. The reason why the present discussion is necessary to science education in non-Western nation-states is that the conflict conceals itself in the use of non-SAE languages in science education. There, because each W-scientific term is already translated, few science educators realize that it conveys a foreign concept their non-SAE language has never articulated. A procedure the present paper discusses will remind science educators of the conflict between the two worldviews. This must be the first step to resolve the conflict.

METALANGUAGE

Metalanguage is relatively opposed to object language, and a possible definition of metalanguage is: an expression of object language. Because of the relativity between meta and object languages, if an expression of a metalanguage is given, the expression is another metalanguage with respect to the metalanguage to be expressed. This distinction between meta and object languages is made within the framework of positivism associated with essentialism. However, it is possible to give a different definition within ant-essentialism. Because anti-essentialism accepts in principle that any concept

always refers to all other concepts surrounding that concept, the following definition of metalanguage is an equivalent of expression of language: A metalanguage is expression of a language or a concept. An expression of a concept is identical with an expression of the language involving the concept.

It should be emphasized that the definition above includes the case where the meta and the object languages differs from each other, e.g., an expression of the English language is given in the Japanese language. From the viewpoint of the language used in the science classroom, it will be convenient to classify metalanguage into two types: a metalanguage is given 1) in the same language as an object one and 2) in a different language from an object one. In both cases, pupils' first language is supposed to be non-SAE languages.

Imagine that a metalanguage is given in the English language. An example of the first type is: The definite article of the English language is "the." This metalanguage is an English expression of "the" articulated in the English language. Both meta and object languages are English. The second one is: The Japanese language has never included any part of speech that performs as the same function as the definite article "the" in the English language (Kawasaki, 2002). In this example, the metalanguage is given in the English language whereas the object language is the Japanese language.

Another example of metalanguage of the second type is an English expression of a Japanese concept. For example:

> The Japanese term "shizen," the counterpart to "nature" in science education in Japan, normally refers to supernatural on the basis of the Japanese belief system (Kawasaki, 1996; 2002).

Being expressed in the English language, the foregoing goes beyond the worldview the English language inherently entails. As this example shows, users of metalanguage are not restricted to a worldview the language entails. It is true that a language entails its inherent worldview, but it is also true that metalanguage users can go beyond the worldview. By means of metalanguage expressed in a specific language, metalanguage users can tell different worldviews entailed by other languages.

This is particularly significant in science education in non-SAE languages, because science

educators are inevitably confronted with the metalanguage of the second type. Actually, elucidating W-scientific concepts, science educators unwittingly manipulate this function of the metalanguage of the second type: going beyond the worldview entailed by the language used. Science educators are familiar with the function of metalanguage but unfamiliar with their unwitting manipulation. Therefore, an issue that needs to be discussed in science education in non-Western nation-stats is how to remind science educators of their manipulating the function of metalanguage of the second type. The axiomatics model as to "metalanguage" will be helpful for their realizing the use of metalanguage.

AXIOMATICS MODEL

The essence of the axiomatics model Kawasaki (2006) proposed is the distinction among the three stages of cognition: the axiom, the postulate and the theorem stages. The axiomatics model uses the three terms, i.e., "axiom, postulate and theorem," in a similar way to the original use in geometry. As is well-known, the system of geometrical axioms makes it possible for mathematicians to think of various types of geometry, i.e., Euclidean and non-Euclidean geometries, "in the one" (Blanche, 1973, p.168). "The one" appears as a system of axioms, and is properly called "the metageometry."

It is the essential characteristic of axiom that every axiom consists only of indefinable terms and those terms which serve logical relationships between the indefinable terms. Mathematicians are prohibited from finding any meaning in the indefinable terms. Combining the axiomatic system with proper postulates respectively, mathematicians construct actual geometries. As is well-known, the typical parallel postulates are: the Euclidean, the Lobachevskian and the Riemannian. It is significant to the present discussion that these postulates are incommensurate with each other (Kawasaki, 2006).

Consequently, corresponding theorems derived in different geometries become incommensurate with each other: "the sum of the angles of a triangle is equal to two right angles in Euclid's geometry, less than two right angles in that of Lobachevsky, and greater than two right angles in that of Riemann" (Poincare, 1952, p. 39). Because mathematicians construct actual geometries from the single axiomatic system, i.e., the metageometry, the system and actual geometries form a genus-species relationship (Kawasaki, 2006). If an appropriate axiomatic system about language-culture phenomena in various

communities is established, the system will makes it possible to think the phenomena in the one.

i) About Science Education

Kawasaki (2006) has proposed a possible axiomatic system which includes the following four indefinable terms: [SCIENCE EDUCATION], [SCIENCE], [KNOWLEDGE] and [NATURE]. Every indefinable term is expressed by capital letters and put into square brackets in order to distinguish from terms in normal use.

[SCIENCE EDUCATION] is a system of teaching [SCIENCE]. (1)

[SCIENCE] is a system of [KNOWLEDGE] about [NATURE]. (2)

Science educators need to understand this axiomatic system at the axiom stage of cognition. There, they are prohibited from finding any meaning in these indefinable terms; the axiomatic system establishes only the relationship among the four indefinable terms.

Combining the axiomatic system with various worldviews at the postulate stage, science educators become able to articulate various language modes of science education and all actual sciences (Kawasaki, 2002), not only W-science but also ethno-sciences. For example, W-science is articulated by the combination of the axiomatic system and the Western worldview. This worldview is characterized by the dichotomy between the phenomenal world and the world of Idea; by contrast, the Japanese worldview has never established such a dichotomy (Kawasaki, 2002; 2006). At the theorem stage of cognition, following their worldview as a postulate, people can experience and perform cultural phenomena in their language-culture community.

The indefinable term [SCIENCE] and actual sciences form a genus-species relationship, and the indefinable term [SCIENCE EDUCATION] and various language modes of science education also form another genus-species relationship. Because various language modes of science education have been articulated, it seems to be possible to make comparative studies on various language modes of science education. However, as discussed in Kawasaki (2006), such comparative studies should be made not at the theorem stage but at the postulate stage.

The reason is that comparing two actual language modes of science education is identical to mathematicians' comparing the theorems about the sum of the angles of a triangle derived in respective geometries. The comparison at the theorem stage will give no information more than "these theorems are incommensurate with each other." The incommensurability among these theorems stems from another type of incommensurability among the Euclidean, the Lobachevskian and the Riemannian parallel postulates.

Similarly, even if incommensurability is found among language-culture phenomena in different communities, the incommensurability should be reduced to another type of incommensurability among worldviews at the postulate stage. Every language-culture phenomenon is confirmed by a worldview shared in a specific language-culture community. There, the worldview is transcendental over all language-culture phenomena at the theorem stage. From comparative studies made at the theorem stage, science educators will not conceive any idea for improving a language mode of science education. Science educators will acquire such an idea from comparative studies made at the postulate stage. By means of those comparative studies, science educators will be able to go beyond science education, i.e., teaching W-science. Kawasaki (2006) has proposed such an education as worldview education.

ii) About Metalanguage

The present paper proposes the following axiomatics model in order to remind science educators of their using metalanguage in the science classroom.

A [METALANGUAGE] is an expression about a [CONCEPT]. (3)

A [CONCEPT] is negatively articulated in a [LANGUAGE]. (4)

Sharing the indefinable term [CONCEPT], the axioms (3) and (4) form an axiomatic system. The axiom (3) establishes the relationship between the indefinable terms [METALANGUAGE] and [CONCEPT]. Because the two indefinable terms in the axiom (3) do not convey any meaning, this axiom includes the two cases: the metalanguage and the expression are given in the same language, the first type, and in different languages, the second type. These types were already discussed above.

The axiom (4) states the negativity of each concept articulated in every human language. Culler (1988) adduces a good example of the negativity of the concept "brown or green."

> Brown is what is not red, black, grey, yellow, etc., and the same holds for each of the other signifieds; When I utter the word green, such 'concept' as might be present is perhaps best represented as the combination of 'not-blue', 'not-red', 'not-yellow', etc. --- a bundle of nots. (p.26; pp.112-113)

Each colour concept depends on all other colour concepts articulated in a language-culture community. All colours form a system because of the negativity; a constituent becomes definable being dependent on all other constituents. Definitely, this takes place at the theorem stage.

For example, in articulation of all colours in a language-culture community, the number of colours in the rainbow is the postulate to be combined with the axiom (4). The number found in the rainbow is transcendental. Imagine a language-culture community where people postulate that the rainbow includes six colours: red, orange, yellow, green, blue and purple. And imagine another community where people postulate that the rainbow includes seven colours: red, orange, yellow, green, blue, *indigo* and purple. From the anti-essentialist viewpoint, the six-colour-community people do not find the six colours in the rainbow, but create the six colours following the postulate the people share (Kawasaki, 1996; 2002; 2006). In the same manner, the seven-colour-community people create these seven colours following the other postulate. In other worlds, the two postulates or worldviews create the two colour systems at the theorem stage respectively.

The discussion above reveals an essential nature of language-culture incommensurability in the anti-essentialist perspective. The "green" in the six-colour system is incommensurate with the "green" in the seven-colour system, even thought these two types of "green" span the same range of the spectrum. The "green" in the six-colour system is articulated against the other five colours whereas the "green" in the seven-colour system is articulated against the other six colours. The interrelationships of the two types of "green" differ from each other. Even though the incommensurability about colour definitely lies at the theorem stage, either people can exchange their respective concepts "green" by

referring to the difference between these colour postulates. Their exchanging ideas about "green" is an archetypal example of the use of metalanguage, and is made at the postulate stage of cognition.

SELF-CONSCIOUNESS

Since essentialists intend to find the universal truth, they tend to discover the genuine postulate among possible ones. However, their attempt seems to be identical to mathematicians' endeavour to find out a genuine parallel postulate. This is meaningless, of course. By contrast, anti-essentialists can accept all worldviews in the same way that mathematicians accept all possible parallel postulates. This is a considerable advantage in equitable treatment of various language modes of science education. Science educators need not reject non-W-scientific worldviews as wrong in the science classroom. In this perspective, the W-science worldview is naturally relativized with respect to a non-W-scientific worldview which pupils are expected to acquire in their language-culture community.

If science teachers successfully relativize W-science, they will always refer to the difference in worldview in non-SAE language modes of science education. This is the first step to worldview education Kawasaki (2006) has proposed with a new rationale for science education in non-SAE language modes of science education. In worldview education, teachers are always forced to cope with metalanguage to express the difference between worldviews. More than one worldview in science education mean that science educators have to cope with more than one language. Science educators' linguistics situation is indicative of that in foreign language education.

However, it is important to distinguish a difference between science and foreign language educations. In foreign language education, pupils as well as foreign language teachers always distinguish between the foreign language to learn and pupils' first language. By contrast, in non-SAE language modes of science education, translation of W-scientific terms tends to hinder science teachers' realizing that they now utter an expression based on a foreign worldview: a metalanguage. Science teachers' unawareness will cause pupils' conceptual confusion. The axiomatics model about metalanguage will remind science teachers of their use of metalanguage, and will resolve pupils' conceptual confusion. Furthermore, the axiomatics model will control the dilemma in non-Western

nation-states which intend to introduce modern science and technology in the service of the nation.

NOTES

1) This term distinguishes between Western and non-Western by the concept "Standard Average European (SAE)" coined by Whorf, a US linguist (Whorf, 1959, p.138). Typical examples of SAE language are English, French and German and languages measure. If a language-culture community share an SAE language as the first language, the present article regards the community as Western. If one's first language is SAE, the person is a Western regardless of where he or she lives.

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