A Literature Review on Content ESL Instruction

Yingli Wang

The School of Foreign Languages, Hebei United University, Hebei, China.

Abstract—Content instruction is a method to integrate language instruction with subject (Crandall, 1987). It has been used in various language learning contexts for the last twenty-five years and its popularity and wider applicability have increased dramatically in the past ten years. They show that content instruction is taken effective in a wide rage context in bilingual education. This literature review focuses on some of the ways in which English language instruction is integrated with science.

Index Terms—content instruction, ESL, bilingual education

I. INTRODUCTION

Content instruction is a method to integrate language instruction with subject (Crandall, 1987). It has been used in a variety of language learning contexts for the last twenty-five years. Its popularity and wider applicability have increased dramatically in the past ten years. A lot of evidence shows that content instruction is taken effective in a wide rage context in bilingual education, such as Canada French/English immersion program, U.S.A. Hispanic/English immersion program, New Zealand Mori/ English immersion program and University of Ottawa sheltered program (Grabe & Stoller, 1997). It also has been a part of elementary and secondary school English-as-Second-Language (ESL) programs. ESL is a system of instruction that enables students whose native language is not English to acquire academic proficiency in English (Ovando & collier, 1998). This literature review focuses on some of the ways in which English language instruction is integrated with science, so it is called content ESL instruction. This review begins with the conception of content ESL instruction. Then it explains why ESL and science through this kind of instruction. After discussing how to use it in classroom through instruction models and strategies, this literature review briefly gives some suggestions for implementing content instruction in bilingual education in China.

What is Content English-as-Second-Language (ESL) instruction?

Content ESL instruction is based on two important linguistic concepts. The first one is Krashen's (1982) concept that language acquisition occurs when students, in an interesting, low-anxiety context, are provided with comprehensible input, which is slightly above the students' level of understanding. The second one is Crandall's (1987) concept that second-language proficiency entails control not only of social but also of academic language. Content ESL is a method that integrates English-as-a-second-language instruction with subject matter instruction (Tarey, 1998). The technique focuses not only on learning a second language, but also using that language as a medium to learn mathematics, science, social studies, or other academic subjects.

Why implement Content Instruction?

According to the theories, content ESL instruction can help students' both language and science learning. In the United States, Krashen's theory (1981, 1982) of second language acquisition has influenced the development of integrated instruction at all levels. Krashen suggests that the focus of the second language classroom should be on something meaningful, such as academic content. He believes that modification of the target language facilitates language acquisition and makes academic content accessible to second language learners. Similar with his theory, Ovando believes that "the process of instructional for content ESL like a continuum (1998, p.185)." At one end of it, using a math or science topic is as a means for developing second-language skills. At the other end, to develop math or science concepts through using techniques of second-language acquisition is to maximize student's understanding of the content. A mastery of science content in the bilingual classroom requires an interplay between language and concept formation (Mason & Barba, 1992). The following will describe the significance of ESL and science learning through content instruction.

Language acquisition in science classroom

On one hand, using content instruction in science classroom can promote LEP students' all aspects of language at school: vocabulary development, listening, speaking, reading, and writing development together.

• Vocabulary development

Science content material copes with the acquisition and usage of new vocabulary. Specialized vocabulary is closely related to the specific content of science. Saville (1984) found that knowledge of vocabulary was the most important aspect of second language competence for learning academic content through that language. Carrasquillo and Todr guez (2002) claims that knowing vocabulary is not just identifying the scientific jargon, it includes the ability to use the vocabulary of science to make informed decisions about science issues which would affect society as well as students personally.

In the content ESL, Crandall (1992) stated that much vocabulary development occurs naturally through the context of science activities, especially when the subjects are taught actively using models, experiments, role playing and so on. A meaningful classroom context can enhance the students' acquisition of the terms, which should convey how the thinking processes in science occur (Crandall, 1987, p188).

• Listening, speaking, reading, and writing develop together

Language is an integration of the four processes of listening, speaking, reading, and writing, which are inseparable (Bernhardt & Kamil, 1998; Cecik & Lauritzen, 1994; Dickinsin, 1987). These four linguistic processes although independent, they are inter-related and work in conjunction with the cognitive process of learning. English as second language students are immersed in an English print environment and "it is only natural that in their creative construction of oral and written language, they will attend to this language data, to this input (the print environment), and will use it to meet some of their needs to communicate in their second language" (Hudelson & Serna, 1994, p.285).

• Affective variables

Research synthesized by Brown (1994); Dulay, Burt, and Krashen (1982); Genesee (1987); and Schumann (1980) suggests that affective factors play a powerful role in the acquisition of a second language. Kessler and Quinn (1987) point out that science can provide an idea environment to stimulate students' affective variables: interesting, motivation, self-confident and low-anxiety. They believe that in science classroom, language involves around relating observations or communicating other aspects of the investigation. In these activities students pay more attention to the meaning rather that the grammar or form in the communication. Using different strategies to cope with the question, discussion or group experiments, students would not become overanxious or feel threatened. In this actively science setting, learners can have high interest and motivation, intrinsic to scientific inquiry as well as language acquisition.

Scientific knowledge expansion through language learning

On the other hand, scientific knowledge can be expanded through language acquisition.

• Conception development

Science learning involves the use of literacy processes, which are the root system for growth in scientific knowledge. Ovando (1998) claimed that scientists and science learners must be literate in the basic literacy process in order to be able to communicate effectively their ideas or discoveries. The science classroom, as Fathman, Quinn and Kessler (1992); Sutman, Allen and Shoemaker (1986)suggest, provides an excellent atmosphere for developing the kinds of social and scientific behaviors LEP students needed in order to find solutions to local and global problems. Content area instruction is based on the notion of "comprehensible input," in which the teacher uses only the vocabulary and structures that can be understood by students (Ramirez, 1986). When teacher uses visual reviews, such as lists, charts, paraphrasing and the salient points where appropriate, students' science conceptions can be developed.

• Cognitive benefits

Kessler and Quinn (1982, 1985) found that bilinguals performed significantly better than monolinguals in formulating solutions to science problems. Their study showed students using ESL were superior in convergent thinking, as seen in the linguistic process of metaphor formation. In addition, Quinn and Kessler (1986) state that conflicting with cognitive structures and cultural experiences in science classroom, bilingual children build new cognitive systems at higher levels. Results from the Multicultural Improvement of Cognitive Abilities (MICA) project also show that participants made improvements not only in cognitive and academic achievements but also in language proficiency (Kessler & Quinn, 1987).

Issues in content instruction:

A major source of support for content area instruction comes from second language acquisition research, particularly the work of Krashen, Swain, and Cummins. Krashen's (1982, 1985) comprehensible language input provides an important rationale for the development second language. He argues that Canadian immersion programs, U.S. bilingual immersion programs, and the University of Ottawa sheltered programs for second learners all provide a degree and L2 (second language) content learning. Particularly, students in Canadian immersion programs have equivalent L 1 (native language) language leaning, and near-native L2 learning.

However, Swain (1985) points out the limitation of instruction, which only promote comprehensible input. Students in Canada immersion program are successful in subject matter and comprehension skill (listening and reading), but are not as successful in speaking and writing. She proposed that it should focus on relevant and contextually appropriate language forms to support content-learning activities in the classroom.

Another issue is about Cummins's (1979, 1981) notion of Cognitive Academic Language Proficiency (CALP). Cummins has hypothesized two different kinds of language proficiency: basic interpersonal communication skills (BICS) and cognitive academic language proficiency (CALP). Cummins suggests that BICS are relatively easy to acquire, taking only 1 to 2 years, but that CALP is much more difficult, taking from 5 to 7 years (Cummins, 1981; Collier, 1987). Postponing content instruction while students develop more advanced academic language is impractical and ignores students' complex educational needs. Students need to be learn content information while they are acquiring CALP. Moreover, the need for more demanding language abilities suggests that a content instruction would be the most effective way for students to develop CALP.

However, Crandall (1992) claimed that it needs further research to evaluate the effectiveness of content-based instruction, specifying optimal conditions for various programmatic effects. Additionally, using of various instructional

strategies, texts, and assessment measures needs to be considered. Content-based teachers would know how to shelter their instruction, and language teachers need to learn how to integrate academic language and content better in their classroom.

Finally, the role of L1 is an important issue. Ovando (1998) believes that using of L1 and L2 can assists students understand the subject matter content deeply. However, finding the appropriate balance in instruction between the first and second language still is a big challenge.

II. IMPLEMENT CONTENT INSTRUCTION IN SCIENCE CLASSROOM

Over the last twenty years, researchers and practitioners have described ways to integrate language and content (Cantoni-Harvey 1987; Crandall 1987; Gibbons 1998), explored techniques and methodologies (Burkart and Sheppard 1998; Case 2000), and examined the learning processes that science requires (Chamot, 1995). To promote both language and science learning effectively, there are variety of models and learning strategies in content second language instructions.

Program models

Crandall (1994) reviewed eight content-area learning models, which are also suitable in science classroom. They are:

- Content-based language instruction,
- sheltered subject,
- matter teaching,
- theme-based,
- sheltered instruction,
- language across the curriculum,
- adjunct model,
- cognitive academic language learning approach (CALLA).

Among these approach, content-based language instruction and theme-based instruction, especially emphasis on learning content through language (Oxford, 2001). Both of these benefit from a diverse range of materials, textbooks, and technologies for the ESL or English Proficiency Limited (EFL) classroom. Theme-based, adjunct, and sheltered are three general models widespread today and they can be found in many innovative ESL and LEP textbooks (Scarcella & Oxford, 1992). In the adjunct model, language and content courses are taught separately but are carefully coordinated. In the sheltered model, the subject matter is taught in simplified English tailored to students' English proficiency level.

Learning strategies:

There are a variety of strategies and techniques used in content-centered second language learning. Fathma, Quinn, and Kessler (1992) integrate second-language acquisition with science content and identify the following strategies for use in classes:

- Promoting collaboration between teachers and among students.
- Modifying language.
- Increasing the relevancy of science lessons to students' everyday lives.
- Adapting science materials.
- Using language teaching techniques in presenting science concept. (p.4)

Chamot and O'Malley (1994) believe that learning strategies need to provide extra support for the negotiation of content area instruction in the second language. By developing the habit of using learning strategies, the students have transferable skills that will stay with them as they progress to higher levels of academic instruction in math and science. According to the language input rational of Krashen's, using strategies such as discovering learning, cooperative learning, can promote language input comprehensible to facility ESL students' understanding of second language (Krashen and Biber & Biber, 1988;Short, 1991). Simultaneously, they can extent vocabulary development, integration of reading and writing, and conception development.

Cooperative language learning

Kessler (1992) pointed out cooperative learning in the science classroom fosters a rich communicative environment for the hand-in-hand development of science and language). Cooperative learning is an excellent means of involving students with limited English proficiency (Cochran, 1989). Fillmore (1983) found that a relatively open class structure works only if students interact with each other. Language is acquired naturally as students listen to others and express themselves while working in a group. In groups, LEP/ELL students can learn how to work with others to achieve a common goal: to plan, discuss, compromise, question, and organize information. Science presents extensive opportunities for students' interaction. Laboratory work is a type of open classroom that provides enough structure and management to make conditions for second language development. It also provides language learners helpful variations for getting input. Peer cooperative work can potentially affects the amount of learning. When classrooms are organized so that ESL students have access to interactive settings, students can acquire both science and English simultaneously (De Avila, 1983).

However, Cohen and Anthony (1982) points out the negative influence in cooperative learning. Students, who are not full proficient in English, are perceived lower status. De Avia and Duncan (1984) agree with them. To reduce this

negative influence, De Avia and Duncan claimed that teacher should take account of status effects and they has got effective results in modifying status effects program-- Finding Out/ Descubrimien. This bilingual science program makes use of learning content in which children take turns at various assigned roles. This multiple-ability approach to peer interaction reduces negative status effects, allowing all students to experience the significant learning gains from group interactions.

• Inquiry-based learning

Steen (1991) believed that science should be taught as science is practiced by investigating and evaluating data. The purpose of using inquiry/discovery strategies in the science classroom is for students to find out science information through their own efforts. Through scientific inquiry, students develop learning processes inherent in thinking: observing, classifying, comparing, communicating, measuring, inferring, and predicting to develop the concept of science (Carrasqu éz, 2002). The hands-on experiments or discussion provide a rich environment for simultaneous cognitive and linguistic development (Crandall, 1987).

However, Carrasqu éz (2002) also mentioned that ESL students need guidance at the beginning to formulate complete thoughts in English and to express their questions and answers. Teachers should provide a variety of resources to support students' discovery activities. Another claim is that time must be built into practitioners' schedules if they are to engage in reflection, meet with colleagues, study the literature and research of the field, analyze data, and document classroom activity (Oxford, 1989).

III. SOME STUDIES IN CHINA

With the economic development and political policy reform in China, all kinds of English proficient people are needed urgently. In order to foster more and more bilingual learners, especially English as second language, China has implemented bilingual education programs after joining to the World Trade Organization (Huang Xiaoyan, 2002).

Content area instruction was taken into effect in some universities, such as Tsinghua University, Peking University and so on. Major courses such as information technology, biotechnology, new material technology, finance and law have been given in both Chinese and English. Five to ten percent of the total course has been taught in English. Except universities, a number of primary and secondary schools and even some kindergartens in Shanghai and Beijing have been taught in English. Content instruction not only improves the students' linguistic ability, but also improves their subject knowledge.

However, in China, there is no national curriculum, achievement standards and instruction material in bilingual education. Additionally, there are short of teachers who teach two different languages in subjects such as science, math, and social studies. All in all implementing a foreign language program requires careful planning, and teachers and administrators must consider the specific learning needs of students at different level (Short & Karen, 1991). Foreign language study can be an enriching experience. It is important to provide students with programs that are challenging, enjoyable, and suited to their specific educational needs.

IV. CONCLUSION

This article firstly introduced the conception of content ESL instruction. Then it explained the reasons why ESL and science learning need to use content instruction. In the following part, the article described the significance of integrating English and science through this kind of instruction. After discussing how to use it in classroom through instruction models and strategies, this literature review briefly gave some suggestions for implementing content instruction in bilingual education in China. Relating to economic and education environment in China, some suggestions are given to promote ESL instruction.

Science learning thrives in vigorous communities that help students make connections with issues of importance to them. Integrating the teaching of science with language learning through collaborative interaction can result in the active negotiation of science knowledge. In the inquiry-based process, students develop English vocabulary, integration of development of writing, reading, listening, and as well as science conception and cognitive benefits. However, there may be some limitations found in the above literature review which are waiting for some further research to consider and solve: The first one is that the detailed procedure of instruction needs to be discussed further. The second one is how to improve and evaluate LEP students' achievement in both language learning and scientific subject learning, and the third one is how to balance L1 and L2 in content instruction classroom.

REFERENCES

- [1] Bernhardt, E.B. & Kamil, M.L. (1998). Literacy instruction for non-native speakers of English. In M.F. Graves, C. Juel & B.B. Graves (eds.) *Teaching in the21st Century* (pp.432-475). Needham Heights, MA: Allyn and Bacon.
- [2] Brown, H. D. (1994). Principles of language learning and teaching (3rd ed.). Englewood Cliffs, NJ: Prentice Hall Regents.
- [3] Carrasquillo, L. A. & Rodr guez, V. (2002). Language Minority Students in the Mainstream Classroom. UK: Multilingual Matters Ltd.
- [4] Cecil, N. & Lauritzen, P. (1994). Literacy and the Arts for the Integrated Classroom. New York: Longman.
- [5] Chamot A, & J. O'Malley. (1994). The CALLA Handbook. Reading, Mass.: Addison-Wesley.

- [6] Chamot, A. U. (1995). Implementing the cognitive academic language learning approach: CALLA in Arlington, Virginia. *Bilingual Research Journal 19*(3): 761-67.
- [7] Cochran, C. (1989). Program information guide. National Clearinghouse for Bilingual Education.
- [8] Collier, V.P. (1987). Age and rate of acquisition of second language for academic purpose. TESOL Quarterly, 21, pp.617-641.
- [9] Collier, V. P. (1995). Acquiring a second language for school. Directions in Language & Education. Washington DC, National Clearinghouse for Bilingual Education.
- [10] Cohen, H.G. & Anthony, G. (1982). Expectation states theory and classroom learning. Paper presented at the American Educational Research Association annual convention, New York.
- [11] Cummins, J. (1979). Linguistic interdependence and educational development of bilingual children. *Review of Educational Research*. 49, pp.222-251.
- [12] Cummins, J. (1981). The role of primary language development in promoting educational success for language minority students. In *Schooling and language minority students: A theoretical framework*." Los Angeles: Evaluation, Dissemination, and Assessment Center.
- [13] Cummins, J. (1989). Empowering minority student. Sacramento, California Association for Bilingual Education.
- [14] Crandall, J. (Eds.). (1987). ESL through Content Area Instruction: Mathematics, science, social studies. Englewood Cliffs, NJ: Prentics Hall Regents.
- [15] Crandall, J. (1992). Content-centered learning in the United States. "Annual Review of Applied Linguistics," 13, pp.111-126.
- [16] De Avila, E. (1983). Bilingualism, cognitive function and language minority group membership. Unpublished manuscript. San Tafael, CA: Linguametrics Group.
- [17] De Avila, E., & Duncan, S. (1984). Finding out and describing to: Teacher's guide. San Tafael, CA: Linguametrics Group.
- [18] Dickinson, D.C. (1987). Oral language, literacy skills and response to literature. In J. R. Esquire (ed.) *The Dynamics of Language Learning* (pp.147-183). Urbana, IL: Clearinghouse on Teaching and Communication skills.
- [19] Dulay, H., & Burt, M., & Krashen, S. (1982). Language two. Oxford: Oxford University Press.
- [20] Fathman, A.K., Quinn, M.E. & Kessler, C. (1992). Teaching Science to English Learners, Grades 4-8. Washington, DC: National Clearinghouse for Bilingual Education.
- [21] Fillmore, L.W. (1983). The language learner as an individual: Implications of research on individual differences for the ESL teacher. In M. Clarke & J. Handscombe (Eds.) On TESOL' 82: Pacific perspectives on language learning and teaching. Washington, DC: Teachers of English to Speakers of Other Languages.
- [22] Genesee, F. (1987). Learning through two languages. New York: Basic Books.
- [23] Grabe, W. & Stoller, L. F. (1997). Content-based Instruction: Research Foundations. In M. A. Snow & D.M. Brinton (Eds.), Content-Based Classroom (pp.5-25).New York: Wesley Longman Publishing Company.
- [24] Kessler, C. and E. M. Quinn. (1987). SEL and Science Learning. ESL through content-area instruction: Mathematics, science, social studies SL and Science Learning, J. Crandall. Englewood Cliffd, NJ, Prentice-Hall Regents.
- [25] Kessler, C., & Quinn, M. E. (1982). Cognitive development in bilingual environments. In B. Hartford, A. Valdman & C. R. Foster (Eds.), *Issues in international bilingual education*. New York: Plenum Press.
- [26] Kessler, C., & Quinn, M. E. (1985). Positive effects of bilingualism on science problem-solving abilities. In J.E. Alatis & J.J. Staczek (Eds.), *Perspectives on bilingualism and bilingual education*. Washington, DC: Georgetown University Press.
- [27] Krashen, S. D. (1981). Second Language acquisition and second language learning. Oxford: Pergamon Press.
- [28] Krashen, S. D. (1982). Principles and practice in second language acquisition. Oxford: Pergamon Press.
- [29] Krashen, S. D. (1985). Inquiries & insights. Hayward, CA: Alemany Press.
- [30] Krashen, S. D. & Biber, D. (1988). On course: Bilingual education's success in California. Los Angeles: California Association for Bilingual Education.
- [31] Hudelson, S. & Serna, I. A. (1994). Beginning literacy in English in a whole language bilingual program. In A. D. Flurkey and R. J. Meyer (Eds.) Under the whole language umbrella: Many Cultures, Many Voices. Urbana, IL: National Council of teachers of English.
- [32] Mason, L. C. and H. R. Barba. (1992). "Equal Opportunity Science." The Science Teacher 59(5): pp.22-26.
- [33] Olivares, A. R. & Lemberger, N. (2002). Identifying and Applying the Communicative and the Constructivist Approaches to Facilitate Transfer of Knowledge in the Bilingual Classroom. *International journal of bilingual and education bilingualism*. 5(1). pp. 72-83.
- [34] Ovando. J. C. (1998). Mathematics and Science. In Ovando. J. C. & Collier. P. V. (Ed.), *Bilingual and ESL classrooms* (174-201). The United State: The McGraw-Hill Companies.
- [35] Ramirez, J. D. "Comparing Structured English Immersion and Bilingual Education: First Year Results of a National Study." American Journal of Education 95: pp.122-149.
- [36] Oxford, R. (2001). Integrated Skills in the ESL/EFL Classroom. ESL Magazine. Vol. 6, No. 1. pp. 58-63.
- [37] Oxford, R. (1989). The Role of Styles and Strategies in Second Language Learning. *ERIC Digest*. ERIC Clearinghouse on Languages and Linguistics Washington DC.
- [38] Quinn, M.E., & Kessler, C. (1986). Bilingual children's cognition and language in science learning. In J.J. Gallagher & G. Dawson (Eds.), *Science education & cultural environments in the Americas*, Washington, DC: National Science Teachers Association.
- [39] Sonw, M.A. (1993). Discipline-based foreign language teaching: Implications from ESL/EFL. In M. Krueger & F. Tyan (Eds.), Language and content: Discipline- and content-based approaches to language study (pp.57-82). Lexington, MA: D.C. Heath.
- [40] Sutman, F.N Allen, V.F. & Shoemaker, F. (1986). Learning English Through Science: A Guide to Collaboration for Science Teacher, English Teachers and Teachers of English as a Second Language. Washington, DC: National Science Teachers Association.
- [41] Saville, T. M. (1984). What really matters in second language learning for academic achievement. *TESOL Quarterly*, 18, pp.199-219.

- [42] Wesche, M. B. (1993). Discipline-based approaches to language study: Research issues and outcomes. In M. Krueger & F. Tyan (Eds.), *Language and content: Discipline- and content-based approaches to language study* (pp.37-56). Lexington, MA: D.C. Heath.
- [43] Srashen, S. D. (1981). Second language acquisition and second language learning. Oxford: Pergamon.
- [44] Srashen, S.D. (1982). Principles and practices in second language acquisition. Oxford: Pergamon.
- [45] Schumann, J. (1980). Affective factors and the problem of age in second language acquisition. In k. Croft (Eds.), *Readings in ESL* (2nd ed.). Cambridge, MA: Winthrop.
- [46] Scarcella, R., & Oxford, R. (1992). The tapestry of language learning: The individual in the communicative classroom. Boston: Heinle & Heinle.
- [47] Short, D. J. (1991). Integrating Language and Content Instruction: Strategies and Techniques. Washington, DC: national Clearing house for Bilingual Education.
- [48] Short, D. J. & Karen W. (1991). Implementing Middle School Foreign Language Programs. ERIC Digest. ERIC Clearinghouse on Languages and Linguistics Washington DC.
- [49] Steen, L. A. (1991). Reading for science literacy. Change 23(4), pp.11-19.
- [50] Tarey, R. (1988).ESL through Content Area Instruction. ERIC Clearin ghouse on Languages and Linguistics Washington DC.

Yingli Wang was born in Tangshan, China in 1981. She received her M.A. degree in English Education from Waikato University, New Zealand in 2006.

She is currently a lecturer in the School of Foreign Languages, Hebei United University, Hebei, China. Her research interests include English teaching and linguistics.