Curriculum and Material Development Using Content and Language Integrated Learning (CLIL) for Teaching Science in Junior High School

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Highlights
•The use of CLIL in teaching Science can support an effective learning.
•The use of CLIL can enhance students' communication skills and practical skills.

ABSTRACT: The use of Content and Language Integrated Learning (CLIL) has been effective to support learning. However, there are still few teachers that implement CLIL in their classroom. The curriculum and material development were made to support science teacher in implementing CLIL in which the integration of both content and language are highlighted. These were designed to enhance bilingual education program in Sekolah Alam Insan Mulia through CLIL. Specifically, these curriculum and material development were for 7th grade students. Using a curriculum and material development approach with 4Cs Framework for analysis, this study involves the design process of incorporating content with CLIL method intended to promote the learning process with high-quality material and learning methods. The process entailed analysing of the context and the curriculum materials, characterizing students' opportunities to learn effectively, and assessing students' learning outcomes. The finding of this study is the product of curriculum and material development using CLIL of a unit entitled interaction with ecosystem. The discussion related the implementation of assessment in CLIL and classroom language use is also presented in this article.

Keywords: CLIL, Curriculum and Material Development, Teaching Science

Introduction
Content and language integrated learning (CLIL) has gained popularity due to its potential in supporting an effective learning. CLIL was a learning concept used in Europe to represent bilingual education in 1990s (Coyle, 2007). This concept was not new since there were some countries that have implemented this program such as in Canada and Italia. As a result, CLIL has been interpreted in various ways by the scholars around the world. Marsh (2002) defined CLIL as a learning process which involves the use of foreign language in non-language subject. Non-language subject can be interpreted as civics, economics, science, and social science. CLIL is dual-focused concepts used for all education level to enhance students' understanding of the content through the use of an additional language (Dalton-Puffer, 2011; Ioannou-Georgiou, 2012; Mehisto et al., 2008).

CLIL was firstly generated before 1995, but there were still few teachers that implemented CLIL in Indonesia (Lee & Chang, 2008). Due to this reason, there has been many problematic issues in the practice of CLIL in Indonesia. First, as in Europe, the emergence of various interpretations of CLIL becomes the foremost problematic issue. According to a report,

many schools and local authorities in Indonesia interpret CLIL as a translation of the subjects' syllabus (Lee & Chang, 2008). Moreover, many schools contend that even in CLIL program, the emphasis toward the subject matter should always be prioritized to support students' comprehension toward the subjects' concepts. Second, referring to the curriculum used (in this case, 2013 curriculum), there is no specific guidance, clear learning outcomes, and materials for the schools which implement CLIL program. In other words, these schools have to independently struggle in constructing a curriculum in which the concepts of CLIL are well-integrated. This issue therefore gains my interest in creating a curriculum unit of a specific subject content in CLIL program.

These curriculum and material development are specifically designed to teach Science by applying CLIL concept in which the integration of both content and language is highlighted. The context chosen is a private junior high school in Surabaya called SMP Sekolah Alam Insan Mulia. Furthermore, the CLIL class which is chosen is the seventh grade. For the seventh-grade students, CLIL program of science runs two-hours every week. Additionally, students in this grade are mostly in their 12 or 13 years old. Overall, these students speak three languages; Javanese, Bahasa, and English. In every day communication, they mostly used Javanese and Bahasa. Meanwhile, in CLIL classroom, they are encouraged to use Bahasa and English. SMP Sekolah Alam Insan Mulia is an Islamic school, therefore, the seventh-grade students are homogeneous in terms of religion. However, diverse socio-economic backgrounds, different ability toward the schools' lessons, and different learning styles also belong to the nature of this context. Hence, careful consideration in developing this curriculum unit is therefore necessary.

The seventh-grade students of SMP Sekolah Alam Insan Mulia has specific nature that might be different from other contexts. First, most students in this grade graduated from primary schools which support bilingual education such as international primary school and private primary school. Most students are thereby familiar with the use of English in teaching learning process. Considering other students which did not graduate from bilingual schools, however, the classroom language use for the CLIL program in this context is 50:50. Second, students in this grade are heterogeneous in terms of learning style. To accommodate this issue, the activities and the way teacher explains the materials in this curriculum unit are varied. For instance, the use of power points, handouts, videos, and experiments. Third, every student in this grade might have different ability in understanding the materials which are explained by teacher. In this case, therefore, the teacher always engages the students in an active discussion to check students' understanding. Additionally, the teacher also conducts some group works to support students' learning process and maximise the potential of an effective learning.

This curriculum development will be divided into two sections. The first section contains a scope and sequence chart for Science in the context which has been mentioned above. In this scope and sequence chart, the 4Cs framework and theory of language of, for and through learning which are suggested by Coyle (2007) are integrated. The second section comprises a discussion about two issues in relation to the teaching science in CLIL program.

Method
This article is a curriculum and material development based on theory and empiric. First of all, the authors started with reviewing the previous literature about CLIL to have the same perceptions of CLIL and analysing the implementation of CLIL around the world. Using a curriculum and material development approach, this study involves the design process of incorporating content with CLIL method intended to promote the learning process with high-quality material and learning methods. The process entailed analysing of the context and the curriculum materials, characterizing students' opportunities to learn effectively, and assessing students' learning outcomes. The researcher used both theoretical and empirical perspectives in the process of design and development, completed with the anticipation of emerging issues in CLIL classroom such as assessment process and classroom language use. This curriculum and material development also contain the refinement process to enhance the learning process and give examples of the resulting features.

In the process of analysing the context and the curriculum, the researcher firstly analysed the problematic issues related to the implementation of CLIL in Indonesia. Then, correlating the use of CLIL to the curriculum used in SMP Sekolah Alam Insan Mulia. Because this curriculum and material development is specifically designed for this school, the researcher also analysed the students' background. Together with the science teacher, the researcher chose one of the units in the Science book. In this material and curriculum development, we decided to use a unit entitled "Interaction within Ecosystem" which is taught in semester 2. In designing this material and curriculum development, the researcher used 4Cs framework and theory of language of, for and through learning which are suggested by Coyle (2007).

Findings and Discussion
Findings

SCOPE AND SEQUENCE CHART

Unit of work	:	Interaction within ecosystem (Science)
Number of hours + total number of lessons	:	2 hours x 6 meetings
Class	:	7th Grade (Semester 2)

Prior knowledge of content and language :
Students have learnt about classification among living things (content).
Students have learnt about the structure of simple present tense (language).

Content goals for unit   :
3.7 Students are able to analyse interaction within ecosystem
3.7 Students are able to analyse the relation between the interaction of living things in their habitat and the effect on their population
4.7 Students are able to present their observation through a report about interaction within ecosystem

Language goals for unit   :
1. Students are able to use vocabularies related to the interaction within ecosystem
2. Students are able to use Simple Present Tense to describe the interaction within ecosystem
3. Students are able to use phrases of description like; There is / are……
4. Students are able to ask questions about the interaction within ecosystem

TOPIC

Meeting 1	:	Environmental interaction: Biotic and Abiotic components
Meeting 2	:	Ecosystem needs relationships
Meeting 3	:	Interaction between organism
Meeting 4	:	Food Chains and Food Webs
Meeting 5	:	Human-environment interaction in an ecosystem
Meeting 6	:	Summative Assessment about interaction within ecosystem

CONTENT FOCUS

Meeting 1   :   Introduction of topic, Explaining the definition of environment, concept of environment and its components (Biotic and Abiotic), Identifying and analysing biotic and abiotic components of ecosystem in school environment (done by the students)

Meeting 2   :   Interaction through feeding relationship, Living levels of organisation within ecosystem

Meeting 3   :   Competition, Predator-prey relationship, Symbiotic relationship (Mutualism, Commensalism, Parasitism)

Meeting 4   :   Definition and comparison between food chain and food web

Meeting 5   :   The effect of human interaction toward an ecosystem, An experiment related to topic (the difference of fish movement and breathe in fresh water, in water with soap, in water with detergent, and in water with mosquito repellent liquid).

Meeting 6   :   None (Summative Assessment)

LANGUAGE FOCUS

Meeting 1	**Language of Learning :** 1.Learning some key vocabularies related to biotic and abiotic component, such as: plants, animals, bacteria, fungi, sunlight, gas, water, and soil. 2.Using simple present tense to describe and explain about biotic and abiotic components. **Language for learning :** 1.Language for discussion with peers. 2.Language for asking and answering questions **Language through learning :** 1.Discussion skills

	2.Dictionary skills
Meeting 2	**Language of learning:** 1.Learning some vocabularies related to the topic, such as: organism, species, population, community. 2.Using simple present tense as language of describing, defining, and explaining. **Language for Learning:** 1.Language for giving reasons 2.Group work skills: doing the tasks using evidence **Language through Learning:** 1.Presenting evidence 2.Dictionary skills
Meeting 3	**Language of learning:** 1.Learning some vocabularies related to the topic such as interspecific competition, intraspecific competition, prey, host, and parasite. 2.Using simple present tense as language of describing, defining, and explaining. **Language for Learning:** 1. Language for research 2. Language for discussion with peers **Language through Learning:** 1.Dictionary skills 2. Discussion skills
Meeting 4	**Language of learning:** 1. Learning some vocabularies related to the topic, such as: food chain, food web, primary producers, and consumers. 2. Using simple present tense in presenting the group work. For example, A food web is a group of food chains. A food chain consists of just one path as animals find their food. eg: An eagle eats a snake, which has eaten a chicken, which has eaten a caterpillar, which has eaten leaves. A food web shows how many different paths of plants and animals are connected. **Language for Learning:** 1.Language for doing a presentation 2.Group work skills **Language through Learning:** 1. Using feedbacks 2.Presentation skills 3.Dictionary skills
Meeting 5	**Language of learning:**

	1.Learning some vocabularies related to the topic such as pollution, global warming, deforestation, and genetic modification. 2.Using some phrases in the report such as: There is…. / There are…. **Language for Learning:** 1.Language use for writing a report 2.Group work skills **Language through Learning:** 1.Using feedbacks 2.Dictionary skills
Meeting 6	**None**

ACTIVITIES
Meeting 1

- Teacher asks students some questions to know students' prior knowledge about the topic.
- Teacher introduces the topic by giving the students pictures to observe.
- Teacher explains the learning objectives which will be achieved by the students in the end of the lesson.
- Teacher explains the topic using a power point. *(The classroom languages use is English and Bahasa. Teacher uses English to explain the material and introduce some vocabularies such as those which are mentioned in language focus section. Meanwhile, teacher uses Bahasa to check students understanding about the teacher's explanation. In answering teacher's questions, students are allowed to speak in Bahasa. This aims to reduce students' anxiety and engage students in an active discussion).*
- Working in groups, students are asked to identify the ecosystems, and analyse biotic and abiotic components of ecosystems which exist at school. *(During this activity, the teacher allows the students to use Bahasa to communicate and discuss with their peers).*

Meeting 2

- Together with the students, teacher reviews the previous lesson about biotic and abiotic components. Moreover, teacher also gives feedback related to students' previous activities about biotic and abiotic components of ecosystems which exist at school.
- Teacher gives the students a handout about the topic. It aims to provide explanation, introduce vocabularies as well as provide some terms definitions related to the topic as those which are mentioned in language focus section.
- Together with the students, the teacher reviews about what has been written in the handout and give more explanation about the concept to avoid misinterpretation. (In reviewing the handout, the teacher mostly uses English. However, code-switching is also used to explain some difficult concepts and vocabularies).

- Working in group of four, students are given two tasks to be completed. First, students are given 12 pictures and asked to classify whether the pictures belong to organism, species, population, or community. The students are also asked to give reasons why they think the pictures belong to certain term by referring to the definitions as the evidence. Second, referring to the previous week observation about ecosystem in school, students are asked to mention which organisms belong to producers and consumers completed with the reasons. (The students discussion can be done in Bahasa, however, the students are encouraged to give the reasons in English).

Meeting 3

- Reviewing the previous lesson about ecosystem needs relationships.
- The teacher plays a video about the topic and engage the students in a discussion about the topic. (The video about the topic is in English. It aims to trigger the students using the terms in English. Meanwhile, Bahasa is used in the discussion as a stimulus to enhance an active discussion).
- Working in groups, students are asked to investigate three problems about interaction between organism and explain the effect of those problems toward a certain ecosystem.

Meeting 4

- Together with the students, teacher reviews the previous lesson about interaction between organism.
- Showing pictures, teacher encourage the students to hyothesize the concept of food chains and food web. Then, the teacher gives further explanation through power point to give clarity and avoid misinterpretation. (In explaining the material, the teacher mostly uses English. However, code-switching is also used to explain some difficult concepts and vocabularies).
- Working in groups, students are firstly asked to draw a food chain and a food web. Then, students make comparison between these two concepts. (The students discussion can be done in Bahasa, however, the students' worksheet of this task is in English).
- Working in groups, students are asked to present their group work. (Student are encouraged to use English especially in using specific terms such as food chain, food web, consumer, and producer).

Meeting 5
- Reviewing the previous lesson about food chains and food webs.
- Asking the students opinion about the effect of human interaction toward an ecosystem. Then, teacher gives further explanation about positive and negative impacts of human interaction toward an ecosystem.

- Working in groups of five, the students do an experiment about the topic. Then, they are asked to observe and analyse the experiment for 5, 10, and 15 minutes. At the end, they are asked to make a report of their observation and analysis.

Meeting 6
- Conducting a written assessment about the materials which have been learned from week 1 to week 5.

ASSESSMENT TASK(S)
Meeting 1 – Formative Assessment
1.Teacher asks students some questions to know students' prior knowledge about the topic.
2. During the group works, the teacher monitors the students' work by walking around the classroom. Teacher also takes note and checks students' understanding about what the teacher has explained.

Meeting 2 – Formative Assessment
1. During the group work, the teacher monitors the students while assessing the students using assessment rubric. It aims to check whether the concept is well-understood by the students.

Meeting 3 – Formative Assessment
1.Asking students questions in a discussion of the video.
2. Monitoring the group work and assessing the students' understanding through a checklist form.

Meeting 4 – Formative Assessment
1. During the group presentation, the teacher uses assessment rubric as the instrument to check whether the concept is well-understood by the students.
2.Other groups are asked to do peer assessment and give feedback to the presenter.

Meeting 5 – Formative Assessment
1. The teacher assesses the students' report to know the students' understanding about the topic.
2. The teacher writes feedback on the students' report. The feedbacks focus on students' understanding toward the content and language (the use of terms, simple present tense, and grammatical errors).

Meeting 6 – Summative Assessment
Summative Assessment
1. The teacher gives the students a written assessment. It aims to review the students' learning about the content and know the students' achievement within 5 weeks of teaching learning process. *[The written assessment consists of 10 open-ended questions. Five questions are written in Bahasa while another five questions are written in English. The questions which are written in English aims to scaffold the students' learning as well as reviews the use of English. However, supports before (explains what the tasks ask for) and during (allow use of a glossary or bilingual dictionary) assessment are also given by the teacher].*

Discussion

The CLIL framework known as 4Cs framework proposed by Coyle (2007) was used in this study. 4Cs framework is content, communication, cognition and culture. The following section contains the discussion of assessment and classroom language use in relation to the above curriculum unit. These two issues are chosen because they have always been a debate in CLIL program of SMP Sekolah Alam Insan Mulia as the chosen context. In terms of assessment, there have always been a confusion about what, how and when to assess students in CLIL program. Meanwhile, in classroom language use, different perspective regarding the portion of the language use is often problematic. Hence, further discussion will be provided below.

Assessment

The term 'assessment' is popular yet sometimes misinterpreted by some people even in educational practice. This statement is supported by Brown (2003) who said people often think that the term 'assessment' and 'test' are synonymous even though they are definitely not. Assessment is an ongoing process which covers much wider domain than a test (Brown, 2003). Test is only a prepared administrative procedure conducted in a specific time in which the learners are expected to show their peak performance (Brown, 2003). Assessment includes the activities which occur in the classroom such as when the students answer teachers' questions, give comments toward the materials, and use a new vocabulary or structure given by the teacher (Brown, 2003). Assessment can be defined as a tool to collect information about the students during the teaching learning process (Bailey, 1998). In other words, assessment is a regular practice embedded in the school system to know how the students is doing (Leal, 2016). Related to this statement, Cassady, Clarke, and Latham (2004) also contend that assessment can give some benefits to the students in relation to their learning process. Assessment does not only give information of what they have been achieved, but also helps students to make improvement toward their learning (Cassady, et al., 2004).

According to Bentley (2010), there are two main types of assessment; formative and summative assessment. Formative assessment is a regular assessment which helps teachers to understand how much and how well their learners are learning about the material (Bentley, 2010). For instance, when the teacher observes students' understanding through the students' collaborative work. Through this assessment, the teachers can give the students constructive feedback on their work. Regarding the aims, formative assessment is an assessment for learning (Bentley, 2010). Comparing to formative assessment which is often informal, summative assessment is a formal assessment which usually occur at the end of a unit or course (Bentley, 2010). It is used to review learning of subject content as well as to know students' achievement at a specific time (Bentley, 2010). Summative assessment is therefore an assessment of learning (Bentley, 2010). In CLIL context, teachers commonly use a range of assessment types. In some teaching learning process, teacher can use formative assessment to monitor the students' progress. Then, occasionally, teacher also needs to conduct summative assessment to know the students achievement within a specific time. The choice of which assessment type is used depends on the reason why the teachers assess the students (Bentley, 2010). Teachers need to know what they want to find out and what standard they will use to evaluate the students (Bentley, 2010). In other words, teacher should have clear goals and criteria of what students should achieve before assessing the students. Additionally, teachers are also suggested to provide high challenge and high support (Mariani, 1997). High challenge aims to scaffold the students toward their learning while high support aims to encourage and motivate the students before and during the assessment process.

Reflecting on the former explanation, this curriculum unit provides teachers an opportunity to use a range of assessment types. In other words, both formative and summative assessment are included in this curriculum unit. Within six weeks meetings, formative assessment is always done during the teaching learning process while summative test is done at the end of the unit (week 6). Formative assessment in this curriculum unit is done by asking questions to the students, taking notes, giving feedback and monitoring students during the group works. Furthermore, assessment rubric and a checklist form are also used as the formative assessment instrument to check students' understanding about the concepts. Summative assessment in this curriculum unit is done by giving the students a written test about the material from week 1 to week 5. The written test consists of 10 open-ended questions. Five questions are written in Bahasa while another five questions are written in English. Referring to Mariani (1997), the questions which are written in English provide high challenge for the students and aim to scaffold the students' learning. Those questions are also used to review the language focus in this CLIL program. However, high support before (explains what the tasks ask for) and during assessment (allow use of a glossary or bilingual dictionary) are also given by the teacher.

CLIL assessment can be challenging for some teachers in terms of what, how and when to assess. Moreover, the unique concept of CLIL can also add the complexity of CLIL assessment. Teachers might therefore wonder whether it should be content, language or both. Referring to Bentley (2010), CLIL assessment can focus on content and language separately or on integrating both content and language. Bentley (2010) also argues that CLIL assessment can also focus on communication skills, cognitive skills, practical skills, and learning to learn. At this point, it is also important to highlight that teachers have to put careful consideration at the standard they will use in assessing the students. For example, when the teachers teach the students in their non-native language, teachers need to be aware of students' language levels as well as students' learning needs. In the above curriculum unit, the CLIL assessment is done by integrating both content and language. For example, the students are asked to do an experiment then make a report of their experiment. Furthermore, it is also designed to cover communication skills (presenting skills), cognitive skills (analysis skills), practical skills (drawing, doing investigation and experiment), and learning to learn (focusing on the process not the result).

Classroom Language Use
As its name, classroom language use refers to the language(s) which are used in teaching learning process. The use of language in the classroom basically depends on the teachers, the subjects, classroom rules or school systems. For example, schools in Indonesia commonly have the same rules in terms of language use. In academic life, teachers, students, administrators, and stakeholders have to use Bahasa as a medium of communication. However, there is of course an exemption for language teaching (e.g. English) and for schools which have CLIL program. In most of CLIL program in Indonesia, the languages use are commonly Bahasa and English. The use of Bahasa in academic life has always been emphasized by the government. Meanwhile, the use of English in most of CLIL program is due to the status of English as an international language. The use of English, furthermore, is expected to give students' ability to access resources from other countries around the world and develop their knowledge in technology, art, science and so forth (Indonesian Ministry of Education and Culture, 2017). Furthermore, English has been increasingly used in most of important sectors in Indonesia such as in government, manufacturing field, and education field. It makes English becomes more prestigious and desirable language in CLIL program in Indonesia. Considering the aforementioned reasons, therefore, the classroom language use in CLIL program in SMP Sekolah Alam Insan Mulia is Bahasa and English.

Referring to Baker and Wright (2017), CLIL belongs to strong form of bilingual education which aims to support the concept of bilingualism and biliteracy. In other words, in terms of language use, the two languages chosen should be both affirmed. However, there are different perspectives about how the teachers should structure the language use in the classroom. In my perspective, it is necessary to firstly put some considerations regarding the nature of the context before structuring the language use. Discussing about the nature of the context, the seventh-grade students of SMP Sekolah Alam Insan Mulia are non-native speakers of English. Furthermore, English is not used as a medium of daily communication. Hence, in this context, the use of Bahasa as the students' own language is still necessary to support students' comprehension toward the concept. Moreover, according to Hall and Cook (2012), the use of students' own language enhances students to actively engage in the classroom activities as well as reduce their anxiety in their learning process. At this point, it is important to highlight that to maintain the effectiveness of language use in CLIL, the teacher is expected not to overuse the students' own language and encourage students to use English in teaching learning process.

Discussing about the portion of using English as one of the language use in this CLIL context, teachers need to be aware of their students' language proficiency. According to the research which was conducted by SMP Sekolah Alam Insan Mulia, most of the students in the seventh grade are in medium proficiency. Referring to the models of language use offered by Czura and Papaja (2013), I would argue that Model B type B is the most appropriate in this context. Model B refers to the use of 50 % target language (in this case, English) and 50% of students' own language (Bahasa). Type B refers to the focus of the program in which content and language are both emphasized. Hence, besides Model B Type B support CLIL as a strong form of bilingual education in terms of language use, this model is also relevant to the main concept of CLIL in which focus on both content and language.

Conclusion

This article is about developing curriculum and material using CLIL approach which focused on both content and language. CLIL has been believed as an effective approach to promote learning. CLIL has also been widely used around the world, but the use of CLIL in Indonesia is still limited. This curriculum and material development focused on a unit entitled *Interaction within Ecosystem*. It is carefully designed by considering the context, in this case SMP Sekolah Alam Insan Mulia. The curriculum and material development contain a detail description about the content and language focus, the activities in the classroom and the assessment tasks. Content focus is the science material that become the focus in the unit. While language focus contains language of learning, language for learning, and language through learning which means the improvement of language that teachers expected students to have. The activities and the assessment tasks are also mentioned in this curriculum and material development to become teachers' guidance in the implementation. Lastly, the discussion about assessment in CLIL and the classroom language use which often become topics that frequently asked by the teachers are also provided.

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