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## An application of digital chemistry telling (DCT) in the basic inorganic chemistry course to improve students' listening and speaking skills

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**Abstract:** *This study aims to design implementation strategies of DCT in the Basic Inorganic Chemistry course, develop an appropriate course to increase students' active participation, and develop an evaluation system capable of providing an integrated assessment (both the learning process and outcomes) in the course. This study was conducted in two cycles for one semester during the academic year of 2008/2009. The implementation applied the principles of classroom action research consisting of four stages, i.e. planning, action implementation, observation, and reflection. The data were analyzed by grouping them into categories. The findings were as follows. Qualitatively, the classroom observations showed an increasing active participation of students, both in making the DCT and in conducting discussions in English. Quantitatively, the results of the observations on the learning activities showed an average value of 4 (scale 1-5) for several aspects of DCT.*

**Keywords:** *DCT, basic inorganic chemistry, integrated assessment, students' participation, communicative academic English (CAE)*

### 1. Introduction

The need for a mastery of English as a second language (not as a foreign language) has been inevitable. This is because the globalization and free trade has begun. At the Asian regional level, free trade has even started a few years ago. As a result, there have been intense competitions between domestic and foreign labors.

The impact of the competition is also felt on the educational ground (Piaget, 1969; Shaffer, 1996; Howe, 1996). With the increasing number of international-like schools as well as international school networks which open their branches in Indonesia, the demand for teachers to master foreign languages, especially English, is getting higher.

As an educational institution to prepare human resources (educational labors), UNY

has anticipated the arrival of the global era and the free market. Reform and improvement of curriculum to address the market demand for labor have been done as well. With a wide mandate owned, UNY also serves to prepare future teachers and professional scientists. In this case, the challenge ahead, of course, is how to prepare graduates capable of competing in the global era. Currently, the most notable weakness is the lack of English mastery, which is a key in the global era. At the Department of Chemical Education, students' TOEFL Prediction score was very low, i.e. at an average of 370 (P3B UNY, 2005). Should there be no immediate and concrete actions to overcome this problem, it could certainly be very worrying. In that context, the existing English classes have not been enough for students. They need a condition where

English is taught not only in theory but is practiced as a daily habit, or at least is conditioned in the whole course.

Therefore, in this study a medium called "digital chemistry telling (DCT)" in the Basic Inorganic Chemistry course will be applied. This subject was chosen because of practical characteristics in the hope that students from the very beginning feel comfortable and easier to understand the academic language in English as the learning is contextual, concrete, and realistic. Theoretical literatures with poor illustration given to first year students are predicted to be complicated enough for them, thus the Basic Inorganic Chemistry course is a good start from which this study is developed.

The roles of a lecturer in DCT-based learning are: (1) as a facilitator in the communication process, (2) as a participant, and (3) as an observer and learner in the classroom. In line with this view, the use of the media in learning makes the assignments more communicative as they are created and developed based on communications. This will provide some benefits, among others: (a) Lecturers can give students the opportunity to actively interact with each other which in turn will be positive points for students; (b) Students can adopt more information (not only from the lecturers) as they get additional information from peer learners; and (c) Lecturers can make the course' circumstances better, in terms of the relaxed relationship between students and lecturer so that the academic atmosphere gets more conducive.

For this reason, it is highly necessary to apply DCT media in the form of hands-on and minds-on activities in the university (Harlen, 1992; Johnson, 2000; Lie, 2002). In this study, the media will be applied into the Basic Inorganic Chemistry course. With the application of this medium from the beginning, students are expected to have a strong foundation for developing bilingual skills of scientific communication that will

be useful for post-college education. This study seeks to improve the quality of content, input, process, and results in higher education so that both innovative courses and better learning outcomes will be implemented and attained systematically. The study also sought to build a practical partnership based on the principle of a sound collaboration between lecturers and students so that reciprocity of benefits between them may take place.

## 2. Method

### Research Setting

This study was conducted in two cycles for one semester of the Basic Inorganic Chemistry course, in the 2008/2009 academic year. Implementation methods followed the principles of classroom action research, which consist of four stages, namely planning, implementation, observation (which includes the recording of observations, interviews and recording) and reflection.

### Research Design

The subject of this research was a group of students majoring in Chemical Education, at FMIPA-UNY, especially those enrolled in the Teacher Education for International School program (RSBI) in the second semester of 2008/2009 academic year, taking the Basic Inorganic Chemistry course convened by the lecturers themselves. The total number of students was 48.

In line with the classroom action research paradigm, there were three main instruments to collect data: observation check list, interview schedule, and recorder.

Meanwhile, the data analysis technique used in this study was the grouping of certain categories that become the researcher's focus (Cohran, 1963; Miles and Huberman: 1984). In this case, the grouping included students' comments, responses, questions, suggestions or criticism to the whole course of the Basic Inorganic Chemistry.

### 3. Findings and Discussions

#### Pre-research

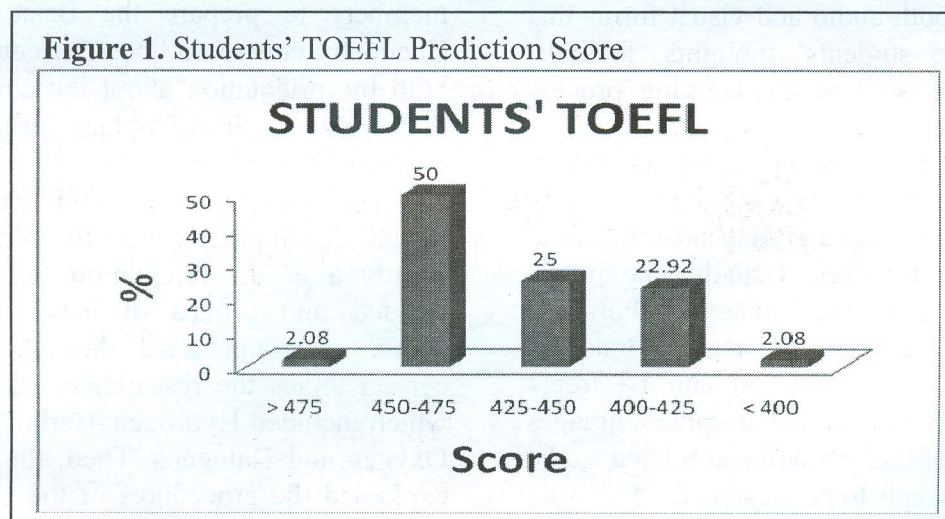
In a classroom action research paradigm, observations and discussions among the convening lecturers based on their experience in convening the Basic Inorganic Chemistry for years deserved an adequate semi-research. The findings of the semi-research (experience) showed that students who took Basic Inorganic Chemistry had a little interest and few learning activities. Among the causes was the monotonous lecture model due to the limited devices or media to promote a student-centered course.

In addition, students' enthusiasm to be actively involved in the learning process was quite low. It was observable from the low frequency of students' questions or responses to the topic discussed, let alone their initiative to enliven the course. The cause of this situation did not merely belong to students.

So far, the monologue technique (lecture method) has been more dominant than the dialogue (interactive discussion).

Students' academic potential was, in fact, strong enough. In general, they also liked an active learning although they did not have the initiative. Lecturers were expected to apply the student-centered method according to the students' ability. Language skills should be improved so that students' existing potential could develop. Language is also a means of communication to access the latest knowledge from global sources. The ability to speak English as an international language is a reasonable demand for academics with a global vision. One of the parameters that show English proficiency is the TOEFL Prediction score. Records showed that the TOEFL score of students who take the Basic Inorganic Chemistry is good enough. This can be seen in Figure 1.

Figure 1. Students' TOEFL Prediction Score



The research subjects were, at the outset, prepared to be teachers at international schools (RSBI). Therefore, the TOEFL Prediction score of this student group was relatively higher compared to that of other groups. From the above table, it is clear that approximately 52.08% of students in Basic Inorganic Chemistry class, i.e., the subject of

research, have achieved a TOEFL Prediction score of 450 or higher. This score indicated their good English proficiency at their third semester. As a comparison, one of the requirements to enroll into a graduate course (S2) at Indonesian universities is a TOEFL Prediction score of 450. However, students' English language proficiency needed to be

improved as for Indonesian English remains a foreign language. Proficiency in foreign language tends to decline if it is not practiced. If the students keep improving their English skills, in the next 2 years it would not be impossible for them to be Chemistry teachers capable of teaching their subject in English at the rapidly growing international schools.

### **The digital chemistry telling (DCT) media**

Audio visual media are media consisting of visual elements (texts and images) combined with sound. A broader definition of audio visual media includes a medium that can be captured by sights and hearing senses (Dahar, 1989; Honebein, 1996; Chang, 2001). The use of audio visual media allows a two-way communication between teachers and students in teaching and learning (Harlen, 1992; Johnson, 2000). Audio visual media in learning are intended as learning materials in both audio and visual forms that can stimulate students' thoughts, feelings, and attentions so that the learning process will be effective.

As a form of media, digital chemistry telling (DCT) combines visual aspects (text and images) and sound effects in the Chemistry learning processes. Usually, the media development uses the Audacity<sup>®</sup> Portable, while the presentation uses Windows<sup>®</sup> MovieMaker<sup>®</sup>. Visualization can be freely designed. For educational purposes, images can include natural phenomena related to the scientific concepts to be presented.

In a previous study, the researchers have conducted a study on communicative academic English (CAE). In the particular study, the skills of students attending the Basic Inorganic Chemistry were improved. The CAE model emphasizes academic communication in English, not in the sense that it is merely language skills; rather, it is aimed as academic skills in general. The function of the English language was as a medium. However, advanced skills in

English will support the communication of the participants studying chemistry. The better the communication is established, the better the cognitive skills students are expected to be. Results obtained from the study showed a good perception, in which 68.29% of participants were more motivated to learn and 65.85% of participants were interested to go on with this model.

The present study is the development of the previous research on CAE through the development of a media called digital chemistry telling (DCT) which can be used by students to improve their skills both in creating visual and audio media and in improving their English. Having finished preparing their media, each group of students presented their DCT medium and discussed it in the class.

This classroom action research was conducted in two cycles. The initial step included coordination with the research team members to prepare the Basic Inorganic Chemistry course outline. The course started with the orientation about the competencies that students must obtain in the Basic Inorganic Chemistry.

The first cycle of the study was the DCT media development. In the first session, shortly after the orientation, students were divided into groups of 9-10. The whole course was conducted through discussing certain topics the researchers had prepared, which included Hydrogen, Carbon, Nitrogen, Oxygen and Halogens. Then, the researcher explained the procedures of the DCT media making. In the second session, students brought in their scripts, pictures, documents and audio with them to be used in the making of DCT media, whereas the computer sets and microphones were prepared by the researchers. Thus, in the second session, the DCT media making began, and it was conducted for three sessions consecutively. During the DCT making process, students were encouraged to communicate in English, although sometimes there were some

speaking Indonesian. At this stage, students concentrated on the script for the DCT (writing skill) and on the bibliographical survey (reading skill). Up to this point, students had not improvised to develop their communication skills yet. Soon after the fourth session completed, the researchers reflected upon the process and discussed the implementation plan for the next sessions.

The fifth session of the course was the beginning of the second cycle. In this session, the group with the topic of Hydrogen presented their DCT. At this time, most students were still shy to respond in English. In the sixth session, however, when the topic of Carbon was presented, students started to ask questions or to give responses in English. This particular trend kept going up to the following sessions. Students found it enjoyable to conduct discussions in English. In this second cycle, the improvement of students' communication skills (particularly speaking) was just about to begin. So was their listening skill, which was mediated by both the DCT media and discussion among students. Here, the lecturers served as facilitators to ensure that the discussion did not go out of topic.

### Scientific skills and attitudes

In the application of the DCT model, English language skills become essential. From the data of the students' TOEFL prediction scores, the English language proficiency of students taking the RSBI Basic Inorganic Chemistry was sufficient.

In practice, the academic discussion and communication in English took place in an impressive progress. In an early presentation, students tried very hard and focused more on "how to say something" rather than on "how to discuss things". Language tensions also became the audience's concerns. In such a condition, the material discussed was a secondary concern. Anyway, active communication in English has not been a habit yet. In the next stage, the students seemed to be

adapted so that both parties (presenters and audience) could discuss the matter more lively. At the end of each session, the lecturers reviewed the discussion for reinforcement and correction.

From the discussions, the students' confidence to give presentations and to respond in English had started to emerge. Several language mistakes appeared in the discussion process. Those mistakes were taken not only as self improvement but also as part of their self-entertainment that enlivened the classroom atmosphere. Some notes in the process of discussion include:

a. Obstacles at the *opening, delivering, and closing*

Giving presentations in English has not been a habit yet, so that at opening, delivery, during the discussion, or closing the discussion, students still had to think about the words and phrases. This situation often put presenters speechless and the discussion stopped. To overcome the condition, Indonesian or body language to convey the meaning of the lost words was allowed.

b. Mispronounced words

Mistakes in pronunciation were frequent because English has been rarely used in their actual conversation, although English has been studied since junior high school levels (some might started even earlier). Students needed to get used to look up the dictionary and learn how words are pronounced correctly.

c. Mistakes in naming chemical compounds

Naming a chemical compound in Indonesian is usually by spelling out its chemical formula, such as NaOH, literally letter-by-letter. In English, however, naming the compound is usually by saying its name, *sodium hydroxide*. The same rule applies to H<sub>2</sub>O (*water*), CH<sub>3</sub>COOH (*acetic acid*). In naming chemical compounds, students often

spelled the formula in English rather than directly saying its proper name.

- d. Difficulties in describing chemical reactions or certain chemical processes

In describing chemical reactions or certain processes, conjunctions such as *from, to, then, results*, and so on, are frequently used. In everyday discussion in Indonesian, a speaker only needs to consider the substances and events. To give a presentation, presenters have to think about the correlation and look for appropriate conjunctions.

- e. Limited vocabulary

Lack of vocabulary is also an effect of the lack of good language practice. With the discussion, students had to search for the necessary vocabulary to convey their ideas by using monolingual English dictionaries.

- f. Misunderstanding chemical terms in English

Students often misunderstood some typical vocabularies of Chemistry in English. For example, some students regarded the English term *base* as the Indonesian *dasar* rather than *basa*.

- g. Mistakes in writing

Writing, especially in a foreign language, is not easy. More than just translating word-for-word, an author should also compose sentences correctly. Grammatical errors including the inaccurate use of singular-plural forms, adverb and adjective, tenses, *verb* and *be*, as well as noun forms are also found in most of students' writings.

From the material point of view, some positive outcome emerged out of this student-centered method. Let the lecturers choose carefully the topic to be discussed, and students will actively search the

literature themselves before writing their paper.

However, some deficiencies are observed from the discussion:

- a. The scope of discussion was developing so broad that it frequently went beyond the competency required for Basic Inorganic Chemistry.
- b. Students were passive on certain topics that they did not understand. It was different from the lecturers' presentation which pays attention to both easy and difficult parts proportionally.
- c. Students are less proactive in managing their task. For example, while working on translating an article, students translated only the paragraph belonging to them and had no curiosity to translate the whole article. As such, they would only get partial understanding, leaving out the whole contexts of the topics.

To overcome this, the lecturer controlled the whole process and provided a review at the end of each session. On such occasion, lecturer strengthened the discussion process by affirming things that had been addressed properly. On the other hand, lecturers also provided correction, in terms of both the materials (*content*) and the delivery of material and communication (*context*).

### Cognitive assessment

To enable students in the learning process and to increase their confidence in the course, structured tasks were given in the last fifteen minutes of each session. These assignments required students to seriously learn the material of the session, to actively get involved and to get prepared by reading the material in advance.

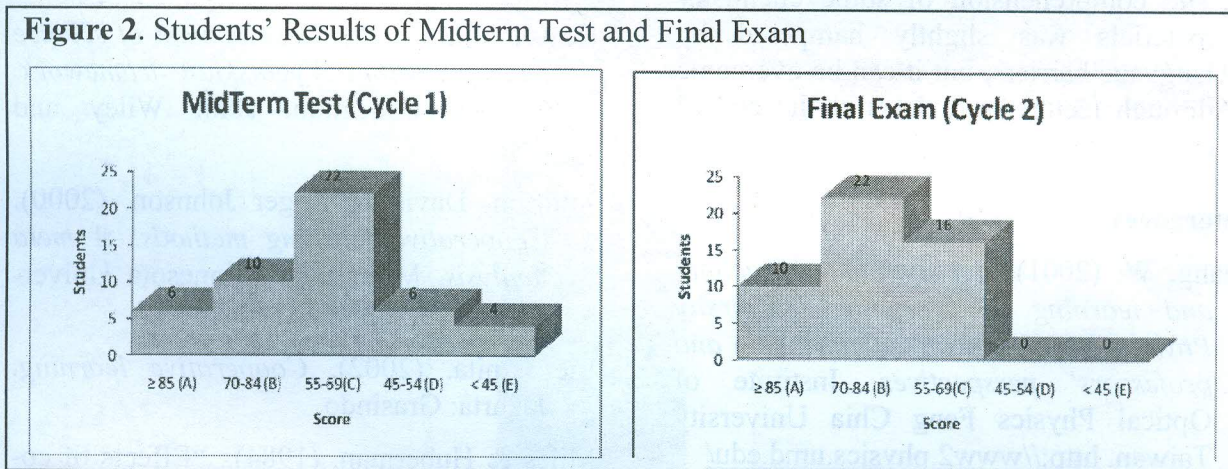
Having been thoroughly checked and provided with notes, comments, feedbacks and suggestions, students' works were then turned out. Depending on the time available,

some mistakes were discussed. Students were advised to revise their works.

At the end of each cycle, students were given an objective test, according to the

workload required in the basic competency. These tests corresponded to midterm test and final exam consecutively. The results are presented in Figure 2.

**Figure 2.** Students' Results of Midterm Test and Final Exam



From both figures, it seems that there is an increased cognitive value from the first to second cycle and the values are in normal distribution. This means that the use of English as a language of instruction does not make students' achievement decrease.

#### Evaluation of the DCT-based learning

At the end of the DCT implementation, an evaluation was conducted by asking each student to fill out an evaluation form. The evaluation results revealed that, for students, an active learning in English was not too difficult to apply and that this even led them to new motivation for learning. New atmosphere in the classroom also inspired them by reducing their boredom in a course dealing with largely abstract materials. Most students also expected to see similar (or more developed) methods in other courses. None of the students rejected the development of this method.

Among the free advices given by students include:

- a. Students expected a better socialization (it should be more early and more

detailed) to give them enough time for preparation.

- b. Students expected gradual stages in communication, in which it should be bilingual (Indonesian-English) and gradually moved toward a course fully conducted in English.
- c. There should be more time for lecturers to give reviews and remarks so that students might obtain a more comprehensive understanding.

#### 4. Conclusions

From the results of the study discussed above, some conclusions can be drawn:

- a. Research shows that learning by DCT media ended up in good results. Qualitatively, the observations showed an improved involvement of student, both in the DCT making process and in the Chemistry discussions in English.
- b. Quantitatively, the results of course evaluation showed an average value of 4 (scale 1-5) for a number of aspects considered, such as presentation activity, asking questions, recording, and para-

graph writing. A good perception was seen through the high percentage of students (72.01%) who felt more motivated to learn and 82.67% of participants want to go on with this model.

- c. The comprehension of some chemistry materials was slightly hampered by language barriers, but it can be overcome through lecturer's reviews at the end of each session.

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