PROMOTING EFL STUDENTS' INFERENTIAL READING SKILLS THROUGH COMPUTERIZED DYNAMIC ASSESSMENT

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Unlike static assessment, which relies on a student's assessment score as the primary indicator of an individual's abilities, dynamic assessment (DA) unifies instruction with assessment to provide learners with *mediation* to promote their hidden learning potential during assessment. Since many Freshman English classes in Taiwan are large in size, providing human-to-human mediation to each individual learner can be unrealistic. In this action research project, the Viewlet Quiz 3 software was used to develop a computerized dynamic assessment (C-DA) program that integrated mediation with assessment to support 68 Taiwanese college EFL learners' inferential reading skills. The C-DA program and the mediation design are presented in detail in this article. The participants' written reflections in their working portfolio are presented to show the effects of C-DA on promoting Taiwanese EFL college students' metacognitive reading strategies in making inferences. In addition, the participants' pre- and post-test scores were compared to determine whether the participants showed any significant progress after receiving computerized mediation in the C-DA program.

Keywords: Computerized Dynamic Assessment, Mediation, Metacognition, Reading

THE PRESENT STUDY

Since 2001, reforms in the Taiwanese national English education policy have resulted in some significant changes in the English education in Taiwan. One of these is that English teachers are required to use not only a static test, but multiple assessments to evaluate what students have learned and to help teachers reflect on the students' actual learning situation (Chan, 2006). Most traditional assessments are called "static assessment" because they tend to measure learners' actual development or what the learners' have already learned (Feuerstein, Rand, & Hoffman, 1979). One of the main criticisms made by critics of static assessment is that we cannot continue to assume that learners' performance is static. For example, Feuerstein, Feuerstein, and Falik (2010) explained that individuals are not born with a certain intelligence that remains fixed throughout life. Individuals have the potential to change and are modifiable if provided with an appropriately-mediated learning environment. However, according to Feuerstein et al. (2010), static assessment is constructed in a way that no learning will take place. It measures a learner's "crystallized intelligence," which does not allow the transfer of the learned principles to new situations, rather than treats one's intelligence as "fluid," which can be shaped (p. 90-91). Thus, in static assessment, the role of the assessor is to look for what is fixed, permanent, and unchanging in the learner. The solution to the problems in static assessment, based on L2 researchers such as Lantolf and Poehner (2004), is to adopt dynamic assessment (DA) where students are able to receive mediation that will help promote their potential learning.

The primary characteristic of dynamic assessment (DA) that differentiates it from other forms of formative assessment is the component of *mediation* in the assessment. In DA, some learning has to take place within the assessment. This means that the learners should receive feedback from the mediator during assessment: responses to the questions tested and clues to where errors were made. The examiner plays a crucial role as a mediator. His responsibility is to bring about change in the learner's cognition through providing constructive mediation in the learners' learning process. Therefore, DA is constructed to create an opportunity for interaction between the learners and the mediator(s) so that the mediator(s) can evaluate the learners' learning process as well as the quality of the mediation.

However, one major barrier many college-level EFL teachers face in Taiwan is the large number of

students. Providing one-on-one mediation to individual students has become a challenging and unmanageable task for many EFL teachers. The researcher in this action research project decided to take advantage of the technology available today and use it to design a computerized dynamic assessment (C-DA) program to overcome the time-constraint challenge many teachers face in their classrooms. The goal of the project was to promote her Taiwanese college EFL students' inferential reading ability. The researcher focused on the inferential reading ability because it is an important skill that involves multi-faceted reading skills. According to Harvey and Goudvis (2000), the inferential reading ability is a cognitively-demanding skill which requires learners to read between the lines and make educated guesses on certain outcomes, events, or actions based on their understanding of the reading materials. Therefore, an EFL student's ability in inferential reading not only reflects whether he understands the overall ideas of the reading materials, but also his own critical thinking skills.

BACKGROUND LITERATURE

Theoretical Concept

The central concept of the computerized dynamic assessment (C-DA) is grounded in Vygotsky's theoretical framework (1978). To challenge the appropriateness of using a static IQ score to predict a child's capabilities in succeeding at school, Vygotsky and his colleagues developed a dynamic assessment by providing the test-takers with meditational prompts during the testing procedures (van der Veer & Valsiner, 1991). They concluded that the children's reactions to the mediation were not the same, and different types of mediation benefitted children in different ways. They also claimed that while a static IQ test helped indicate the children's present level of ability, providing mediation to the test-takers during the assessment allowed teachers to determine the learners' assisted performance, which indicated their potential future IQ.

Vygotsky (1978) also introduced the concept of Zone of Proximal Development (ZPD), which emphasized that a learner should receive structured intervention from mediators that aimed at promoting his development. With the assistance of a mediator, a learner can move from his current level where he can't work independently to a level where he can accomplish the same task on his own. The focused intervention, which comes from a more mature counterpart, can be from a human, a cultural artifact, an object, or a tool. With the advancement of technology, Dixon-Krauss (1996) suggested the use of technology to realize Vygotsky's vision of designing lessons in a way that facilitates instruction that is slightly ahead of the learner's development. Crook (1991) also claimed that computers could act much like a human partner or classroom teacher within the ZPD, and technology makes the computerized tool pertinent to the mediation periods associated with internalization. Therefore, the C-DA program in the current project was designed based on the belief that when human mediators are not accessible, the social process necessary for development can be facilitated through computer assisted devices.

Metacognition and Reading Comprehension

Metacognition is defined as thinking about one's thoughts (Harris & Hodges, 1995). Perkins (1992) identified four types of readers based on four different levels of metacognitive knowledge the readers employ in their reading strategies. The four types of readers are: (1) tacit readers; (2) aware readers; (3) strategic readers; and (4) reflective readers. Tacit readers are not aware of how they think when they read; aware readers do not know how to fix their problems although they know that they do not comprehend the meaning from their reading materials. Strategic readers are those who are capable of using effective reading strategies and repairing meaning on their own when necessary. Reflective readers are able to reflect on the strategies they use in reading and can apply and revise the strategies flexibly in different contexts. Researchers such as Pressley and Afflerback (1995) found that high-skilled readers were able to use specific and appropriate metacognitive strategies before, during and after reading to help their comprehension of the texts they read. In Perkins' terms (1992), these types of readers would be

categorized as the strategic and reflective readers. Pressley and Afflerback as well as other researchers such as Block and Mangieri (2003) suggest that it is crucial for teachers to integrate metacognitive strategies in their literacy instruction to help the learners become independent and self-regulated readers. Therefore, the C-DA program consisted of mediation that was designed to improve the learners' metacognitive strategies, especially with the intention of training them to be strategic and reflective readers. One of the main purposes in the present study was exploring the effect of the C-DA program on the participants' metacognition.

Research Questions

The current action research was conducted to answer the following two research questions:

1. What are the effects of the C-DA program on promoting the participants' metacognition in their inferential reading skill?

2. Is there a difference in the participants' performance before and after the use of the C-DA program?

METHODOLOGY

Participants and Setting

The action research project was carried out at a university in Taiwan. The participants were 68 EFL college freshmen who were enrolled in a required two-semester course titled "Freshman English for Non-English Major Students" (FENEMS) taught by the researcher. FENEMS was held two hours weekly for eighteen weeks each semester. At the beginning of the semester, the participants were assigned to the FENEMS course by the university's General Education Department based on their scores in the English subject of the Taiwanese national college entrance exam. Their scores ranged from 38 to 90 out of 100, which placed their English proficiency levels from intermediate low to advanced. There were 33 males and 35 females participants whose ages ranged from 18 to 19 in this research project. The participants were from five different departments at the university, namely the Statistics Department, the Information Management Department, the Public Health Department, the Occupational Therapy Department, and the Respiratory Treatment Department. None of the participants had experienced computerized dynamic assessment (C-DA) prior to the current project. The C-DA program was implemented as a part of the curriculum in the FENEMS course, which took place in a computer lab at the university where each participant had his own computer and could get access to the Internet to work on the C-DA program individually.

Method Design and Procedure

The research method design took the form of a "sandwich" format (Sternberg and Grigorenko, 2002). This means that the participants took a traditional static test as a pre-test where no mediation was provided. Then, in the intervention phase, the computerized mediation was provided for the participants through the computerized dynamic assessment (C-DA) program. Afterward, each participant took a post-test. This design allowed the researcher to compare the participants' performance before and after the mediation intervention. Also, during the intervention phase, each participant was given time to record their reading strategies and reflections in their working portfolio.

The action research project lasted 10 weeks. In the first week, the participants took a pre-test created specifically for the current research project. The reading passages used for the pre-test were selected from previous years' TOEFL samples. Twelve reading passages were in the pre-test that consisted of 12 multiple-choice inferential reading questions. In the pre-test, the participants worked independently without receiving any mediation. The pre-test helped the researcher get a sense of the participants' current level in their English inferential reading skills. Based on the mistakes the participants made in their pre-test, the researcher designed a set of mediation for the C-DA program that would be used in the

mediational phase. The meditational phase lasted eight consecutive weeks, beginning from the second week. The mediation sessions were held once a week. During each weekly mediation session, the participants worked on three reading passages. Each reading passage involved an inferential question. In the tenth week, the participants took a post-test, in which 12 reading passages and inferential questions were designed in the same format as the pre-test. Since the passages used in the pre-test, mediation, and post-test stages were adapted from the TOEFL exam samples, which were designed and tested in advance by a team of professional language test-designers, their validity and reliability were believed to be highly acceptable.

There was no time limit for each C-DA session. The participants were allowed to work on the activities at their own pace during or after the class session. Although they were informed that they could continue working on the activities after class if they could not complete the task within the two-hour class time, all students were able to complete the C-DA sessions during class time throughout the current ten-week research project. Besides reading passages and answering questions posted on the C-DA program, for each mediated session, all participants were asked to write down their reflections on the mediation provided by the C-DA program, record their reading process and use of reading strategies, and supply concrete self-selected evidence of their growing/changing reading abilities. The participants were encouraged to do so during—not after—the mediated session when they were presented each slide. The reason was to allow actual documentation of one's reading process in the C-DA program to take place, rather than solely relying on introspective accounts of perceived strengths, weaknesses, and affective reactions to the C-DA program. Reflections anchored in concrete evidence of learning experiences recorded in the participants' working portfolio served as a benchmark for the participants to think about their metacognitive reading development and monitor their performance.

At the beginning of each session before the participants started working on the C-DA program, the researcher modeled how to record reflections and comments in the working portfolio. However, participants were not given any specific guidelines concerning what to write; the evidence to be submitted was controlled and selected by the participants themselves. They were also asked to explain why they thought the evidence they provided helped them learn the reading strategies. Since there were no fixed guidelines for the recording of their working portfolio, the participants were provided with unlimited freedom for self-reflection, critical analysis, and the discovery of new strategic orientations towards their L2 reading processes and development.

C-DA Mediation Designs

The researcher developed the C-DA program by using the user-friendly Viewlet Quiz 3 software to integrate mediation with assessment. The software uses Adobe Flash technology and allows educators to create dynamic and interactive programs that can be saved as executable files and accessed through a web browser on the Internet. The C-DA program created by the researcher also stored the students' responses and recorded the number of incorrect responses as well as the mediation that were activated by each student.

The C-DA program allowed the learners to interact with and respond to the preprogrammed computerized intervention. There were four levels of mediation in the C-DA procedure, and it progressed gradually from implicit to explicit. After a learner finished reading a passage, he would be asked an inferential question, followed by five multiple choices. He was asked to select one correct answer from the choices given. Each time a learner answered a question incorrectly, the computerized mediation would be presented to him in order of increasing explicitness. The computerized mediation ended automatically when the learners found the correct answer to the question. The maximum level of mediation each student received was four. Appendix A shows a flowchart of the arrangement of the mediation slides in the C-DA program. Also, the following website presents one of the C-DA activities the learners in the current project worked on: http://tinyurl.com/ch4ws8h.

The following section details the types of assistance each level of mediation provided for the learners.

Mediation Level 1

This level provides the most implicit mediation. The mediation focuses on explaining what inferential reading means. Then, the mediation involves asking a general question to guide the learners to find the main idea in the passage, which is an essential step prior to helping them to read between the lines. At this level, definitions of keywords in the passage as well as some common places where main ideas can be found are provided to help the learners identify the main idea.

Example: *To make inferences successfully, you need to read between the lines. This means that an inferential question cannot be answered by looking at the text itself. Instead, you will need to use the information stated in the passage to infer what is **not** stated. Your job is to make your best guess based on what you read. First, think about what the main idea of the passage is. The list below gives you the meanings of the keywords and places where you can possibly find the main ideas. Use the information to help you.*

Mediation Level 2

This level provides more explicit mediation than the one in Level 1. Hints are narrowed down to guide the learners to focus on certain paragraphs, or sentences, while looking for the correct answer. This more specific information is followed by an explanation of the overall meaning of the specific context.

Example: *Read the **third sentence through the last sentence** of the passage very carefully. The author is trying to point out something serious about the society at that time. **What is it?***

Mediation Level 3

This level provides very explicit mediation. Therefore, the mediation focuses on ONE sentence, phrase, or word. The explanation given at this level is very context-specific, instead of emphasizing the overall meaning of the entire passage or specific paragraphs/sentences. The goal is to pinpoint for the learners how the specific information can lead to the correct answer.

Example: *Pay attention to the **second sentence**. The author said two things "bore little relation." So, ask yourself: according to the author, what are the two things that were not related to each other? Since these two things were not related, it caused some serious societal problems. Think about it, and then answer the inferential question.*

Mediation Level 4

At this level the correct answer is provided and then is followed by a step-by-step explanation. When a learner arrives at this stage, it usually shows that he is still far from fully mastering the reading strategy required to understand the concept tested. Thus, this stage focuses on explaining "how" the answer is obtained so that the learner can follow the instructions to justify the correct answer.

Example: *The word "critical" in the 5th sentence gives out a sense of urgency. The author used this word to express how serious the air pollution problem is. Although she did not say it directly in the passage, she was implying that the problem needed to be solved urgently because of its critical condition.*

RESULTS

Two types of data were collected: (1) the participants' written reflections in their working portfolio, and (2) the p value based on a paired samples t-test. The participants' working portfolio was collected to answer the first research question, investigating the effects of the C-DA program on promoting the participants' metacognition in their inferential reading ability. The p value was calculated to determine whether there was a statistically significant difference in the participants' performance before and after the use of the C-DA program.

Baker and Brown (2002) stated that we should not exclusively rely on a reader's self-report techniques,

since research has found that sometimes one is less able to be introspective about one's cognitive knowledge than one would like. Thus, IBM SPSS Statistics 19 was used to run the paired samples *t*-test to determine whether the difference between the pre- and post-test scores was significant as a result of the computerized mediation. The result shown in Table 1 indicates that there was a significant difference between the pre-test and post-test scores, *t* (67) = -2.70, *p* = 0.009. This means that the participants scored significantly higher on the post-test (*M* = 7.28, *SD* = 3.00) than on the pre-test (*M* = 6.04, *SD* = 3.00) in their inferential reading skill after the computerized mediation.

Table 1. *Paired Samples* T-*Test*

	Mean	*SD*	95% CI		*t*	*df*	*p***
			Lower	Upper			
Pretest	6.04	3.00					
Posttest	7.28	3.00					
Pretest-Posttest Comparison	-1.24	3.78	-2.15	-.32	-2.70	67	.009

*Note. **p* <0.05; CI = confidence interval.

The qualitative data, which was based on the participant's self-reflection in their working portfolio, generated rich information showing their metacognition (the process of thinking about thinking) in their reading processes. The participants were encouraged to use their L1, Chinese, to write in their working portfolio so that they could easily express themselves clearly and in depth. Their writing was then translated into English and analyzed. According to Farris, Fuhler, and Walther (2004), one's awareness of one's own reading strategies is essential for reading success. Appendix B shows several essential characteristics of metacognition that emerged from the learners' responses in their working portfolio. These characteristics indicated that the computerized mediated assistance helped the participants become consciously aware of their metacognition and actively monitor and regulate their reading process.

REFLECTION

This action research enlightened the researcher/instructor in several essential ways. First, computerized dynamic assessment (C-DA) is a powerful tool to help her understand her students' potential in learning to read in English by examining their reaction to different types of mediation. The number of attempts the participants made and the corresponding answers they chose helped the researcher determine which types of mediation worked and which did not. The results generated in the C-DA program then helped her modify and fine-tune mediations to accommodate the learner's needs in one-on-one human interactions. For example, when one participant, while working on the C-DA program activities, repeatedly arrived at Mediation Level 3 (as described in the above section "C-DA Mediation Designs") before being able to provide the correct answer, it indicated that he needed more elaborate mediation at this level than what was provided originally in the C-DA program. In this case, the learner would likely need extra help from the teacher on a one-on-one basis. When the teacher, who served as a mediator, worked with this particular learner, she would observe closely what was lacking in the Level 3 mediation for this learner, and then modify it by adding a more explicit, more powerful, and ultimately more understandable intervention based on every interaction between herself and the learner. As a result, the information generated from the C-DA program became a valuable resource for the teacher to create an effective one-on-one mediated learning environment that meets individual learners' needs. Secondly, the C-DA program is not merely an assessment tool but also an effective tool to teach the learners useful reading strategies through the test. The participants were given an optimal amount of assistance based on their individual needs when the mediation was presented in a gradual progression from implicit to explicit design.

Furthermore, the participants benefitted greatly from the C-DA program where instruction and assessment were unified into a single activity. Based on the four types of readers identified by Perkins (1992), it is noteworthy that many of the participants in the present action research demonstrated rather high levels of metacognitive knowledge in their reading strategies. The C-DA program helped the participants move beyond merely answering the questions in the assessment and transcend into what Perkins called "strategic" and "reflective" readers. As shown in the evidence listed in Appendix B, the participants were capable of using effective reading strategies and repairing meaning on their own when necessary. They also demonstrated profound awareness of their reading behaviors. In addition, their effective metacognitive strategies increased their meaning construction, their monitoring of text, and their ability to evaluate their own performance. During the C-DA process, the participants became strategic and reflective readers who are aware of knowledge, procedures, and controls of their reading processes.

The C-DA program has also met the researcher's teaching needs very well. First, it does not have to be restricted to the classroom only. Instead, it can be used at home or outside the classroom. Since the procedures can be posted on the Internet, burned onto CDs, or stored on portable flash drives, they can be implemented anywhere and at the students' convenience as long as they can get access to a computer. The C-DA program thus places the classroom teacher in the role of a guide or facilitator, who intervenes only as necessary. Secondly, the C-DA program can also be simultaneously administered to large numbers of learners; individuals may be re-assessed as frequently as needed; and reports of learners' performances can be automatically generated. It allows the researcher to make good use of computer technology as a mediator to help support her students' learning process in and outside the classroom more efficiently.

LIMITATIONS, RECOMMENDATIONS, AND CONCLUSION

The main limitation of this action research is its within-group design. It focused on one targeted group of learners' pre- and post-test performance by providing the mediation in the treatment phase. The weakness of the within-group design is that it could not determine with absolute confidence whether the improvement was caused by frequent practices or indeed the result of the C-DA program. Thus, it is recommended that future studies take another perspective by designing a between-group design, which would compare a control group and an experimental group, to alleviate the potential factor of frequent practice that might influence the results.

To conclude, the C-DA program is a breakthrough in the L2 language assessment field because it integrates instruction with assessment. It allowed the participants to interact with a human-like "more competent other" in the C-DA program. When the mediation in the C-DA program became a tool that acted as a more competent peer, it allowed for the internalization of information, which in turn helped promote learners' potential development and assess the learners' reading levels in the process of learning.

APPENDIX A. Flow chart for inferential questions
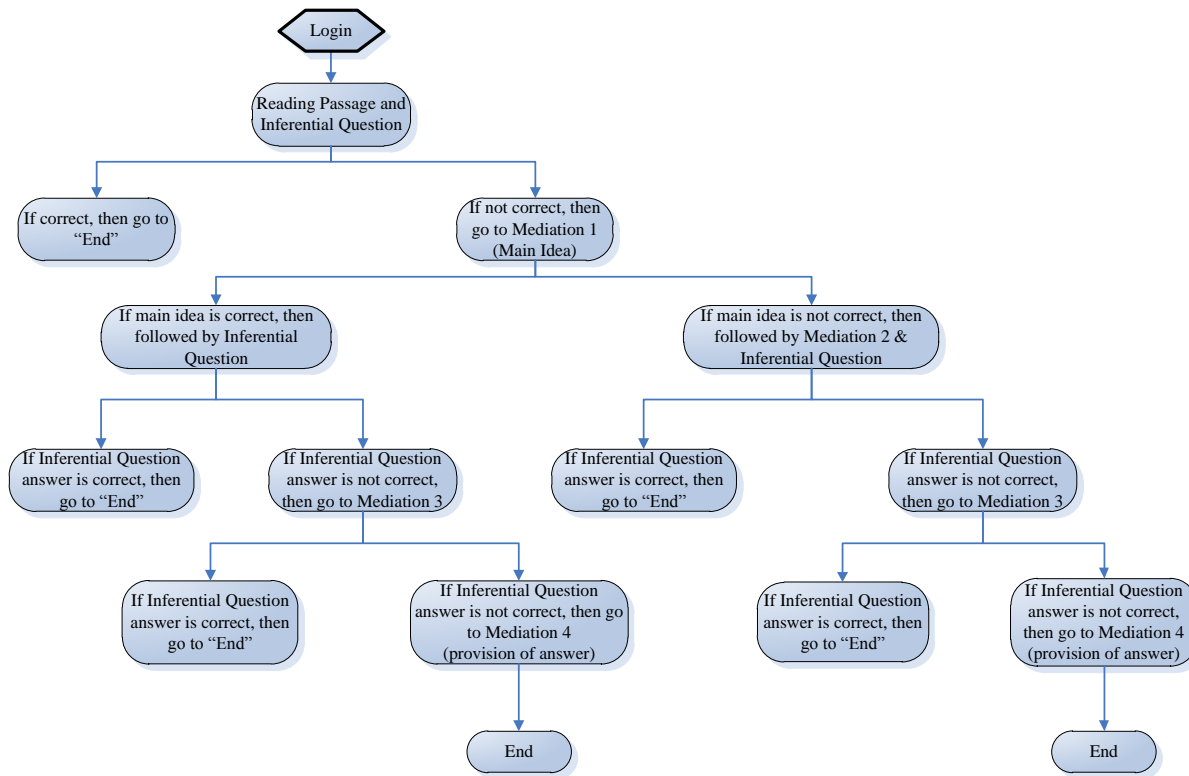
APPENDIX B. Metacognition Characteristics

1. Activating prior knowledge and utilizing self-correction behaviors

The participants responded that they used their prior knowledge to help comprehend the reading. Meanwhile, they also learned new knowledge from the instruction given in the computerized mediation and self-corrected their misconceptions.

Examples:

This activity is very helpful. I learned that I had mistaken 'conclusion' for 'main idea' in the past until the hints pointed out what these terms are exactly. I made mistakes in the past couple of weeks because I couldn't tell the difference between the two terms. Now I understand the difference and it helps me comprehend the passage more easily.

At first sight, I thought I got the overall message in the first (introduction) paragraph. But then I noticed there were a few points that kept popping up in the passage. So, I began to read these points closely. I then realized that the author discussed his main views in the second and third paragraphs, where the overall main points of the passage are. I learned that sometimes main ideas can be stated somewhere else, not just in the introductory paragraph.

2. Relating text-to-self and text-to-world strategies

The participants reported that they related their personal experience, or what they knew about the world to what they were reading to help themselves comprehend meaning.

>   Examples:

>   (Text-to-Self): At the beginning I didn't know what the author inferred about college students' lives. But after reading the examples, I found that college students in the passage are like us, who always have much work to do. So, I chose the answer "College students have many responsibilities." I am right!

>   (Text-to-World): The hint asks me to think about if women in the 19th century did the activities stated in the passage on their own, or if they were forced to do so. When I read this hint, I compared what happened back then and what is happening in the modern days. I then got a better idea about the differences between the lives of women in different generations.

3. Selecting and executing appropriate strategies

The participants were able to explain the necessary cognitive strategies to process texts, and why they executed these strategies.

>   Examples:

>   The question asks 'how' the animals molt, so I need to find the information about the 'methods' they use to molt.

>   When the hint asked me what the author was comparing in the passage, I jotted down the notes "visible" and "invisible." But my answer was wrong. I think my problem is that I tried to guess based on my personal views, not from the author's perspectives. Then, I knew that I probably should focus on all the keywords that tell the differences between the two types of arts. The example about Beethoven's music gave me a clearer idea. The author was actually showing the arts that can and can't be kept permanently.

>   I recorded and underlined the keywords for each paragraph. E.g. The first paragraph is about what permanent magnets are. The second paragraph is about how to make permanent magnets. The third paragraph is about how to make temporary magnets. The fourth is about how to make ceramic magnets. The last paragraph is about how to make electromagnets. I looked at all the parts I underlined, and then I know the author is trying to show how magnets in general are made. His purpose is not to show us something about a particular type of magnet.

4. Being aware of one's own poor reading habits

With the help of computerized mediation, the participants reflected on their poor reading habits that needed to be corrected.

>   Examples:

>   The first and second hints told me my answers were wrong. It helped me realize that I made mistakes in the first and second attempts because I read too fast and was too careless.

After reading the instructions given, I learned that very often I read too much into what I read. I could have answered the question correctly the first time.

The computerized activities helped me change my bad habits in reading. I got caught up by trying to understand every sentence when I read. The instruction guided me to focus on the main points. I spent too much time reading sentences that are just examples or details.

5. Evaluating one's own changes in reading as a result of the C-DA program

The participants self-evaluated the changes or progress in their reading processes brought on by the C-DA program.

Examples:

This activity really gives me more confidence and makes me feel that I can do better in reading. This way of learning English is really special and great. The tests we had in the past never gave us a second chance to check or think about our answers. With this type of activity, I can face my reading problems and am given opportunities to discover and analyze the problems. This is the first time I did a test not just for "scores," but for the sake of gaining "real knowledge."

I find the inferential questions very challenging. More importantly, I now know that I can't use the strategies I usually used in the past to find the answer. The answer is not directly written in the passage. Now I have to understand the main idea, and then think "critically". At the beginning it was very difficult because I was not used to it, but now I feel that it is quite fun sometimes because the answer is not straight-forward. It is like a guessing game. I think I am getting better now in reading the author's mind after I have practiced this activity so many times.

At the beginning when I did this activity, I was confused because I thought it was just a typical test. But then it gave me one instruction after another to help me get the correct answer each time. I couldn't believe that a test could be designed this way. This approach is very innovative and helpful to me. I see myself improve a lot in my reading!

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