

The Effect of Using Different Multi Modal Representations within Writing to Learn Activities on Learning Force and Motion Unit at the Middle School Setting

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Received: 25.05.2009 **Revised:** 04.05.2010 **Accepted:** 17.05.2010

The original language of the article is Turkish (v.7, n.4, December 2010, pp.113-127)

Key Words: Writing-to-Learn; Science Literacy; Multimodal Representation; Elementary Science Education.

SYNOPSIS

INTRODUCTION

Conventional writing strategies tend to support copying the information rather than re/representation of the information (Gunel, Hand, & Prain, 2007). However, it was stressed that writing activities should be adapted to science courses in such a way to help students to understand fundamental ideas of science and the value of writing in science (Holiday, Yore, & Alverman, 1994). Since this activity and writing awareness include and require internal negotiation of the students about science, technology and environmental issues and the interaction of the students with different levels of the society, the writing activity becomes different from conventional forms of writing (Yore, Hand, & Prain, 2002).

Prain and Hand (1996) devised a framework for the use of writing to learn in science. This framework provides opportunity to students to think deeply and express their ideas of science through use of writing. Aligned with the research findings in their theoretical framework, Prain and Hand concluded that in writing to learn activities in the area of science, writing should include five critical elements. These elements include writing objectives, writing types, the audience, subject matter containing concept clusters and method of text production (Hand & Prain, 2002). Critical combination of those elements can yield



meaningful science learning. Further, they argued that language especially writing has an essential role in doing science as well as learning science.

Norris and Phillips (2003) reported that language has two main roles in science literacy. The first role is that reading and writing are not only simple tools providing communication and storage of information in science. As the fundamental components of science, reading and writing have an integrative role. These structures are among the primary components that form the whole. The second view about literacy is the fundamental view of scientific literacy. This fundamental view requires understanding, interpreting, analyzing and criticizing a the whole that makes science. Lemke (2004) reported that “scientific literacy does not mean understanding scientific phenomenon and concepts. Instead, it means the ability of forming collective meaning with visual representations, mathematical relationships, manual or technical operations and verbal concepts” (p.38). Hand, Gunel and Ulu (2009) enhanced this scientific literacy view with different modes of representation. Since modes of representation are not directly understood like reading and writing but are integrated parts of reading and writing, it is necessary to understand function of the modes. In other words, science is not only the perception of the written part of the text. Literature includes a limited number of studies on the use of multi modal representation within writing to learn activities.

PURPOSE OF THE STUDY

The purpose of the present study is to investigate the effect of embedding multi modal representations within writing to learn activities on the unit based science academic achievement of primary education 6th grade students. In this context, the following questions were investigated with this study:

1. Is there a significant difference between the students who use only textual mode of representation and the students who use any mode of representation in terms of the unit based academic achievement?
2. Is there a significant difference between the students who have to use a certain mode of representation and the students who use any mode of representation in terms of the unit based academic achievement?
3. Is there a significant difference between the students who use only textual mode of representation and the students who have to use a certain mode of representation with textual mode of representation in terms of the unit based academic achievement?

METHODOLOGY

A quasi-experimental research method was used in this study. The sampling of the study consisted of 74 sixth grade (4 classes) students enrolled in a public school in Erzurum province of Turkey. The study was conducted in the Science and Technology course that is a 4-credit per-week course. At the beginning of the unit, the students were administered a pre-test about the unit “Force and Motion”. 6th grade students in 4 different classes all studied the unit (force and motion) with the same lecturer using the same method, strategy and materials, and spending equal time on task. Upon completion of the unit, those 4 classes were selected into 4 random implementation groups. The first treatment group (class A) wrote a letter to 5th grade students including only text (other modes are not allowed) for the representation (only text); the second treatment group wrote a letter to 5th grade students including text and any other mode(s) of representation (any one or combination of picture, graphic, and mathematical modes of representation) (text + any mode); the third treatment group (class C) wrote a letter to 5th grade students including text and graphical modal representation (text + graphic); the

fourth treatment group (class D) wrote a letter to 5th grade students including text and mathematical representation (text + mathematics). At the end of the unit, prior to writing activity all groups were given information and instructions about writing a letter and mode of representation by the researcher for 2 hours. Following this stage of preparation, the students prepared and handed in their letters in one week. The assignment prepared by 6th grade students were evaluated by 5th grade students under the control of Science and Technology teacher in a public school in the same school district. 5th grade students evaluated the letters according to a 4-item scale (weak to very good) in terms of certain criteria such as explanation of the topic, effective use of modes, and appropriateness of the writing to the audience. 5th grade students then marked their evaluations on a rubric and attached it to the letter. Prior to the evaluation, 5th grade students were informed about “Force and Motion” unit and about the ideas they should pay attention in their evaluations. After the evaluation, the letters were handed back to 6th grade students with the evaluations rubrics. The students were asked to make revisions in their letters according to the evaluations if they feel to.

Under the overarching theme of “Force and Motion”, the students wrote four different letters about force unit. Two of those letters were about “Force”; two were about “speed/acceleration” subtopics. For each letter the same evaluation and feedback procedure, as described above, were followed Post-test was implemented two weeks after the last letter was handed in. The posttest consisted of a total of 22 questions, 16 of which were multiple-choice, 6 of which were open-ended questions. The test was used as pre-test and post-test. Semi-structured interviews were conducted upon implementation of the post-test. Pre-test and post-test data were analyzed using One Way Analysis of Variance (One Way ANOVA).

FINDINGS

a) Pre-Test Findings

Analysis of the pre-test findings indicated that there was no statistical difference among the groups $p < 0.05$ in terms of multiple choice questions total, conceptual questions total, and total test scores. The One Way ANOVA results were as followed; open-ended questions total was $F(3, 68) = 0.525$, $p = 0.667$, multiple choice questions total was $F(3, 70) = 0.926$, $p = 0.433$, total test score was $F(3, 70) = 0.904$, $p = 0.443$.

b) Post-test Findings

Analysis of the post-test indicated that there were no statistical difference among the groups in terms of multiple-choice questions total $F(3, 65) = 1.785$, $p = 0.159$. However there was a significant difference among the groups on conceptual questions total $F(3, 66) = 6.972$, $p = 0.05$ and total test scores $F(3, 66) = 4.532$, $p = 0.006$. In order to investigate initial group difference at significance the level of $p < 0.05$ LSD among Post-Hoc test was used. The analysis of the post-test conceptual questions yielded there were significant differences among 3rd group (text + graphic), 1st group (only text) and 2nd group (text + any) in favor of the 3rd group. Further similar difference appeared among 4th group (text + mathematics), 1st group and 2nd group in favor of the 4th group. When the post-test total scores were analyzed there were several significant mean differences obtained among the groups. First, there were significant difference among the 3rd group, 1st group and 2nd group in favor of the 3rd group; and there were significant difference among 4th group, 1st group and 2nd group in favor of the 4th group. Table 1 shows the distribution of mean scores (X) and standard deviations (SD) on post-test scores by the groups.

Table 2. Distribution of post-test scores on multiple choice, conceptual, and total test questions

Groups	N	Multiple Choice Questions Total		Conceptual Questions Total		Total test Questions	
		X	SD	X	SD	X	SD
1 st group	18	26.00	8.296	19.44	15.309	46.00	21.936
2 nd group	15	22.40	8.919	20.40	17.037	43.47	23.679
3 rd group	20	28.20	8.050	35.20	19.557	63.40	26.156
4 th group	17	27.56	5.501	42.88	19.329	68.59	24.416

DISCUSSION and RESULT

The purpose of the present study was not to compare writing to learn with conventional writing or summary activities, instead it was focused on effect of embedding multi modal representation within the writing to learn activities. In this context, it is important to note that writing activities constructed around the idea of “writing to learn” prepared by the students contributed to learning science. Using regression analysis, Gunel, Hand and McDermott (2009) found that writing to learn had around 30% effect on biology-based final test performances of high school students. Aside from the learning enhancement with writing, this study compared the particular effect of using/embedding modes within the writing activities.

Post-test analyses indicated that there was no statistically significant difference between the students who only used text and the students who used any mode of representation. This has important implication. As argued by Airey and Linder (2009), multimodal representations are not sufficient for the students who simply use or try something in disciplinary dimension, instead, the students need to use and practice the disciplinary discourse to form their own understanding. From this aspect, the students who used any mode of representation, without deeper understanding of the mode(s), might have not developed fundamental understanding of the function and role of modes. Such claim in some extent supported with text only group results. That is, limiting students to not use any mode other than the text and not limiting them to use any particular mode(s) makes no difference in terms of students content understanding. One would argue that when students were not limited, they use multi modal representations without integrating them to each other. However, in order to support such an affirmation there is a need for research studies where the integration level of the modes investigated with limitations considered.

The second research question investigated in this study was “Is there a significant difference between the students who have to use a certain mode of representation and the students who use any mode of representation in terms of unit based academic achievement?” According to post-test analyses, it can be stated that unit based academic achievement of the students who have to use a certain mode of representation with textual mode of representation (text + mathematics and text + graphic) were higher than those who used any mode of representation. This result is consistent with previous studies. Organizing and representing ideas about science by means of multimodal model representations are beneficial for students to develop deeper science understanding (McDermott & Hand, 2009). Hand et al. (2009) emphasized that multimodal representations in a text has a critical importance in contributing to the comprehension of the subject. When encouraged to use two different modes of representation (text + graphic or text + mathematics) together, the students were more successful than the non-restricted group (free group).

When the possible reason of the achievement gap was investigated through interview analysis it appears that being able to embed a particular mode with more condensed internal negotiation as the are writing helped students to conceptualize the concept. Further, interview analyses indicated that when students repeatedly used a particular mode with the text, their

understanding about the function of the mode within the given concept has been extended. Aligned with the suggestion stated above, the students in the non-restricted group may have thought of enriching their writing with different representations, instead of providing conceptual transition between different modes of representation. Although they were free to use all modes, their academic achievements were found to be lower than the students who used two modes.

The third research question was asked to analyze academic achievements of the students who only used textual mode of representation and the students who have to use a certain mode of representation with the text. Study results indicated that the students who used a certain mode of representation with the text had higher academic achievement. Embedding a multi modal representation into writing to learn activities is more beneficial than using only the text (Mcdermott & Hand, 2009). In addition to themes aroused with research questions stated above the authors would like to point out another important outcome of this research study. In general, writing in Turkish school setting used as in “conventional” form. When writing is shifted from conventional sense toward “writing-to-learn”, teachers and researchers need to pay special attention to modal representations to be used in writing to learn activities. The students need to conceptually understand and appropriately use modes within writing activities to learn science concepts. Although the students constantly encounter different modes of representation in different process and sources, they do not feel the need of using modes of representation, especially the ones that require advanced cognitive skills (like mathematical and graphical modes of representation); they prefer not to use these modes as they find them difficult to understand or they prefer to use the modes without integrating with the text to enrich the inventory.

SUGGESTIONS

Findings pointed out that there was no difference between asking the students to use any of the modes and asking the students not to use any text in terms of academic achievement. However, it can be stated that the students who have to use a certain mode of representation had higher academic achievement than those who used any of the modes of representation and those who used only textual mode of representation. Based on these results, we can suggest that the teachers need to encourage students to use modes of representation they find difficult to understand. Further students may use these modes of representation under restrictions. In addition, the teachers who want to practice writing to learn activities in classroom environment may need to be aware of the benefits and restrictions of writing to learn activities.

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