# Effects of Multimodal Representations on Students' Science Learning

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**Abstract**: Multimodal representations play crucial role in students' learning process that students communicate their ideas by using representations. The main aim of this research is to determine the effects of multimodal representations on students' science learning. Quasi-experimental with pre-test and post-test design was used in this study. This study was conducted with total of 35 students that were 7th graders of a public middle school located in Istanbul province in Turkey. Experimental group (n=19) was taught science lessons according to multimodal representations. They performed writing tasks by using multimodal representations. Control group (n=16) was taught science lessons according to National Ministry of Education's existing program. The data was gathered by Science Achievement Test that was used as a pre-test and post-test. Results of the study indicated that there is a meaningful difference between pretests and posttests of science achievement test scores in both experimental and control group. Thus, findings supported that teaching science to students with multimodal representations contributed to their science learning.

**Keywords:** Multimodal representations, Science learning, Academic success

## Introduction

Communication is important in our lives to transfer our ideas and we use language for this aim. In science education, language has a crucial role on the grounds that students communicate their ideas by the help of language elements and this process contributes to their science learning. Students transform their science understandings, they gain in science activities, to new meanings by using verbal, visual and mathematical modes during construction process (AL-salahat, 2022; Doruk, 2019; Hand et al., 2015; Kula Unver & Bukova Guzel, E. 2019; Kutbay & Akpinar 2020; Mainali, 2021; Nurnberger-Haag, Scheuermann, & McTeer, 2021; Ulusoy & Argun, 2019; Utomo & Syarifah, 2021; Yilmaz, Durmus, & Yaman, 2018). At this point the importance of multimodal representations arises.

During the social construction process of scientific knowledge text and verbalization are constituent elements



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(National Research Council, NRC, 1996). In mathematical competence and core competences in science/technology, one of eight competencies of Turkey Qualifications Framework, students are expected to integrate various modes while presenting their thoughts (MEB, 2018). According to Next Generation Science Standards (National Research Council, 2013) developing and using models is significant to improve nature of science knowledge.

Students are successful at understanding the knowledge by creating (constructing) their own representations. This construction process contributes to their understanding (Ainsworth, 2006). Students' construction of their own texts demonstrate their cognitive process (Jewitt et al., 2001). In this study, the effects of multimodal representations on students' science learning was investigated by using multimodal representations in science lessons of experimental group. The importance of the study is that it reveals the effect of using multimodal representations as a teaching method on seventh grade students in a public school that is in a low socio-economic region.

## Method

### Research Design

In this study, quasi-experimental design with pretest and posttest was used to determine the effects of multimodal representations on middle school students' science learning. Science achievement test is used as pretest and posttest.

### Participants

Participants of this study were 35 students from a middle school in Istanbul province in Turkey that were seventh graders. Experimental group includes 19 students and control group includes 16 students.

### Instruments

The data was collected through Science Achievement Test that is developed by Toprak (2021). Test includes 34 multiple choice items. Kuder-Richardson 20 (KR-20) coefficient of the test was measured as 0,848 by the developer. Correct answers were given 1 point, others were given 0 point. Thus maximum score is 34 points and minimum score is 0 in this test.

### Procedure

This study was conducted with 7th grade students through 7 weeks. Teaching method was different in groups. In experimental group multimodal representations teaching method was implemented. Representations were introduced to students with introductory activities and lessons were instructed with the integration of

multimodal representations. In control group, recommended teaching method by National Ministry of Education was implemented.

**Data Analysis**

The quantitative data, collected through science achievement test, was analyzed through statistical tests. To determine the difference between pretest and posttest in experimental group Wilcoxon Signed Rank Test was used, in control group Paired t test was used.

## Results

Results of the data collected through Science Achievement Test are given in this part. Pretest of experimental group did not meet with parametric test conditions by regarding Shapiro-Wilk test. Since experimental group's pretest scores' distributions did not similar, to compare the difference between pretest and posttest scores of experimental group Wilcoxon Signed Rank Test was used.

Table 1. Wilcoxon Signed Rank Test Results of Experimental Group

| | N | Median | Z | p |
|---|---|---|---|---|
| Pretest | 19 | 13,00 | 153.000 | 0.000 |
| Posttest | 19 | 24,00 | | |

The results of experimental group's Wilcoxon Signed Rank Test is given in Table 1. This result indicated that there is a significant difference between pretest and posttest of experimental group (Z=153.000, p=.000). Posttest scores (Median=24) is higher than pretest scores (Median=13). According to this result, multimodal representation teaching method has an effect on students' test scores.

Table 2. Paired t Test Results of Control Group

| | N | $\bar{X}$ | Ss | sd | t | p |
|---|---|---|---|---|---|---|
| Pretest | 16 | 10,00 | 3,31 | 15 | -2.887 | 0.011 |
| Posttest | 16 | 13,81 | 6,47 | | | |

Control group's scores matched with parametric test conditions so paired t test was used to determine the differences between pretest and posttest. In Table 2, Paired t Test results of control group is given. According to the results, there is a significant difference between the pretest and posttest of control group ($t=-2.887$, $p<0.05$). This result indicates that existing teaching method has an effect on students' test scores.

## Conclusion

Multimodal representations contribute to students' learning process on the grounds that using different modes in a lesson triggers cognitive processes that result in learning. From the results of the difference between pretest and posttest of experimental group, it can be said that teaching with multimodal representations has an effect on students' science learning. Results of the research point out that there is a significant difference between pretests and posttests of science achievement test scores in both experimental and control group.

Findings indicate that multimodal representation teaching method and existing teaching method that National Ministry of Education recommend both contribute to students' science learning. Thus, multimodal representation teaching method could be used as an alternative to the existing teaching method in science lessons to promote learning in middle school level.

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