

Using arts integration to make science learning memorable in the upper elementary grades: A quasi-experimental study

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Abstract:

The study tested the hypothesis that the arts might provide upper-elementary students, who were still concrete thinkers, with a powerful means of envisioning phenomena that they could not directly observe. This study investigated the impact of STEAM lessons on physical science learning in grades 3 to 5. Ten out of the 55 high-poverty (Title 1) elementary schools in a large urban district in California were randomly chosen as treatment schools and divided into two cohorts. Using a quasi-experimental design that holds general student scientific achievement constant, the study found that students exposed to the STEAM lessons demonstrated greater improvement on physical science benchmark assessments than students exposed to a STEM-only physical science curriculum.

Key Findings:

Students who received nine hours of STEAM instruction made improvements in their science achievement. When controlling for all other factors, students who received the STEAM instruction from a well-trained teacher went from the 50th percentile to the 63rd percentile in the district science assessment. The gain is significant given that there were only nine hours of exposure to the intervention.

Significance of the Findings:

Previously it was assumed that the most significant gains from arts integration in science were among English learners. However, the results of this study suggest that benefits are not limited to English learners, a range of high-poverty learners can share the gains. The study demonstrated that all students could potentially benefit from integrated STEAM, helping them envision phenomena that they were not able to directly observe.

Methodology:

The study examined ten of 55 high-poverty elementary schools in a large California district that were chosen at random. The schools were split into two cohorts of five schools each. In the study, the researchers used a quasi-experimental design that attempted to hold student scientific achievement constant by holding scores in non-targeted science content (i.e., earth science).

Students in the cohorts received nine hour-long arts and physical science lessons during the 2011-2012 school year. The curriculum was designed to correct student misconceptions and clarify concepts students had struggled within the past year.

Previous year assessments were used to identify the target areas for the curriculum. The curriculum that was implemented uses the visual and performing arts to help students understand science concepts and allows students to become more comfortable using science vocabulary. The nine lessons used a combination of dance, theatre, and visual arts to review science vocabulary and concepts. Each lesson consisted of a 10-minute warm up where students received a preview of the day's lesson, a 20-minute modeling segment where students were exposed to new vocabulary, and a 15-minute guide practice segment where students applied their knowledge and received guided feedback. During the final portion of the lesson, teachers debriefed the activity and evaluated student progress towards accomplishing the lesson goals.

The first cohort consisted of 893 students where the teachers had one year of training before the experiment. The second cohort consisted of 1,263 students whose teachers were currently co-teaching with a person who was trained in the curriculum integrating arts and STEM. The control group consisted of 5,683 with the usual course curriculum.

Student achievement was measured by students' scores on standardized district-wide tests, which teachers must administer to all third, fourth, and fifth-grade students. The researchers used an OLS regression to demonstrate the effectiveness of the STEAM curriculum. They controlled for socio-demographic covariates and non-targeted science scores that may naturally vary by school. The researchers provided three models; 1)

controlled for the effect of being within an experimental cohort, 2) controlled for socio-demographic characteristics, and 3) controlled for non-targeted science benchmarks.

Limitations of the Research:

The assessment that was used to measure student achievement did not necessarily focus on the concepts that were the primary target of the lesson. The assessments looked more broadly at the content area as opposed to measuring the specific instructional content. Having a control group take the Misconceptions-Oriented Standards-Based Assessment Resources for Teachers may address this issue in future studies.

In the study, only one year of data is analyzed, which may not be sufficient to assess long-term memory. Further, the sample at the 5th-grade level was too small to detect any meaningful changes. There was no control for differences in student ability (e.g., no pre-test, limited availability of non-targeted scores, etc.).

Questions to Guide New Research:

- How might arts-integrated instruction impact middle school and/or secondary STEM learners?
- What role does developmental readiness play in student understanding of scientific concepts in upper elementary grades?
- How do achievement gains from arts integration into STEM instruction among students in Title 1 schools compare to gains by students in non-Title 1 schools? If gaps exist between science performance among the two populations, how effective is arts-integrated instruction in closing the science achievement gap in Title 1 schools?
- What teacher preparation, training and professional development is most effective in ensuring teachers are able to gain content knowledge necessary to provide adequate instruction?
- How does teacher content knowledge impact student achievement in arts integrated STEM lessons?
- Do programs that focus integration of either visual arts, performing arts or music with science lead to greater achievement gains in science?
- How might student achievement improve if STEM activities were integrated into an arts-centric curriculum?

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