



McREL's findings on Science4Us efficacy: A summary

The goals of **Science4Us** are to improve early elementary science instruction and student outcomes in science while reinforcing critical math and language core skills. Science4Us provides teachers with structured on-demand professional development. The student activities are highly engaging interactive activities which provide 5E-based learning with scaffolding to support the process. To measure the success of the curriculum, McREL, a private education research and development corporation, was contracted to evaluate one, two week instructional module. The States of Matter module, from Physical Science, was selected for evaluation.

To identify the impact the module had on teachers and students surveys, think alouds, interviews, and assessments were designed and implemented by McREL. Additionally, independent classroom observations were made to collect evidence of use of the States of Matter module. Information regarding the following student and teacher data was collected:

- Extent of the teacher support (including instructional strategies, content-related support, and technology support)
- Level of student engagement
- Ability to engender confidence in students and teachers
- Ability to motivate students
- Measure of student achievement outcomes

To evaluate the components of the States of Matter module, science content experts from McREL evaluated the extent to which the module reflects sound teaching practices. Specifically, assessing the following key components:

- Extent of the alignment to the Next Generation Science Standards (NGSS)
- Inclusion of inquiry opportunities for students
- Implementation of the 5E instructional model
- Presence or absence of a clear storyline (progression sequence throughout the module)
- Opportunities for formative assessment
- Identification of clear learning goals

The Study

Primary teachers from four Denver area public schools participated in the two week project. Seven teachers served as the experimental group, implementing the States of Matter module with their 156 students, of which 76 were male and 80 were female. Five teachers and 116 students (60 male, 56 female) served as the control group and did not implement the Science4Us module. The control teachers carried on "business as usual" science instruction. All of the teachers participating in the study were female and felt "adequately qualified" to teach science and provided science instruction, on average, three days a week for 35 minutes.

Both the experimental and control teachers were asked to complete surveys regarding their self-efficacy in science and their perceptions of student engagement during science instruction. All of the teachers felt they were equipped to provide quality science instruction prior to the intervention; whether or not they were implementing the module did not change their feeling of self-efficacy in science. Similarly, all teachers reported their students to be highly engaged and motivated during science instruction. Experimental teachers, those implementing the States of Matter module with their students, were asked to share their perception of it. Specifically, these teachers were asked to rate the quality, utility and relevance of the States of Matter module student activities and the embedded teacher support



Teachers using the module felt that it was easy to use and didn't require the sometimes excessive preparation that a traditional science lesson does. They found the interactive student components of the module to be highly engaging for their students and were surprised by how "into it" their students, even the kindergarteners, were. While some of the teachers mentioned that the content, states of matter, was not a subject normally taught at their grade level, they still found the activities to be developmentally appropriate for their students. Additionally, even though the material was not traditionally covered, their students were still able to participate in the online activities and successfully complete the Evaluate. One teacher commented, "They did not know what matter was before this."

In addition to assessing the student components of the module, teachers were asked to evaluate the teacher support materials including the teacher guides and professional development pieces. The teachers found the guides helpful for understanding the content covered by the activity and the layout and pacing of the lessons. Suggestions for improvement included making it possible for all of the teacher guides to be accessible from one document.

Through their use of the States of Matter module, some teachers (43%) found they adjusted their instructional practice stating "It (Science4Us) offered new ideas of what engaged students and excited them towards learning."

Overall, the majority (72%) of teachers implementing Science4Us felt that their students did learn "some" or "a lot" about states of matter.

In addition to teachers' perceptions of the States of Matter module, data on student usage was collected via direct observation, think alouds, student interviews, surveys and assessments. The majority of students (83%) felt that using Science4Us helped them learn new things and understand science, while 83% of students enjoyed using Science4Us and 80% felt that using Science4Us made them like science even more. Both the control and experimental students felt equally motivated to learn science. Surprisingly, students not using the States of Matter module felt more confident about what they knew and were learning about in science than those who received the module. Researchers suggested that the shortened two week time frame of the implementation may have highlighted, for the students, what they did not know. Additionally, using a computer rather than traditional instructional practices may have caused the students to second guess their confidence in science.

Pre and Post Assessment Results

Both the control and experimental students were provided a pre and post assessment in physical science to measure content knowledge. While the scores of both groups improved from pre to posttest, students receiving the Science4Us States of Matter module showed greater learning gains than students engaged in "business as usual" science instruction. The average score earned by the experimental group was 7.05 compared to 6.57 of the control group. Students participating in the Science4Us module may not have felt confident about what they knew or were learning, but the results of their post assessment reveal they gained a significant amount of understanding in a two week time period.

Alignment to NGSS and the 5E Model

Finally, researchers at McREL provided a thorough review of the alignment of the module to the Next Generation Science Standards (NGSS) as well as the 5E model and teaching practices embedded in the States of Matter module. While the content included in the States of Matter module is best aligned with the NGSS second grade Structure and Properties of Matter core idea, researchers found the content and activities to be appropriate for K-2 students stating, "It provides a foundational understanding (of the properties of matter) that is needed as students progress through their learning." Researchers also noted the inquiry opportunities included in the States of Matter module are supportive of the NGSS approach to inquiry-based learning. The Science4Us module provides students multiple opportunities to actively engage in complete investigations as well as mini-inquiries both online and as offline, hands-on activities.



The 5E instructional model provides a framework to help students build conceptual understanding as they move through each of the Es: Engage, Explore, Explain, Elaborate and Evaluate. Science4Us implements the 5E model at the lesson level, providing each E with a daily session over the course of two weeks. Researchers found the adaptation of the Engage, Explore, Explain and Evaluate to be aligned with the intent and purpose of the 5E model. It was suggested that the multiple Elaborate opportunities provided in the States of Matter module be given an organization scheme the teacher could follow, thus clarifying which activity be performed first by the students. Additionally, it was suggested that the cross-curricular nature of the Elaborate activities be highlighted to make the connection to literacy clear. In general, implementation of the 5E instructional model was sound, providing clear learning progressions for students as they move through the module.

Teaching Practices and Formative Assessments

A review of general teaching practices, including formative assessment opportunities and the presence (or absence) of clear learning goals was also addressed. The ability of a teacher to assess student understanding “as they go” is important and provides both teachers and students an opportunity to work together to attain learning goals. A curriculum that provides embedded opportunities for formative assessment can boost student learning and motivation. Researchers found multiple types of formative assessment embedded in the Science4Us States of Matter module. Formative assessments can be found in online activities that require an answer and provide instructional feedback, for student self-assessment, as well as those that prompt open class discussion. Offline, the opportunities for formative assessment are accomplished through writing, drawing, and discussion with peers and as a whole class.

Given the short implementation period of this research project, the gains in student achievement came as a surprise to the researchers at McREL. As it is the goal of Science4Us to improve early elementary science instruction and student outcomes in science, these results motivate us to continue working towards our goal.

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