



Impacts of an Exploratory and Kinesthetic Astronomy Afterschool Program on Students' Interest in STEM

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B.A.S.E. Camp (Before and After School Enrichment) Larimer County, Colorado, July 2017

Credit: NASA/JPL

Credit: NASA/ESA/HST NGC299

Introduction

Astronomy is one of the oldest sciences and in ancient times peoples' lives depended on a basic understanding of the sky because it served as their compass, clock, and calendar. Today, students are drawn to the beauty of the night sky and wonder what lies beyond our celestial sphere. The multidisciplinary nature of the field provides opportunities for students to understand how the subjects they study intersect and lead to new discoveries.

Few elementary teachers have training in astronomy and they often believe the subject relies heavily on math, physics or requires technical equipment, thus they hesitate to incorporate it in their lesson plans (Percy, 1995). Astronomy teaching partners can help teachers by designing and facilitating highly engaging activities that make astronomy more tangible for students, ultimately increasing their interest in STEM majors (Miranda, 2012). The Afterschool Alliance reported the number of students attending afterschool programs in the U.S. continues to grow sharply (n.d.). More than 50% of Colorado parents feel afterschool programs with STEM content could help their children develop interests and skills in STEM subjects (Afterschool Alliance, 2016). The America After 3PM Full STEM Ahead report (n.d.) identified afterschool programs as stimulating settings for inventive STEM education.

The goal of my educational research project was to teach astronomy topics and supplement elementary classroom curriculum during an afterschool program. By facilitating kinesthetic activities, encouraging investigation, and helping students connect concepts in an environment that rewarded curiosity and engagement, I hoped to increase students' interest in STEM topics and build confidence in their ability to learn about and do science. I partnered with the Before and After School Enrichment (B.A.S.E.) Camp, an afterschool program in Larimer County, Colorado associated with the school district.

Focus Question

Will students' self-efficacy towards science and interest in STEM increase as a result of participating in exploratory and kinesthetic activities focused on astronomy during an afterschool program?

Methodology

- The week-long program focused on utilizing kinesthetic, exploratory, and collaborative activities to teach content and help students make observations, build models, predict outcomes, and develop explanations.
- Monday - Earth topics (shape of Earth, diurnal motion, orbits, and seasons)
 - Tuesday - Moon (lunar phases, observations, and predictable motions)
 - Wednesday - Constellations (patterns of motion, art and cultural interpretations, and navigation uses)
 - Thursday - Solar system and other astronomical objects (planets, moons, stars, nebulae, and galaxies)
 - Friday - Telescope demonstration and an observing session

Assessments were administered using an apparatus with small flip charts. Questions were printed and attached to the structure with the possible responses written down with corresponding bags. Each student received a paper star color-coded to the question. The students were asked to place their star in the bag corresponding to the response that made the most sense to them.

Sub-categories of Focus Question	Data Source 1	Data Source 2	Data Source 3	Data Source 4
Increased interest in STEM topics	A pre- and post-attitude Likert-style survey	Semi-structured interviews	Instructor observation journal	Teacher feedback on long-term impact
Improved self-efficacy towards science	A pre- and post-attitude Likert-style survey	Semi-structured interviews	Instructor observation journal	Teacher feedback on long-term impact
Broadened understanding of astronomy concepts	Content pre- and post-assessments	Semi-structured interviews		

Literature cited

Afterschool Alliance. (2016). *Afterschool Fostering Student Success in Colorado*. Retrieved September 26, 2016 from http://www.afterschoolalliance.org/policyStateFacts.cfm?state_abbr=CO

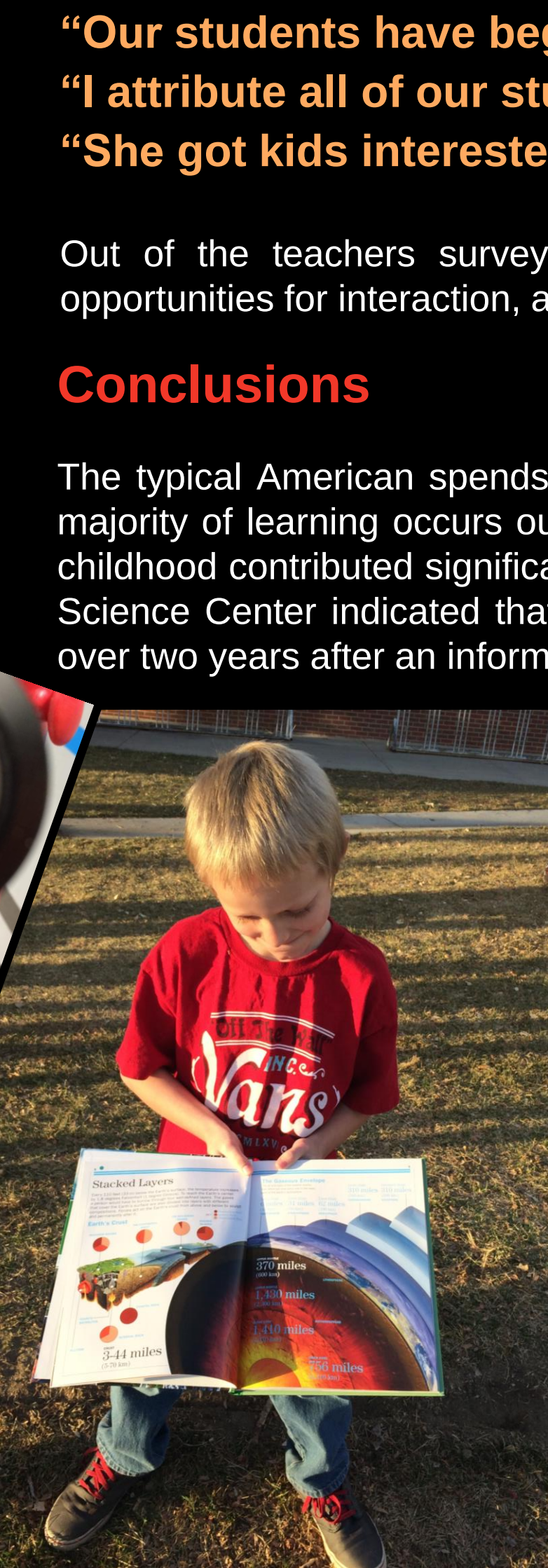
Afterschool Alliance. (n.d.). *America after 3PM Afterschool Programs in Demand*. Retrieved September 26, 2016 from http://www.afterschoolalliance.org/documents/aa3pm-2014/aa3pm_national_report.pdf

Afterschool Alliance. (n.d.). *America after 3PM Full STEM Ahead: Afterschool Programs Step Up as Key Partners in STEM Education*. Retrieved Sept. 26, 2016 from <http://www.afterschoolalliance.org/aa3pm/STEM.pdf>

Falk, J.H. & Dierking, L.D. (2010). The 95 Percent Solution. *American Scientist*, 98(6), 486-493.

Miranda, R.J. (2012). Urban middle-school science teachers beliefs about the influence of their astronomer-educator partnerships on students' astronomy learner characteristics. *Astronomy Education Review*, 11(1), 1-9.

Percy, J. (1995). Astronomy education: A global perspective. *Journal of the International Planetarium Society*, 24(3), 6-7, 9.



Results

The results of the Self-Efficacy Towards Science instrument indicated that 72% of students liked to learn about science, 77% believed it helped them understand their world, and 60% liked to discuss science with their friends (N=51). These findings were corroborated by the Instructor Observation Journal that detailed a comment on the second day of the program at Ponderosa Elementary. A female student who was leaving prior to the start of the activities said, **"Oh no! I'm missing out on science today."**

Students were encouraged to participate in the assessments and the daily activities, but did so of their own accord. Attendance varied on a daily basis and participation rates declined significantly towards the end of the day and later in the week. This contributed to the difficulty of collecting data and maintaining a consistent sample sizes. Despite these challenges, the students were engaged and learning. During the fourth day at Tavelli Elementary, a bell rang indicating a parent had arrived to pick up a student. A female student told a friend sitting next to her, **"Oh, I hope it isn't for me."**

Comments from the Teacher Feedback Forms indicated that overall interest had increased.

- "Kids kept asking if she [the instructor] was coming back."**
- "Our students have begun to ask more questions about space and space travel."**
- "I attribute all of our students interest in this subject to the program."**
- "She got kids interested in presenting [to other students] about astronomy!"**

Out of the teachers surveyed, 100% felt the program enhanced students' understanding, provided opportunities for interaction, and that the kinesthetic activities aided in the learning process.

Conclusions

The typical American spends less than five percent of their lifetime in formal education settings and the majority of learning occurs outside of school time. Opportunities to learn in informal environments during childhood contributed significantly to science knowledge in adulthood. A study conducted by the California Science Center indicated that an individual's conceptual understanding of science continued to grow for over two years after an informal learning experience (Falk & Dierking, 2010). Free-choice learning centers

provide opportunities for students to participate in activities and learn at their own pace without pressures or constraints.

Notes from the Semi-Structured Interviews and the Instructor Observation Journal notated that students began checking out books from the library related to science, specifically earth science, geology, and astronomy and brought them to the program to show the instructor and their friends. The program inspired many of the students to take the initiative to decide what they wanted to learn and how they wanted to learn it – launching them on their own journey of lifelong learning.

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