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NASA Heliophysics Education Activation Team

A Case for Retrospective Pretests in Young Learner Research Designs

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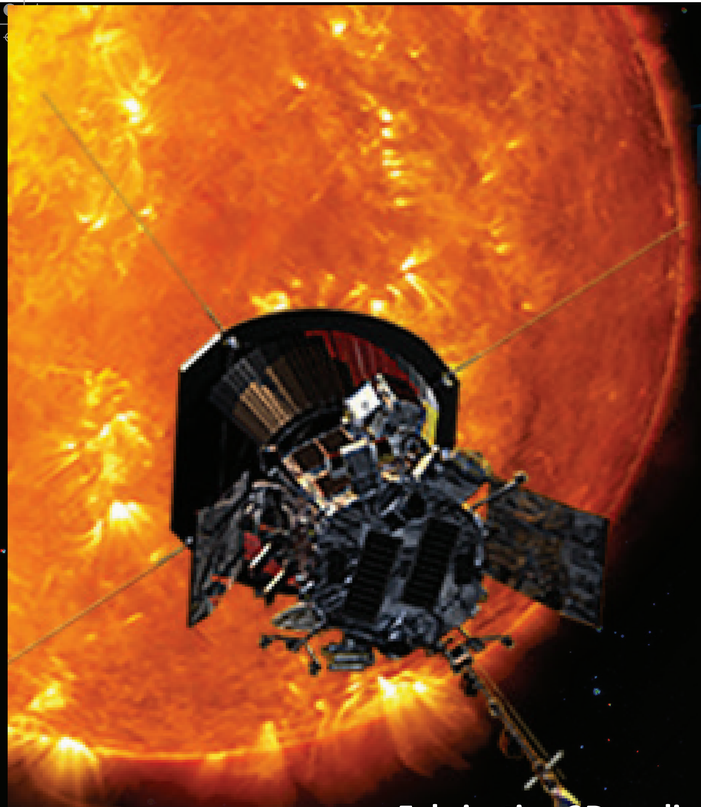
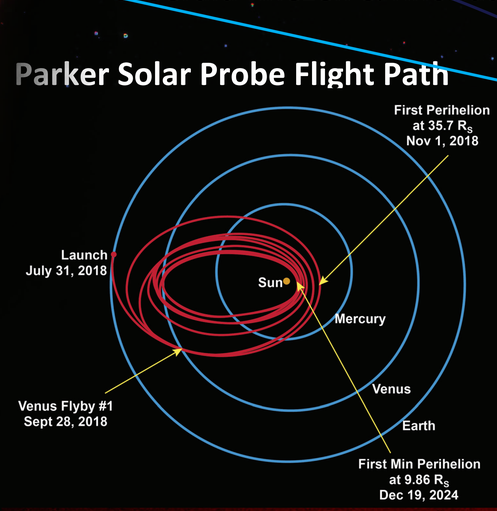
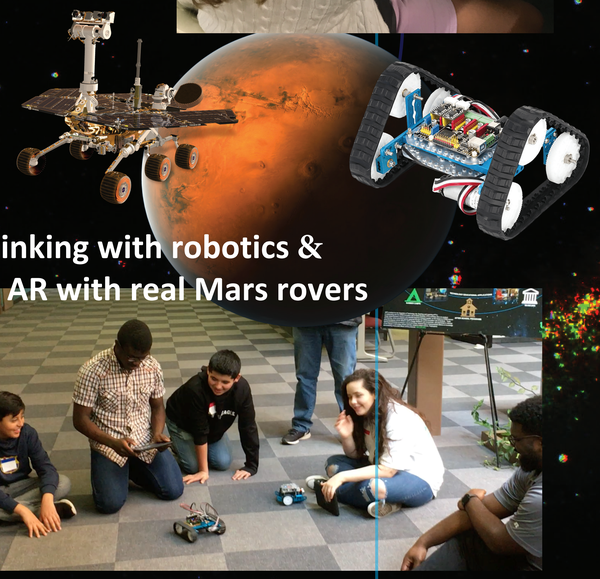
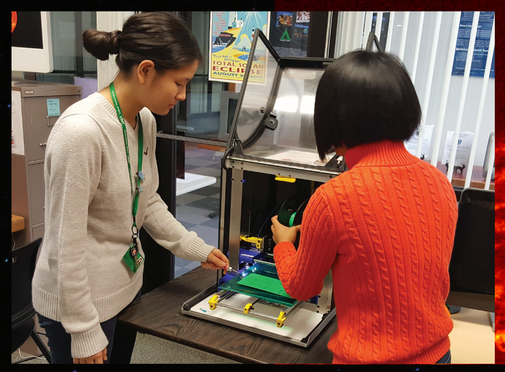






Fabricating 3D replicas of launch rockets & Sun surface



Computational thinking with robotics & drones relates to AR with real Mars rovers

Middle School Space Science Activities

Focus: Parker Solar Probe, ARTEMIS/Mars using AR/VR, Robotics & Drones /Computational Thinking, & 3D Fabrication.

Formats: 2 focused days of a week- long Sciquest summer camp; also 45 minute activities with AR/VR, half-day camps using AR/VR, 3D & drones; teacher training for school based classrom and after school activities.

Measures of Impact: Retrospective Pretests augmented by traditional Pre-Post Assessments.
Development of interest in space science (Interest)
Development of positive dispositions toward STEM (Attitudes)
Gains in content knowledge (Knowledge), from BASIK framework (Davis et al, 2018; Freidman, 2008)

Findings: 2021 SciQuest summer camp retrospective pretest outcomes strongly align withretrospective pretest findings from a similar weekend camp conducted for 21 grade 6 students one year earlier (Christensen, 2020), and are also consistent with results obtained by the authors in similar contexts over the past five years (Knezek & Christensen, 2020). Significant ($p < .05$) knowledge gains with an effect size of Cohen's $d = .60$ (Cohen, 1988) & $p < .05$ gains in interest in space science as a subject and/or career resulted.

Preliminary Conclusions: Children in grades 2-7 often do not have a well-formed concept of what they are rating on pretest surveys, but once they have been through the learning experiences they usually have a firm opinion of how much they liked the activity and can reflect on before versus after the event. Retrospective pretests as research methodologe are worthy of broader use, as proposed by Howard et al. (1979).

Paired Sample Retrospective Pre-Post t-tests & Effect Size Estimations for Summer Camps

	Retrospective Items	Mean	N	Std. Dev.	Sig.	Effect Size
Pair 1	BEFORE: I am interested in space science.	3.88	16	1.15		
	AFTER: I am interested in space science.	4.34	16	1.11	.020	.65
Pair 2	BEFORE: I would like to learn more about Mars.	3.78	16	1.20		
	AFTER: I would like to learn more about Mars.	3.94	16	1.39	.585	.14
Pair 3	BEFORE: I would like to learn more about the Sun.	3.75	16	1.13		
	AFTER: I would like to learn more about the Sun.	3.94	16	1.29	.485	.18
Pair 4	BEFORE: I am interested in a career in space science.	3.19	16	1.56		
	AFTER: I am interested in a career in space science.	3.47	16	1.56	.070	.49

Summer 2021 grade 2-6 participants in a 5-day, arboretum-based SciQuest Camp completed two days of hands-on space science activities (M & F) with retrospective pre-post items administered at camp's end. Meaningful gains (ES > .3, Bialo & Sivin-Kachala, 1996) were recorded for interest in space science and space science careers.

Paired Sample Retrospective Pre-Post t-tests & Effect Size Estimations

	Retrospective Items	Mean	N	Std. Dev.	Sig.	Effect Size
Pair 1	BEFORE: I am interested in space science.	3.43	173	1.25		
	AFTER: I am interested in space science.	3.79	173	1.18	.000	.86
Pair 2	BEFORE: I would like to learn more about the moon and space.	3.46	173	1.23		
	AFTER: I would like to learn more about the moon and space.	3.69	173	1.21	.000	.71
Pair 3	BEFORE: I believe exploring space can teach us things about the earth.	4.14	173	.96		
	AFTER: I believe exploring space can teach us things about the earth.	4.32	173	.92	.000	.71
Pair 4	BEFORE: Innovative technologies make learning more engaging.	3.88	173	1.08		
	AFTER: Innovative technologies make learning more engaging.	4.14	173	.99	.000	.80

From Christensen & Knezek (2021): Retrospective Pre-Post Gains for 173 6th Graders Engaged in School-Based Space Science Activities