Explorer At Large

Pilot Implementation Study Report

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Executive Summary

With funding from the Bezos Family Foundation, Battelle, the Columbus Foundation, and the Harold C. Schott Foundation, Explorer at Large (XAL) partnered with the PAST Foundation and Oregon State University (OSU) for a pilot implementation of their videos and instructional materials in Central Ohio schools.

XAL is a new initiative that aims to engage, inspire and educate PreK-12 students through freely distributed videos in the context of a broader learning ecology that includes classroom instructional materials and out-of-school activities, including Family Moments that encourage parent-student engagement.

In this pilot implementation, XAL content was placed in front of a sample of roughly 600 kindergarten and 3rd grade students across the central Ohio region as a proof of concept exercise to understand the extent to which teachers could implement the materials effectively in ways that resulted in student outcomes. A research team from OSU implemented an effectiveness study to demonstrate the extent to which the materials can be successfully utilized by teachers and to measure student outcomes. This report summarizes the findings of the effectiveness study, drawing on data collected using a variety of strategies and perspectives. The report concludes with recommendations to inform future refinement of the materials and guide scale-up efforts.

The research study focused on the following overarching research questions:

1. Will grades K and 3 elementary school teachers be able to successfully include instructional units of varying length based on one or more XAL videos in their classrooms, given that the videos aim at instilling curiosity, discovery, experimentation, or questioning?
2. Will grades K and 3 elementary school teachers who experience these instructional units show growth on fundamental measures of affective and cognitive learning associated with discovery-based instruction?
3. Will grades K and 3 elementary school students who experience these instructional units show growth on fundamental measures of affective and cognitive learning associated with discovery-based instruction?
4. Will the inclusion of XAL Family Moments create awareness in parents of the value of curiosity, discovery, exploration, and questioning in their child(ren)?

We used a complementary, mixed methods approach to understand these research questions using the following data collection methods:

- Pre-post surveys of teachers;
- Instructional module feedback form;
- Teacher focus groups;
- Classroom observations;
- 3rd grade student survey;
- Focus groups with Kindergarten students;

- Parent/caregiver survey.

Across these various data sources, the following key findings emerged:

- The results of the study confirmed that the pilot implementation of XAL materials in Ohio schools was successful in two ways: 1) teachers were able to fit the materials in to their classroom instruction and 2) teachers were able to implement the materials effectively, resulting in positive outcomes for students.
- Teachers self-reported high levels of satisfaction with the materials and indicated that they found the materials valuable for supporting student engagement with science concepts and practices. They also noted that their participation in XAL resulted in changes to their instructional practices, including implementation of a problem-based learning approach, hands-on activities, and deeper engagement with science concepts;
- Through implementing the materials and participating in the professional learning opportunities supported by the PAST Foundation, teachers reported greater self-efficacy or confidence for teaching science in ways that align with problem-based learning and the science and engineering practices outlined in the NGSS;
- The videos and instructional materials were particularly successful at motivating students. There was conclusive evidence to suggest that the videos were highly engaging to students and inspired a sense of enjoyment and fun for learning science, resulting in shifts in their attitudes toward science.
- Students demonstrated cognitive and affective learning gains including learning science concepts, engagement with the process and practices of science, and developing an identity as a learner of science;
- Although the changes related to exploration were limited, there was initial evidence of students developing positive associations with being an explorer, noting it would be "cool" and "fun" to explore;
- The materials demonstrated initial limited success at developing aspects of persistence and growth mindset in students;
- A few of the parents/caregivers of students in the study developed awareness of the XAL materials and noted the excitement of their students. Some even completed activities at home and indicated on the survey a potential chance of continued engagement if additional activities are offered. However, the ratings from parents/caregivers regarding the Family Moment activities suggested that there was minimal uptake and when families completed the activities, they generally provided low ratings suggesting the activities were not engaging for families.
- According to the Kindergarten teachers, some of the videos were not developmentally appropriate for younger students. Although the videos were not intentionally designed for this particular age group, it is worth considering how to design videos to meet the needs of young learners in future scale-up efforts.

Overall, the XAL materials offer a promising approach and we recommend the teams pursue additional scale-up efforts guided by the data and recommendations reported in this study for improving the videos and building the ecosystem of learning opportunities connected to the media.

Introduction

Explorer At Large (XAL) is a new initiative aimed at improving education by inspiring exploration and curiosity to engage, stimulate and educate PreK-12 students. Through freely distributed videos and associated instructional materials (study and teacher guides), hands-on in-class and outdoor activities, field trips to relevant local settings, and parent-student engagements, XAL aims to enable students to experience and practice scientific thinking skills that prepare them for advanced education and career success within a pedagogical approach that taps into their natural curiosity and playfulness. A holistic ecosystem of curriculum-driven content invites students on journeys in the field and in the lab, together with experts in pursuit of knowledge and discovery, and provide corresponding resources and support for teachers and other educators. XAL's goal is to engage students with elements of authenticity, real-world exploration, and live-action adventure and to deliver meaningful science content while preparing them for future learning and success in life.

In an earlier Pilot Phase, XAL developed and tested educational videos that included 35 episodes with 25 experts from 13 institutions. Through this pilot phase, XAL learned how to best approach the challenge of creating educational videos that 1) pose a curriculum-driven question, 2) introduce an appropriate expert, and 3) deliver an answer to that question—all while staying both engaging and entertaining. Following the Pilot Phase, XAL initiated planning for an Implementation Phase to test content with students.

The implementation phase placed XAL content (videos, study guides, field trips, and family moments) in front of a selection of roughly 600 kindergarten and 3rd grade students to track the specific goals and outcomes of XAL. An element of the Implementation Phase was an effectiveness study implemented by the research team from OSU and conducted in parallel to the implementation of the materials in Central Ohio classrooms. The study was implemented as a proof-of-concept exercise to demonstrate that the materials can be successfully utilized by teachers in a way that leads to positive outcomes for students. This report details the research study and summarizes the key findings.

Study Overview

During the 2018 spring semester, the OSU team developed and executed the research study with 21 Kindergarten and 3rd grade classrooms across the Central Ohio region. The study built on the previous pilot of XAL videos and instructional materials in Central Ohio schools that both assessed the impact on students around a set of connected learning outcomes and determined the feasibility of using the XAL materials in the classroom. Specifically, we wanted to understand: are the XAL Units engaging and motivating (as intended)? Do they allow students to learn procedural aspects of STEM in a playful and active way (for instance, the eight science and engineering practices of the Next Generation Science Standards or NGSS)? Are they nurturing or creating in students a sense of curiosity, wonder, and excitement? Do they entice "generative thinking" in students—that is, allow them to ask questions that express their cognitive engagement with the subject matter (Ritchhart, 2011)? And do the Units support

students' identities as learners of science (or other subjects or disciplines), including increased self-efficacy and persistence around their own ability to learn? Finally, we asked how teachers were able to implement the XAL resources and materials in their classrooms.

Research Questions

The study was designed to specifically address the following research questions:

5. Will grades K and 3 elementary school teachers be able to successfully include instructional units of varying length based on one or more XAL videos in their classrooms, given that the videos aim at instilling curiosity, discovery, experimentation, or questioning?
   - Do teachers consider the XAL instructional units valuable for their students' engagement, learning, and growth?
   - Are the XAL instructional units easy for teachers to use?

6. Will grades K and 3 elementary school teachers who experience these instructional units show growth on fundamental measures of affective and cognitive learning associated with discovery-based instruction?

7. Will grades K and 3 elementary school students who experience these instructional units show growth on fundamental measures of affective and cognitive learning associated with discovery-based instruction?
   - Will the units be interesting, satisfying, and thus engaging for children?
   - Will the units achieve certain desired outcomes, including content and process learning; STEM Learner Identity; STEM Capital or STEM Affinity; growth mindset; self-assessed persistence; and self-assessed curiosity?

8. Will the inclusion of XAL Family Moments create awareness in parents of the value of curiosity, discovery, exploration, and questioning in their child(ren)?

Logic Model & Performance Indicators

Early in the collaboration all three teams --- XAL, the PAST Foundation, and OSU – worked together to develop a logic model (Appendix A) to illustrate how the project outputs would result in anticipated short-term, mid-term, and long-term outcomes. The teams also identified key performance indicators (Appendix B) and mapped these to the theory of change and short-term outcomes for students described in the logic model.

Study Methodology

This section outlines the data sources, study context, sample and data analysis processes implemented for the XAL research study during the pilot implementation in Central Ohio. In order to gain insight into our research questions and understand outcomes of the materials, we used a complementary, mixed-methods study design drawing on both quantitative and

qualitative sources of data. The quantitative data provided a broad overview of the effectiveness and outcomes of the XAL videos and materials while the qualitative data from focus groups and open-ended items on questionnaires provided nuanced, in-depth data in support of interpreting quantitative results.

Study Context and Sample

The pilot and associated research and evaluation study was implemented in a small community of schools in Central Ohio. Central Ohio was selected because it has a network of schools who use a problem-based approach and it offers access to a range of schools – including rural, small-town, suburban, and urban schools. Moreover, schools in this region have access to a wealth of out-of-school resources such as the Columbus Zoo and Aquarium, the Franklin Conservatory, COSI Columbus, and The Wilds, to name a few. The project partner, PAST Foundation, is also located in the Central Ohio region and provides a readily available facility for developing and testing the instructional materials associated with the XAL videos.

The sample in Central Ohio included 21 teachers across 10 schools. In total, 15 kindergarten teachers and six 3rd grade teachers across five districts participated in the pilot implementation and associated study. The key characteristics of each school and district is presented in Table 1. As represented in the table, the districts included in the study were diverse across school type (i.e., public school versus public charter program), school setting, and student population.

Table 1*: Participating Schools*

School	District	Setting[1]	Student Population	# of Teachers
United Preparatory Academy	United Schools Network	Urban	Charter School	2 – K Teachers
Berwick Elementary	Columbus City Schools	Urban	Very High Student Poverty & Very Large Student Population	6 – K Teachers
Highland Elementary				
Huy Elementary				
Salem Elementary				

[1] We categorized school setting using school typologies and definitions derived from the Ohio Department of Education website: https://education.ohio.gov/Topics/Data/Report-Card-Resources/Report-Card-Data-Forms-and-Information/Typology-of-Ohio-School-Districts. The "small town" category is defined as: schools in "outlying towns and county seats that share many characteristics of urban districts despite their rural locations."

Westgate Elementary				
Herbert Mills Elementary	Reynoldsburg City Schools	Suburban	Low Student Poverty & Average Student Population Size	2 – K Teachers 6 – 3rd grade Teachers
Summit Elementary				
Liberty Union Elementary	Liberty Union-Thurston Public Schools	Small Town	Low Student Poverty & Small Student Population	1 – K Teacher 2 - 3rd grade Teachers
KIPP Columbus Elementary	KIPP Foundation	Urban	Charter School	2 – K Teachers

We administered a questionnaire to teachers at the start of the pilot to gather basic information and baseline data from the teachers. As displayed in Table 2, all of the teachers had at least three years of teaching experience and six of the teachers were veteran teachers with more than 11 years of teaching. All of the teachers have at least some prior experience using a problem-based learning approach but most had low to moderate experience (mean = 4.5 on a 10-point scale). Of the 15 teachers who responded to the pre-survey, 6 had previously participated in a PAST professional development opportunity, including 4 teachers who participated in 1-2 prior workshops, 2 teachers who participated in 3-4 prior workshops, and 3 teachers who participated in 5 or more prior workshops.

Table 2: *XAL Teacher Characteristics*

Characteristic		
Years of Teaching Experience (n=15)	3 to 5 years	n = 5
	6 to 10 years	n = 4
	11 to 20 years	n = 4
	More than 20 years	n = 2
Number of Students (n=16)	1 to 10 students	n = 6
	11 to 20 students	n = 0
	21 to 30 students	n = 7
	31 to 40 students	n = 0
	41 to 50 students	n = 3
Number of English Language Learners (n=15)	None	n = 7
	1 to 5 students	n = 3
	6 to 10 students	n = 3
	11 to 15 students	n = 0
	16 to 20 students	n = 1
	21 to 25 students	n = 1
Number of Students who qualify for free/reduced lunch (n=15)	None	n = 1
	1 to 5 students	n = 2
	6 to 10 students	n = 1
	11 to 15 students	

	16 to 20 students 21 to 25 students	n = 2 n = 3 n = 6
Number of Special Education Students/ Students with Special Needs (n=15)	None 1 to 5 students 6 to 10 students 11 to 15 students 16 to 20 students 21 to 25 students	n = 3 n = 10 n = 1 n = 0 n = 1 n = 0
Participated in a prior PAST PD workshop or online meeting (n=15)	Yes No	n = 9 n = 6
*Prior Participation in PAST PD workshop or meeting (*n=9)	1-2 workshops or meetings 3-4 workshops or meetings 5 or more workshops or meetings	n = 4 n = 2 n = 3

From the teachers who responded to the survey, we learned that at least 407 kindergarten and 3rd grade students engaged with the XAL materials. However, we know that this number is unreported as 6 of the 21 XAL teachers did not respond to the survey. The average teacher in our sample had 29 students in their classes with roughly 5 students who were language learners, 17-18 students with free or reduced lunch, and 3-4 students with special needs.

The student participants in the study included the kindergarten and 3rd grade students of the participating XAL teachers as well as a 3rd grade students who served as a comparison group. Specifically, 20 kindergarten students participated in the data collection through focus groups, 132- 3rd grade students participated in the treatment group by completing surveys and there were 42 students in a comparison group that also completed a modified version of a post-survey.

Data Collection Strategies

Data collection included teacher, parent/caregiver, and 3rd grader written surveys; online module feedback forms (for teachers); teacher and kindergartener focus groups; and classroom observations (see Table 3, and Appendix C for details). Questionnaires were developed de novo, but used existing scales and questions from published or prior reports where appropriate.

Table 3: *Data Collection Strategies*

INSTRUMENT	AUDIENCE	SAMPLE	DESCRIPTION
Baseline information questionnaire	XAL Teachers	15 responses	The questionnaire provided us with background information about participating teachers such as their years of teaching and prior experience.
Instructional Module Feedback Form	XAL Teachers	32 responses	The instructional module feedback form prompted teachers to provide their feedback after implementing each of the instructional modules.
Classroom Observation Protocol	OSU Research team	8 teachers	The OSU research and evaluation team conducted classroom observations of XAL classrooms. The protocol allowed the team to gather evidence of benefits for students as a result of engaging with the XAL instructional materials.
Teacher Post-Survey	XAL Teachers	15 teachers	A post-survey for teachers gathered concluding thoughts and input from teachers and helped us understand potential outcomes for teachers and their students.
Teacher Focus Group Guide	XAL Teachers	4 focus groups	The focus group guide was designed for teachers to reflect on their experience implementing XAL videos and instructional materials. We conducted 4 focus groups with a total of eleven teachers (4 third grade and 7 kindergarten).
Student Post-Survey	XAL 3rd Grade Students and Comparison Group of 3rd Grade Students	Treatment: 130 students Comparison: 42 students	We developed a retrospective post-survey for 3rd grade students to document potential outcomes of the XAL materials. The survey was designed to measure the following constructs: science learner identity, attitudes toward science, curiosity/exploration, and persistence. A modified version of the survey was administered to 3rd grade classrooms with students who did not engage with XAL materials to allow us to make comparisons.
Kindergarten Focus Group Guide	XAL Kindergarten Students	20 students	Due to limited reading proficiency, we developed a focus group guide for collecting data regarding outcomes for Kindergarten students. We implemented a total of 4 focus groups with kindergarten students.
Parent/ Caregiver Survey	Parent/ Caregivers of XAL Students	11 parents/ caregivers	The parents of XAL students also received a survey at the conclusion of implementation to gather evidence from their perspective regarding outcomes of videos and instructional materials. This survey also included items designed to gather feedback regarding the Family Moment activities.

Data Analysis[2]

The teacher surveys and module feedback form were administered through Qualtrics, an online survey platform. All other quantitative data from observations and student surveys were entered into Excel spreadsheets and checked for errors. Quantitative data was used to generate descriptive statistics for frequencies and central tendencies (e.g., mean scores) and inferential statistics (e.g., comparisons from pre- to post-) using the analysis software, SPSS.

Data from the teacher and Kindergarten focus groups and open-ended survey items were analyzed using qualitative methods. We used inductive coding (Charmaz, 2006) to code the focus group data and open-ended items to identify themes that emerged from participants' responses and that were informed by the research questions. The themes were then checked against the corpus of data to look for confirming and disconfirming evidence to support our claims and assertions.

Key Findings from Pilot Implementation

The key findings discussed in this section reflect the broad themes that emerged across the various data collection strategies and are organized by each of our research questions and sub-questions.

Research Question 1: Will grades K and 3 elementary school teachers be able to successfully include instructional units of varying length based on one or multiple XAL videos in their classrooms, given that the videos aim at instilling curiosity, discovery, experimentation, or questioning?

Research question 1 focused on the value of the integrated XAL Video and classroom Instruction Units for teachers. We explored this idea by using the following sub-questions:

- Do teachers consider the XAL instructional units valuable for their students' engagement, learning, and growth?
- Are the XAL instructional units easy to use for teachers?

Value of XAL Modules

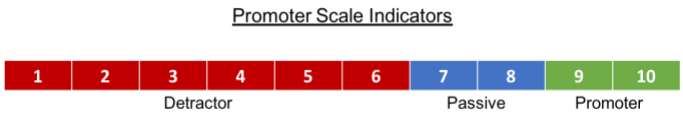


Figure 1. *Illustration of Net Promoter scale indicators*

[2] Due to challenges with recruiting, the sample for the comparison group is considerably smaller than the treatment group. However, a sample size of over 20 was acceptable; we conducted additional statistical analyses to account for uneven sample sizes.

To assess the perceived value of the XAL materials to teacher participants, the OSU Research team asked a series of three questions on post-implementation surveys that rated the value, likelihood of future use, and likelihood of recommending the materials to a colleague on a 10-point scale (Figure 1). For each individual, the average rating of those three statements created a Net Promoter score, ranging from 1 to 10. Figure 1 illustrates the delineation of Promoter scale indicators. Respondents with an average rating of 9 or 10 are considered "Promoters" who had a positive experience and are willing to actively promote it with others. Those with average scores of 7 or 8 are considered "Passive" and are satisfied with their experience, but perhaps unwilling to actively recruit new participants. Those with an average score of 6 or below are considered "Detractors" who are dissatisfied with their experience and likely to share their dissatisfaction with others. When using the Net Promoter score as a tool, the aim is to maximize the ratio of Promoters to Detractors, resulting in a positive score. It is never expected that there will be zero Detractors who walk away from engaging in an organization, but successful organizations will have more Promoters than Detractors. When asked to rate the XAL materials overall (Figure 2), respondents reported an average Promoter score of 8 and overall there were 53% Promoters and 20% Detractors (Figure 2), giving XAL an overall Net Promoter Score[3] of +33 (on a scale of -100 to +100). This figure shows **satisfaction with the materials** and a modest **willingness among teachers to promote them**. As one teacher said, "The activities were wonderful. I had another teacher come in while we were working, and she said she had never seen kids so excited." Table 4 shows the overall Net Promoter score for XAL materials, along with individual scores for each of the three modules.

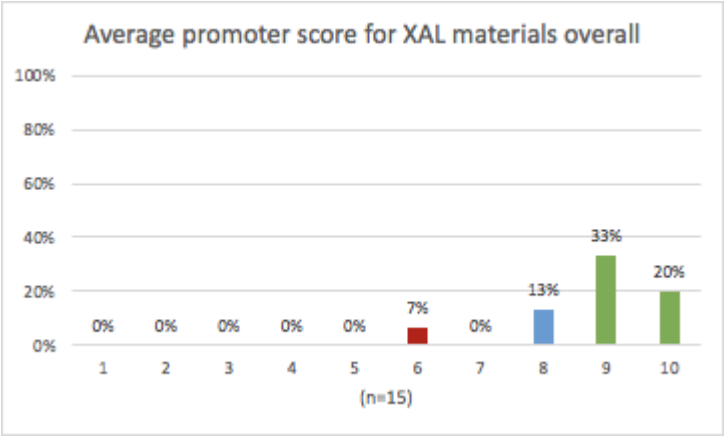


Figure 2. *Distribution of Promoter scores for XAL overall*

Table 4: *Net promoter scores (scale -100 to +100) and average promoter scores (scale 1-10)*

	Nutrition and Poop module	Orchids module	Waterways module	XAL materials overall
Net Promoter	+27	+25	+33	+33
Average Rating	8.1	8.3	8.6	8.0

[3] Net promoter scores range on a scale from -100 to +100. In general, any positive value for a net promoter score is encouraging as it reflects that there are more promoters than detractors. An ideal Net Promoter Score would be 100, suggesting that all of the respondents are promoters; however, a score of 50 is considered good.

Teachers also provided ratings for the Nutrition and Poop, Orchids, and Waterways modules. Each of the modules included videos and activities specific to the topics at hand. The assessments provided by Net Promoter scores were corroborated by the average ratings given by teachers in module feedback forms (Table 5).

When asked to rate the helpfulness of module materials in achieving key learning outcomes for students, teachers highly rated all three modules (with an average above 4 on a 5-point scale) for their **use in helping students learn key scientific concepts**. The Nutrition & Poop and Waterways modules were similarly highly rated for **being engaging for students**, while the Waterways module was highly rated for **developing students' questioning skills**.

Table 5: *Module feedback on XAL materials (5-point scale)*

	Nutrition & Poop n = 11	Orchids n = 12	Waterways n = 9
This module helped students learn key scientific concepts.	4.3	4.1	4.0
This module was engaging for my students.	4.5	3.9	4.6
This module developed students questioning skills.	3.8	3.7	4.2

In responses to the teacher pre- and post-implementation surveys there was a split between teachers who had previously participated in PAST Foundation workshops (n=9) and those who had not (n=6). Those who had, felt that the materials reinforced for them the value of active learning while those who had not appeared to welcome the new experience.

- ***Reinforcing existing approaches*** (3 comments): *"For me, it strengthened the importance of the focus on the design cycle[4], on STEM, and the hands-on aspect as a valuable resource for all children."*
- ***Replacing traditional methods*** (3 comments): *"I liked that we didn't [have to] open a single textbook. Sure, we would sometimes read about topics, but the activities were very hands-on and the learning still happened."*

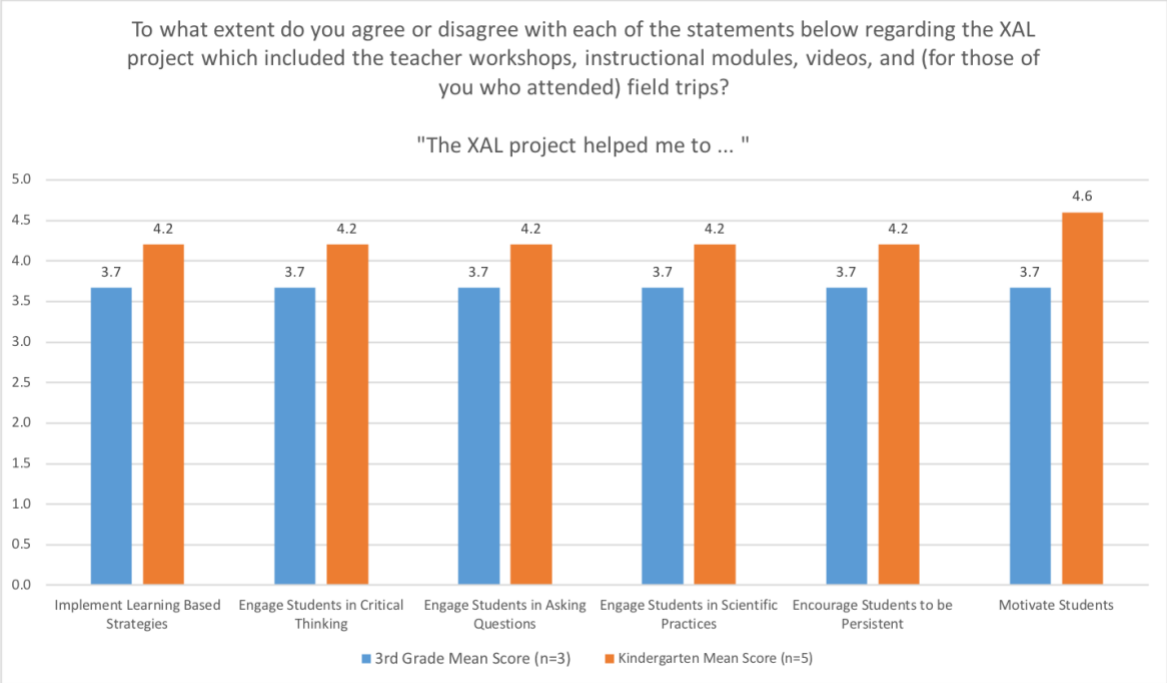
During focus groups, teachers were asked to speak about the ways in which their experience with XAL (including the accompanying professional development opportunities) may have impacted their students. Teachers provided the following types of responses:

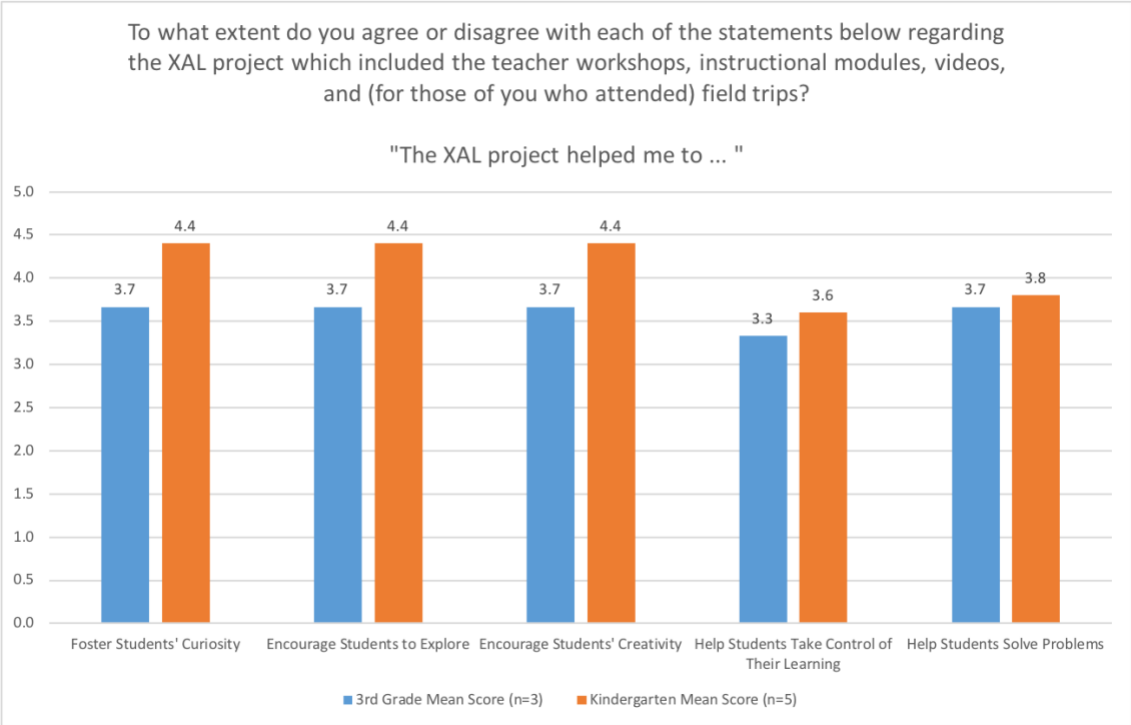
[4] By "design cycle", this respondent is referring to the development cycle of inquiry and analysis, idea development, solution creation, and evaluation (thus returning to inquiry and analysis) that is frequently taught to students in project-based learning environments as a process guide for designing solutions to a problem.

- ***Expanded vocabulary*:** *"They kept the vocab they learned in Nutrition and carried it into Waterways. They were able to take what they learned in one module and carry it into the next."*
- ***Enthusiasm for the topics***: *"A large portion of their responses was that their favorite thing to do was learn about flowers, or learn about pandas. Their enthusiasm showed up in their responses, when it could have been any number of things from throughout the year."*
- ***Access to quality materials and resources***: *"I was able to be more creative for some of the things because of the funds provided by the Pilot."*
- ***Classroom preparedness***: *"Things went so much smoother in class when we [teachers] took time to practice the activities with PAST."*

Shortly after the conclusion of Pilot project activities, teachers were asked to rate how well XAL aided them in achieving certain outcomes related to active learning, instilling curiosity, discovery, and questioning (Figure 3). Ranked on a 5-point scale, teachers rated each of the outcomes at an average score above 3, indicating that the **XAL materials added at least a moderate degree of support across the board**. Kindergarten teachers provided high (above 4) average ratings for nine out of eleven listed outcomes. 3rd grade teachers, on the other hand, provided more modest ratings (between 3 and 4) for most listed outcomes. Although these results should be interpreted with caution due to low response rates for these questions, and though further study is required in the next phase of this project, there is an initial indication that materials generally worked better for kindergarten teachers than for 3rd grade teachers.

Figure 3. *Teacher ratings for support in achieving outcomes*





Usability of Videos and Materials

In focus groups and feedback forms, teachers had much to say about the quality and usability of the videos and materials. Overall, this feedback suggested that the XAL videos and materials were easy to use. When asked open-ended questions about what should be kept or used as the basis of future materials, teachers provided the following types of responses:

- ***Engaging topics*** (9 comments): *"The topic of conversation every morning class meeting was the modules and what they might get to do next."*
- ***High production quality*** (6 comments): *"The hands-on activities were wonderful! I had another teacher come into the room while we were working on the insect project and she said she had never seen kids so excited." "The videos were documentary-esque, just like shows that the students watch and are into at home."*
- ***Expanding on existing curriculum*** (6 comments): *"These are units that I usually struggle to find design challenges for. I appreciate that these are projects I can use to expand those units."*

Across the board, teachers used each video for three primary reasons: 1) to **introduce the topic** to their students, 2) to **motivate or excite** students, and 3) to **explain a concept**. While occasional technological issues were reported (e.g. "my video froze during viewing", "my school blocked the content"), **26 out of 32 module feedback responses reported no technical issues**. Below are usage statistics for each module and video, which corroborate the primary use of the videos as introductory "hooks" to motivate and excite students for the upcoming unit, and as

mid-module "explainers" to describe topics and phenomena (Tables 6-8). The most prominent figures are highlighted in orange.

Table 6: *Orchids Module Usage (n=12)*

Timing of video usage during module implementation:	Smithsonian Gardens	Orchids
Beginning	55%	55%
Middle	18%	9%
End	9%	9%
Continuously	18%	27%
Mean no. days of module implementation: 10.5		

Table 7: *Nutrition & Poop Module Usage (n=11)*

Timing of video usage during module implementation:	Lion Nutrition	Lion Poop	Panda Nutrition	Panda Poop	Poop Analysis
Beginning	56%	33%	60%	73%	33%
Middle	44%	44%	30%	18%	50%
End	0%	22%	0%	0%	17%
Continuously	0%	0%	10%	9%	0%
Mean no. days of module implementation: 9.5					

Table 8*: Waterways Module Usage (n=9)*

Timing of video usage during module implementation:	Electrofishing	Catfish Surgery	Crab Tagging	Seining
Beginning	33%	17%	14%	50%
Middle	33%	50%	71%	13%
End	17%	17%	0%	25%
Continuously	17%	17%	14%	13%
Mean no. days of module implementation: 10				

Teachers generally noted that the videos and materials were easy to use and of high quality. Nonetheless, a few teachers experienced minor usability issues that are common when using technology in classrooms. Most commonly, teachers noted that they had challenges showing the videos because their schools blocked the content, and slow internet or streaming capabilities resulted in the videos freezing or audio lagging behind in the video. However, teachers in this project were also provided access to videos and materials through individual USB drives which providing offline access that helped to combat these issues.

During focus groups and on the module feedback form teachers made suggestions for improving the materials in the future: stronger integration of the materials with other subjects (e.g. building in opportunities to practice reading and writing, or forming stronger connections between XAL module subjects), ensuring that materials were more developmentally appropriate for kindergarteners, and adding suggested supplemental resources. Examples of teacher feedback for improvements are as follows:

- **Stronger integration with other subjects** (10 comments): *"The three separate units could have been put together as one huge unit, a giant habitat unit." "I would have liked suggestions for incorporating other areas like reading and writing."*
- **Making materials more developmentally appropriate for kindergarteners** (9 comments): *"I think it went over their heads a little. I was a little bit hesitant after watching [the videos] that for the kindergarteners the content would go over their heads, but the kids loved them." "The lion portion, especially dealing with hormones, was way over their head." "The videos were a little too fast to play just once-- I had to play them multiple times for maximum absorption." "With the orchids module I had to give my [kindergarten] students more support and guidance than with the other modules."*
- **Including recommendations for supplemental resources** (7 comments)**: "***We added a lot of books, videos and songs to extend the learning and activities. It would be nice to have a list of books, videos, songs to supplement."*

Research Question 2: Will grades K and 3 elementary school teachers who experience these instructional units show growth on fundamental measures of affective and cognitive learning associated with discovery-based instruction?

Research question 2 is aimed at understanding whether use of the XAL Instructional Units influenced participating teachers' thinking about discovery-based instruction and their self-efficacy in using such approaches.

Teacher Pedagogy

A key theme that emerged from the research and evaluation study were slight but noticeable shifts in teachers' pedagogy and thinking about science instruction. Teachers were prompted to reflect on and note any changes in their teaching as a result of participating and having access

to XAL materials. Although some of the teachers indicated that their instruction remained the same (e.g., "*I wouldn't say that my instruction changed much*."), others noted that the videos and instructional units were different from the instructional practices they would normally implement or it gave them fresh ideas for teaching the topics in new ways. In particular, teachers indicated that the activities were more "hands-on" than how they would typically teach.

The responses on the module feedback form highlights these ideas:

> *"Many of the XAL activities were ones that I would not have developed on my own. As a result, my students had the opportunity to engage in hands-on activities that they normally would not have."*
>
> *"The activities in the waterways module were not something that I would have thought of doing in the past. However, the students were highly engaged in the activities and did gain knowledge that will hopefully stick with them."*
>
> *"The module gave me ideas for hands-on activities."*

Teacher focus groups provided a rich space for XAL participants to reflect upon their experiences with XAL and how those experiences might carry forward into their practice. When asked how, if at all, their **participation in the XAL project has influenced <u>how they think about teaching science</u>,** teachers discussed the following four key points:

- ***Shifting expectations for student learning***: Expressing a realization that students could learn or achieve more than teachers expected.

  > *"We didn't just learn the plant parts, we took it one step further. They learned so much more than I thought they could at this age."*

- ***Hands-on activities***: An increased openness to using hands-on activities in the classroom.

  > *"Prior to this I was really hesitant to do hands-on activities but I pushed myself. It really encouraged me to let them use their creative abilities, to give them free reign."*

- ***Integrating subjects***: Realizing that science can be integrated into other subjects covered in elementary school classrooms, such as reading or writing assignments.

  > *"You can incorporate science into a journal for writing, a measuring unit for math—you can make a science lesson stretch into a whole day and incorporate it into everything."*

- ***Focus on science***: Recognizing a need to teach more science in the classroom.

  > *"I need to do more science." "My school usually pushes science and social studies through reading, and this gave me a way to do more with hands-on activities in science."*

When asked in what ways, if at all, the **professional learning opportunities they participated in with PAST influenced their instructional approach and practices moving forward**, teachers discussed:

- **Value of collaboration**: Finding the value of collaborating with other teachers to test or co-develop activities before implementing them in the classroom.

  "[XAL] gave you the opportunity to outline everything and think about what you were going to do, and use other people's ideas. The opportunity to share gave you space to brainstorm and collaborate that was really valuable to me."

- ***Importance of preparation***: Recognizing the smoothing effect of preparing for classroom implementation.

  "Doing it ahead of time like the students gave us the opportunity to see what we might need to change to get the most out of it."

- ***Space for creative exploration***: Giving students space to independently create and explore, in order to grow as learners.

  "I let them build and create whatever they were envisioning. It was hard at first, but I learned to step back and let them work through their challenges and grow through the experience."

- ***Reinforced approach***: Reinforcing the value of approaches teachers already take in using the design cycle, focusing on STEM, and using hands-on activities in the classroom.

  "For me, it strengthened the importance of the focus on the design cycle, on STEM, and the hands-on aspect as a valuable resource for all children."

And when asked in what ways, if at all, will their experience **implementing the videos, instructional modules, and field trips with students influence their instructional practice moving forward,** teachers spoke about:

- **Enriching students in and out of class**: Recognizing that the experiences students have in the classroom have the potential to enrich their lives outside of class, as well.

  "95% of my class has never been to a zoo, for them to grasp that concept that there's a place where you can go to see lions that isn't in the wild or in a book, that was amazing to them-- that is real, it's not just something on TV."
  "Something I would push myself to do in the future is how to connect this at home… looking at ways that I can reach out to families and get them able to explore the community."

- **Experiential learning**: Noticing the effect of experiential learning in creating formative connections for students.

  "I have to wonder if the connections they could make because of their trip to the conservatory, if that was why they showed the most growth in the pre/post tests

in the orchids module." "Yes, the kids can read about animal adaptations, but to see it takes it to a whole different level. It brought it all to life"

- **Peer-sharing and showcasing student work**: Using the strategy of peer-sharing and showcasing student work to hold students accountable for the content they learn.
  "It held students more accountable because then they knew that they were responsible for sharing that knowledge with others… they had to be accountable because they needed to show what they know to their families and their peers."

Teacher Self-Efficacy

Collectively, the data gathered from teachers highlighted a shift in aspects of their self-efficacy, their confidence in being able to perform certain tasks, as a result of participating in the XAL pilot. In particular, teachers noted changes related to working within collaborative teams and through participation in the professional opportunities offered by PAST, especially the 2-day workshop. One teacher explained on the survey how her confidence was shaped by these activities:

> *"I brainstormed with colleagues from my school and our other district school. Because the whole unit was planned out and discussed, I felt very confident in implementation. I also attended the Saturday workshop at PAST where we worked through the activities and had the opportunity to share and discuss ways that we would implement them with our students. Hearing the ideas of other kindergarten teachers was very helpful when it came time to plan and implement in my classroom."*

In focus groups, teachers spoke particularly about two main shifts in how they think about teaching:

- Shifting expectations about **how much their students are capable of learning** in the classroom, and
- A willingness to **include more hands-on and experiential learning** in their classrooms.

Teachers also told of realizations they had about the content they usually cover:

- The possibility of **integrating other subjects** into science lessons.
  "You can incorporate [science] into so much more. Next time I can incorporate a journal piece for writing, a measuring unit for mathematics-- you can make a science lesson stretch into a whole day and incorporate it into everything."
- A need to **focus more on science** as a subject.
  "[XAL] made me really spend the time to teach each lesson where so often science and social studies are heavily pushed through reading [at my school], so I don't

usually spend a lot of time doing hands-on activities in science. It gave me an excuse to play more with that area."

In pre- and post-implementation surveys, teachers were asked to rate their confidence in their ability to perform tasks associated with discovery-based instruction on a scale of 1 “Cannot do it at all” to 10 “Highly certain I can do it”. Table 9 shows the mean difference for each item from before to after participating in XAL. The results of these data are limited by the small sample size (n=8) and further results should be explored with a larger pool of respondents in the next phase of this project. However, these preliminary results indicate a statistically significant increase in the self-efficacy on **engaging students in stating problems**, and **encouraging students to think critically**.

Table 9: *Teacher confidence from pre- and post-surveys (10-point scale)*

TASK:	**MEAN PRE-SCORE**	**MEAN POST-SCORE**	**MEAN INCREASE:**
Implement problem-based learning strategies with students in the classroom	5.5	6.0	0.50
Engage students in stating problems *	5.3	6.0	0.75
Help students brainstorm solutions	6.0	6.3	0.25
Help students design solutions	5.9	6.3	0.37
Help students build solutions	5.9	6.1	0.25
Help students evaluate solutions	5.6	6.0	0.37
Help students modify solutions	5.8	6.1	0.37
Help students share and communicate solutions	6.0	6.4	0.37
Engage students in asking questions	6.1	6.3	0.12
Engage students in scientific practices	5.4	5.8	0.37
Encourage students to be persistent	5.9	6.0	0.12
Motivate students	6.1	6.3	0.12
Foster students' curiosity	6.1	6.1	0.00
Encourage students to explore	5.8	6.3	0.50
Encourage students' creativity	6.3	6.3	0.00
Encourage students to think critically *	5.6	6.3	0.62
Help students take control of their learning	5.4	6.3	0.87

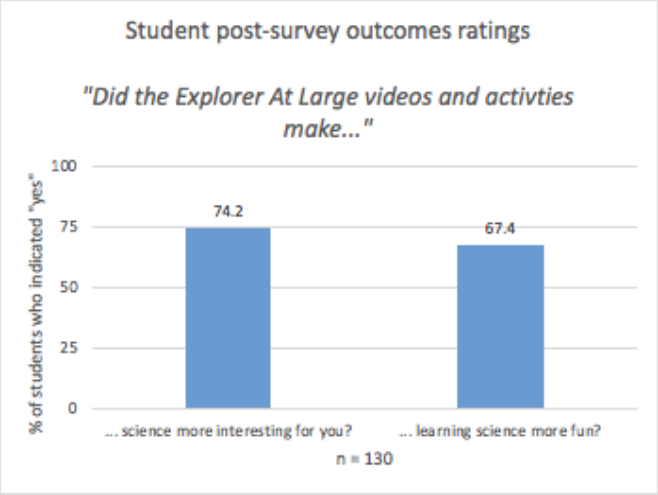
Research Question 3: Will grades K and 3 elementary school students who experience these instructional units show growth on fundamental measures of affective and cognitive learning associated with discovery-based instruction?

Research question 3 examines learning outcomes for the students who engage with XAL materials and is divided into the following set of connected sub-questions:

- Will the units be interesting, satisfying, and thus engaging for children?
- Will the units achieve certain desired outcomes, including content and process learning, STEM Learner Identity, STEM Capital or STEM Affinity, growth mindset; self-assessed persistence, and self-assessed curiosity?

Enjoyment and Satisfaction

Figure 4. *Student post-survey ratings of XAL videos*



Across the data sources, teachers reported a high level of student engagement with the materials, but most especially with the Waterways and Nutrition & Poop modules (see Table 5). As one teacher reported in a focus group, "The topic of conversation during morning meetings was always the modules and what they might get to do next." Figure 4 shows the percentage of 3rd graders who affirmed in post-implementation surveys that they felt XAL **made science more interesting** for them and **made learning science more fun**.

Focus groups with kindergarten students revealed that the **videos were memorable and exciting** for the students. Kindergarten students made comments such as: "I remember it was a good video" and "It was so funny when he got the poop." Even weeks after watching the videos, kindergarten students remembered the videos and were able to recall specific examples from watching the videos, particularly for the Nutrition & Poop activities. For example, students explained: "I remember they were outside and they saw lions and they were pick up poop and they saw glitter in them." Another student explained, "I remember when he was on the boat, they put something in the water. A net. To catch stuff."

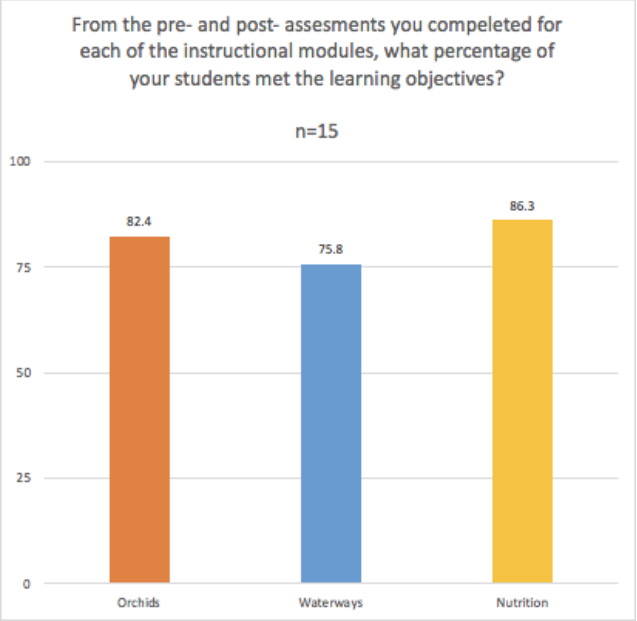
This enjoyment was further corroborated by both parents and teachers. During focus groups and in module feedback forms, at least five teachers made comments about **how much students loved the module topics** (*"They loved learning about poop!"*) and videos (*"The videos made the kids interested. Without the videos, I do not feel like they would have been as engaged."*), while one teacher reported that a caregiver reached out to express how much their child loved the science they were learning. 3 out of 4 kindergarten caregivers and 6 out of 7

third grade caregivers reported that they were "familiar with the XAL project". When asked whether their child talked about the XAL videos, 2 out of 4 kindergarten and 3 out of 5 third grade caregivers said "yes". Of those caregivers whose children attended a field trip, all respondents reported that their child talked to them about the field trip. These data demonstrate a level of satisfaction among students that was great enough for them to **talk about their experiences at home**.

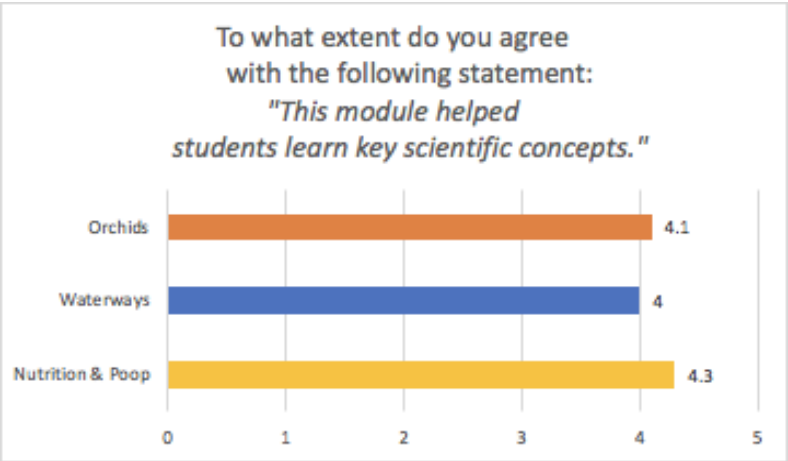
Student Learning

Science Content. According to teacher assessments, a notable number of students met learning outcomes using the XAL materials. In post-surveys, teachers reported the percentage of their students who met the learning objectives for each module, based on personally designed and administered pre- and post-module evaluations (Figure 5). On average, students met the learning objectives for each module at the following rates: 86.3% in Nutrition & Poop, 82.4% in Orchids, and 75.8% in Waterways.

Figure 5. *Percentage of students that met learning objectives*



When asked open-ended questions about how well they believe the materials helped them engage their students in exploration of scientific concepts, **there was evidence that students gained transferable knowledge** and an **emergent understanding of scientific concepts** (Figure 6). Examples include:



- ***Transferable knowledge*** (5 comments): *"They were able to take what they learned in one module and carry it into the next."*

- ***Emergent understanding*** of concepts (7 comments): *"It's a good introduction to scientific concepts, considering they're in kindergarten and it's their first year in school."*

Figure 6. *Teacher post-survey module outcomes ratings*

One kindergarten teacher on the module feedback form was especially excited to share an example of their students' science content learning. They explained:

> *"My students learned new vocabulary and were able to apply them correctly in discussions and/or activities. An example would be pollinators and pollination: When we went to the wetlands they were 'finding pollinators,' in their words. We had a Metro Parks person talk to us about invasive species and my kids could tell him what they were and were not with examples shown to them. I was quite proud. :)"*

We used focus groups to understand how kindergarten students learned science content through the XAL videos and materials. There was evidence from the kindergarten focus groups that the students learned science content as a result of implementing the XAL materials. A few examples included:

> *"The bees, they were gonna get it to another one [flower]. They take it from the flower to another"*

> *"I learned from the videos that they [pandas] have a pseudo-thumb, sharp teeth, they eat bamboo, and their poop is green and the panda even poops in their sleep."*

> *"They use the poop to make sure that the animals are healthy and they use a magnifying glass to look at the animal poop."*

The self-reported teacher and student data was complemented by the classroom observations conducted in a sample of classrooms by a member of the OSU research team. There was some additional evidence of students engaging in science concepts throughout the 8 lessons observed, primarily through learning vocabulary terms associated with the science topics of the modules. A few excerpts from the OSU team member's notes on the observation protocol highlight some of the ways students were engaging with science concepts through the XAL materials:

- In a kindergarten classroom, students were learning science concepts related to animal habitats and three aspects of a habitat: food, water, and shelter, as evidenced by students' comments during the think-pair-share activity and subsequent whole group discussion:

> *"My panda's name is Ana. In Ana's habitat, I'm going to include some trees and leaves."*

> *"In my panda's habitat, I'm going to put water, a house, and food."*

"In my panda's habitat, I'll be able to give him bamboo, a little bit of bamboo, and then food and a drink. I'll give him some water."

- The students in a 3rd grade class were raising chickens as part of another science unit and a few of the first eggs hatched shortly before observed XAL lesson. The students made a connection between the XAL and their experience learning about the chickens. The excitedly called out to the teacher: "*Ms. [teacher's name], our chicks are omnivores!*"

These snapshots of classrooms offer additional evidence that the XAL modules demonstrated success in introducing students to science concepts.

Process of Science. We wanted to also understand how students engaged in the process of science using the eight science practices outlined in the Next Generation Science Standards (NGSS) as indicator. Evidence from the module feedback form, surveys, focus groups, and classroom observations indicated that the XAL materials engaged students in these scientific practices. Because the videos and materials focus on curiosity and exploration, we anticipated that students would particularly develop and refine their questioning skills and therefore our data collection specifically probed for this skill.

The module feedback form asked teachers to indicate which science and engineering practices their classes engaged in as a result of engaging with each module. Table 10 shows the percentage of teachers who affirmed that their class engaged in each practice. Most notably, a large majority of teachers reported that all three modules engaged students in ***asking and defining problems***, ***planning and carrying out investigations***, and ***obtaining, evaluating, and communicating information***. A large majority of teachers also indicated that both the Nutrition & Poop and Waterways modules engaged students in ***analyzing and interpreting data***. That is, the modules were seen by teachers as engaging students in half of the 8 science and engineering practices of the NGSS.

Table 10: *Percentage of classes that engaged in each science and engineering practice*

	Nutrition & Poop (n=11)	Orchids (n=14)	Waterways (n=9)
Asking questions and defining problems	73%	71%	78%
Developing and using module solutions	27%	29%	56%
Planning and carrying out investigations	64%	64%	89%
Analyzing and interpreting data	73%	14%	89%
Using mathematical and computational thinking	18%	14%	56%
Constructing explanations and designing solutions	27%	50%	56%

Engaging an argument from evidence	18%	7%	44%
Obtaining, evaluating and communicating information	82%	64%	67%
I do not think students engaged in any science or engineering practices	0%	0%	0%

Teachers expanded on these items through an open-ended prompt that asked them to provide evidence, if possible, of how the students engaged in practices through the XAL activities. The following represent a few of the examples shared by teachers:

> *"The scat hunt allowed them to analyze the data as they found the scat and determined what animals ate."* (Analyzing and Interpreting Data, Nutrition and Poop Module)

> *"I had students complete a nutrition and poop journal on themselves to see how what they eat affects what/how they poop. Students developed questions based on the information they obtained from these journals and discussed their findings with their classmates."* (Asking Questions & Communicating Information, Nutrition and Poop Module)

> *"During the tracking activity, my students took turns being scientists and tracked the movement of a group of 'fish'. We then drew conclusions about why they may have gone to our avoided certain areas."* (Analyzing and Interpreting Data, Waterways Module)

To probe teachers' perceptions specifically regarding the science practice of asking questions, we included an item on the module feedback form asking teachers to elaborate on the development of these skills in their students. In response to this item, teachers primarily shared examples of the kind of questions they asked with students in relation to each module. One teacher pointed out that questioning, in her opinion, was a challenging skill to develop with kindergarten students. However, teachers who responded to this item suggested that students did generate some questions throughout the implementation of the three instructional modules:

> *"My students were very inquisitive about learning more about animals and what their scat can tell us." (Nutrition and Poop Module)*

> *"When we saw geese poop on the playground, they wondered if they could determine its diet from the appearance of the poop." (Nutrition and Poop Module)*

> *"The students questioned how flowers are similar and different. They questioned why flowers might have specific characteristics." (Orchids Module)*

"We asked questions about what we saw in the creek." (Waterways Module)

When asked during the focus group **how well the materials, if at all, helped develop students' questioning skills** teachers spoke about two aspects of questioning: student-driven inquiry, and prompted inquiry. Exemplary comments included:

- ***Student driven-inquiry*** (4 comments): *"I had to make them promise me that they would not go home and take their poop out of the potty to figure out what their diet is… they had decided that they could ask questions, and they could find their own answers, and I love that they believe that."*
- ***Prompting student inquiry*** (2 comments): *"It gave them the confidence to ask and answer questions on their own because the topic and the layout of the activities prompted that-- there was a natural next step to asking questions and guiding that [inquiry]."*

During the Kindergarten the focus groups, students were asked if the videos or learning activities prompted them to want to ask questions. Most of the students (17/20) noted they had questions to ask and when probed further, some provided specific examples:

"Why don't those pandas have thumbs?"

"Why were they using the net to check on the animals?"

"Why were they putting poop in the fridgerator [sic] or the freezer?"

"Why [do] pandas eat bamboo?"

The other students who responded yes were either not able to articulate their questions or made statements from the video (e.g., "*The panda bears. They eat too much bamboo and they drink water*.") rather than providing questions.

The OSU research team only observed one example of students engaged in science practices during classroom observations. Specifically, in one classroom implementing the Nutrition and Poop module, the **students were engaging in asking questions**. In the previous day's class, they discussed questions they could ask while they were at the zoo about the animals and how the zoo cares for animals. As a whole group they created a list of questions they could explore during their experience at the zoo. In the class observed, they considered these questions in their field trip planning and also brainstormed new questions they might ask about the animals they plan to visit at each continent. For example:

- Why do markhor have swirled antlers? How does this adaptation help them?
- What do bonobos eat?
- Why are red pandas so cute?

- I know that baby kangaroos are called joeys and live in their mom's pouch, but where do they come from?
- Why do mandrill baboons have blue on their bottoms? Is their face blue and red because they painted them that way like native Americans paint their faces?

Another theme, related to the process of science, that emerged from the input we gathered with teachers was the notion of students understanding the work of scientists. Teachers pointed out that the videos highlighted scientists engaged in research and the supplementary learning activities allowed them to make connections to this work in the classroom. In this way, the XAL videos and activities promoted awareness among students of the real work of scientists. The following responses on the module feedback form highlight this emergent finding:

> *"The modules connected the content that we are required to teach to how it is used by scientists. This gave the students more understanding of why they were learning about it."*
>
> *"They much better understand the wetlands habitat and how scientists monitor the health of waterways."*
>
> *"Students learned a lot of what scientists do through watching the videos."*
>
> *"My students gained a better understanding about a day in the life of a scientist."*

Student Engagement

A theme that emerged across the data collected was that the XAL videos and activities were highly effective at engaging students. Nearly all of the responses to the module feedback form (34 out of 35) either agreed or strongly agreed that the modules were engaging for students. As one teacher commented on the module feedback form, "*They were incredibly engaged in this content*" while another noted, "*Not only did they learn throughout the unit, but they were excited to know what was coming next. And they were engaged throughout each lesson every day*."

Teachers and students noted that the materials were engaging because the topics were interesting— especially the content from Nutrition and Poop materials: "*Talking about poop builds high interest whereas if I were to teach about nutrition and healthy eating alone, students would not have been as motivated."* The videos, a teacher pointed out, allowed students to experience places they might not otherwise have an opportunity to see*: "They were able to see places and things they have not seen. The lion in the zoo they see but not the behind the wall. Seeing the research area was valuable. The electric fishing, they would not be able to experience this. These are just a few examples I can think of."*

Moreover, the teachers noted that the classroom activities offered choices, opportunities for "hands-on" instruction, and encouraged students to be creative. For example, on the teacher post-survey, three respondents mentioned that having *"more hands-on, student led activities"* was one of the major impacts upon their students. As one teacher commented about the Orchids unit, *"I think this was effective because students were able to be very creative in creating their own flowers, but at the same time learning concepts and vocab."* These themes also emerged at various times on the module feedback form and during focus groups when teachers talked about the impact of XAL in engaging students through the hands-on activities and active learning:

> *"My students chose their own animal to research. They loved picking it out and creating a habitat for that animal."*
>
> *"The students were so excited to create their own flowers and pollinators. They especially liked that they could create anything and had so many choices for materials."*
>
> *"My students were highly engaged when they were able to create their new species of flower and how they designed their flower based on a specific climate and to attract a specific pollinator."*

This was also a salient theme during the classroom observation, where the XAL materials seemed particularly successful at engaging students in the activities and relevant science topics. An OSU team member noted high levels of engagement on the observation protocol, indicating that 100% of students were engaged in 7 out of 8 of the classrooms. Informal conversations following the observations revealed that teachers believed the students liked the activities and they thought they were fun. The students liked that the activities got them out of their seats, moving around, and active. Many of the activities also offered choices for students which helped with engagement because the students had greater "buy-in". For example, some of the teachers allowed students to select an animal for the My Plate activity and students were excited to learn more about their chosen animal's diet.

Responses on the parent/caregiver survey offer a final perspective that further corroborates these findings. While there were limited responses on the survey (n=11), parents/caregivers comments highlighted that the XAL videos and activities were exciting and fun for the students.

> *"My daughter said that they were funny and very interesting. She said she would get excited because she knew after the videos that there would be a fun activity. She loved learning new things in fun ways."*
>
> *"My child was more excited to talk about what they learned in class."*
>
> *"PLEASE continue to do things like this. My daughter enjoyed going to school and participating in this."*

The quotes exemplify how students were excited enough to talk about their experiences at home and that parents noticed this excitement.

Attitudes Toward Science

The 3rd grade student survey contained two scales targeted at understanding any changes in students' attitudes toward science and science learning resulting from engaging withe XAL videos and instructional materials. Because we used a retrospective survey, third grade students were asked to rate the items on these scales after the implementation of XAL in their classroom and prompted to reflect on how they would have responded before XAL.

Table 11 displays findings from the attitude scales included on the 3rd grade survey. There was a statistically significant increase from before to after implementation of XAL on both the attitudes toward science and attitudes toward science learning scales. However, only the attitudes toward science learning scale was found to be statistically higher than the comparison group. This means that although there were positive changes on both of the attitudes scales, only attitudes toward science learning can be statistically attributed to interacting with XAL materials and activities.

Table 11: *Science Attitude Scales*

	Retrospective Pre- (Treatment)	Post- (Treatment)	Comparison
Attitudes toward Science	3.6 n=132	4.5* n=132	4.4 n=42
Attitudes toward Science Learning	3.4 n=123	4.2* n=122	3.7* n=42

* Indicates results were statistically significant

Identity

Another construct we explored as a potential outcome was students' identities. By identity, we refer to students' sense of self in science and specifically, their identity as a learner of science. We anticipated that activities designed to engage students in the science process would influence how they thought of themselves as a learner of science. Table 12 highlights the findings related to the identity scale included on the 3rd grade student post-survey. Across the four items on the scale, **students indicated an increase from before to after the XAL implementation** and this change was statistically significant. And, when compared to a comparison group of students, these changes were found to be statistically significant.

Table 12: *Science Learner Identity Scale*

	Retrospective Pre- (Treatment)	Post- (Treatment)	Comparison
Science Learning Identity	3.3 (n=115)	4.2 (n=112)	3.6* (n=39)

*Indicates results were statistically significant

Of the caregivers who completed the section on science learner identity in the family survey, all five respondents agreed that after participating in XAL their child both ***thinks of themselves more as someone who like to learn science*** and that ***they (the caregiver) thinks of their child more as someone who likes science***.

In the teacher post-survey, two teachers mentioned that one of the major impacts of XAL was that their students "**felt like real scientists"** and "**came to believe that they were scientists and explorers**", particularly as they engaged in hands-on activities like visits to the Battelle Darby Creek.

Curiosity and Exploration

The XAL videos and learning activities are intentionally designed to spark students' creativity and tap in to their natural curiosity and sense of wonder. As such, the study was designed to measure any potential changes in students' curiosity and sense of exploration through the 3rd grade surveys and Kindergarten focus groups.

An item on the 3rd grade post-survey asked students to rate the degree to which the XAL videos and materials resulted in changes related to curiosity and exploration (Figure 7). As displayed in Figure 7, **most students (63-77%) indicated that the XAL materials did lead to changes related to curiosity and exploration** such as wanting to figure things out, explore new places, solve problems, wonder about how things work, and come up with new ideas.

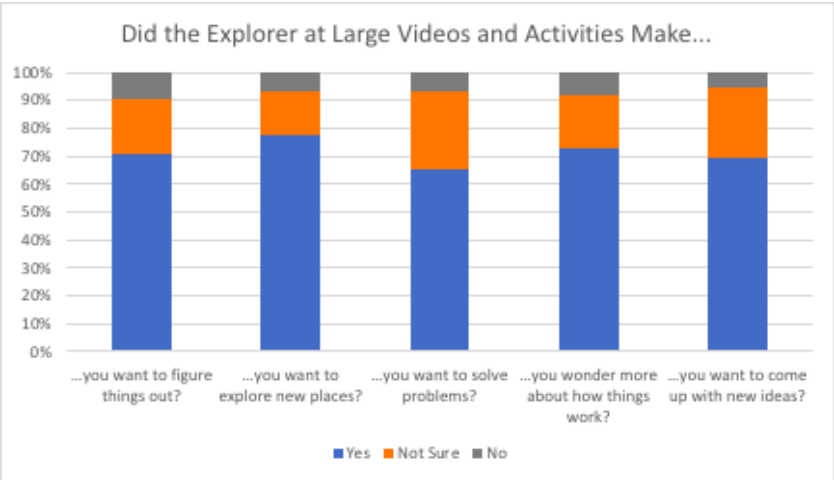


Figure 7. *Changes in Students' Curiosity and Exploration*

We also included a scale with curiosity items that asked students to rate from before to after implementation and we compared their responses on this scale to those from students in the comparison group. As noted in Table 13, there were positive changes for the treatment group on the curiosity scale from the pre- to the post-survey. However, when we compared these to the comparison students, there was no statistically significant difference between the groups on this scale.

Table 13: *Curiosity and Exploration Scales*

	Retrospective Pre- (Treatment)	Post- (Treatment)	Comparison
Curiosity Scale	4.0 (n=117)	4.4* (n=120)	4.4 (n=42)

*Indicates results were statistically significant

One interpretation of these findings is that the curiosity scale might have been too coarse-grained to capture the nuanced changes for students on curiosity and exploration. It is promising, though, that students reflected and perceived a change in their sense of curiosity and exploration, as exemplified from the findings from the previous question presented in Figure 7. Further, teachers noticed some of these changes making comments such as, "*My students showed a lot of wonder, generated questions, and had a strong desire to learn more*."

The comments from the kindergarten focus group suggest that one positive outcome for students was their understanding of what it means to be an explorer. The videos and activities gave students a sense of what it means to be an explorer, as evidenced by the kindergarten students' comments:

> *"What it means to be an explorer is to explore animals and explore different types of places and explore nature."*
>
> *"He explores animals, he goes places, he even gets bugs, watches animals, goes to the zoo, he works at the zoo, he's a zoo keeper, so that how I know he's an explorer."*
>
> *"To be an explorer, you have to teach, some explorers watch out for the animals so they won't die and feed them once a day."*

Most of the students noticed and recognized Josh as an explorer which resulted in them having positive associations with being an explorer (e.g., it's cool, he gets to go places and watch animals, it would be good to be an explorer):

> *"It feels pretty, pretty, pretty, pretty, pretty cool to be an explorer."*

"To be explorer, I would get to go wherever I want and travel in a forest."

"I mean it means to be an explorer because you watch wild animals from the zoo like a tiger…so it could be good to be an explorer."

Persistence and Growth Mindset

A final outcome we anticipated for students was changes related to their persistence or what has popularly become referred to as the notion of "grit" and "growth mindset" (Duckworth, 2016; Dweck, 2007). Similar to curiosity and exploration, we included an item where we asked students to rate the degree to which the XAL videos and materials resulted in changes (Figure 8) and we asked them to indicate their ratings from pre- to post- which we then analyzed against a comparison group (Table 14).

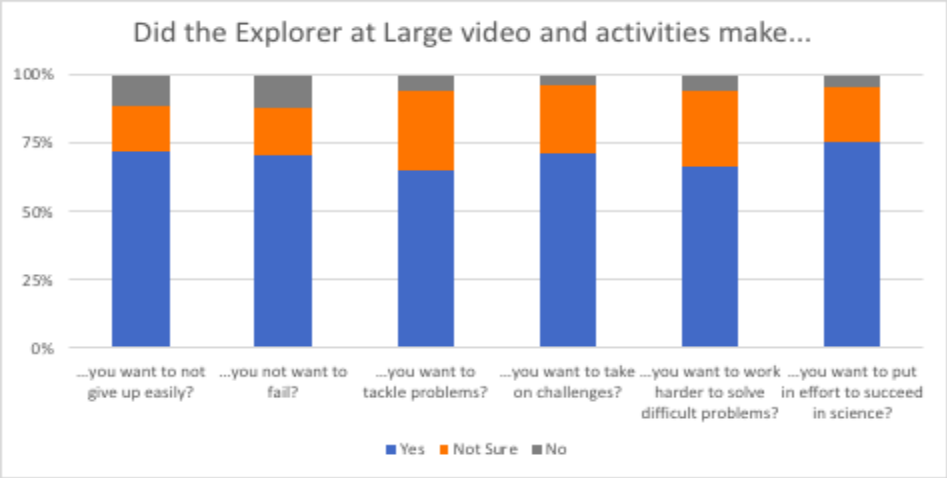


Figure 8. *Changes in Students' Persistence*

Across each statement, most students were generally positive with 60-72% indicating the materials did help them develop skills related to persistence. Table 14 shows results from pre-post analysis of the persistence scale and growth mindset item. Although there were statistically significant changes from the pre- to post- for persistence and growth mindset, these changes were not found to be significant against the comparison group.

Table 14: *Persistence and Growth Mindset Scales*

	Retrospective Pre- (Treatment)	Post- (Treatment)	Comparison
Persistence Scale	3.8 n=120	4.3* n=123	4.0 n=41
Growth Mindset	4.0 n=123	4.5* n=124	4.3 (n=42)

*Indicates results were statistically significant

Research Question 4: Will the inclusion of XAL Family Moments create awareness in parents of the value of curiosity, discovery, exploration, and questioning in their child(ren)?

Research question 4 examines parent/caregivers' perceptions of the XAL program (quality, value to child, value to self) and the degree to which the program might have created opportunities for joint exploration or discovery as a family.

Parent Perceptions

Due to the late timing of the request for feedback, the Parent & Caregiver survey received a low response rate (n=11), as well as a low completion rate (5 out of 11). Because of this, results should be taken with caution, and further exploration of the subject is required in future phases of this project. Although the overall sample is small, the responses were useful in providing initial insights and feedback regarding the Family Moments.

Of the caregivers who responded to questions about outcomes for their child, on a scale of 1 "totally disagree" to 5 "totally agree" respondents gave an average rating of 4 or above for eight of the nine listed outcomes (Figure 9). For one outcome, "My child likes to figure things out", kindergarten caregivers provided a more neutral average rating of 3.3. These data show that **both kindergarten and third grade student's caregivers perceive a somewhat positive change** in their child's sense identity as an explorer and disposition toward science after participating in XAL.

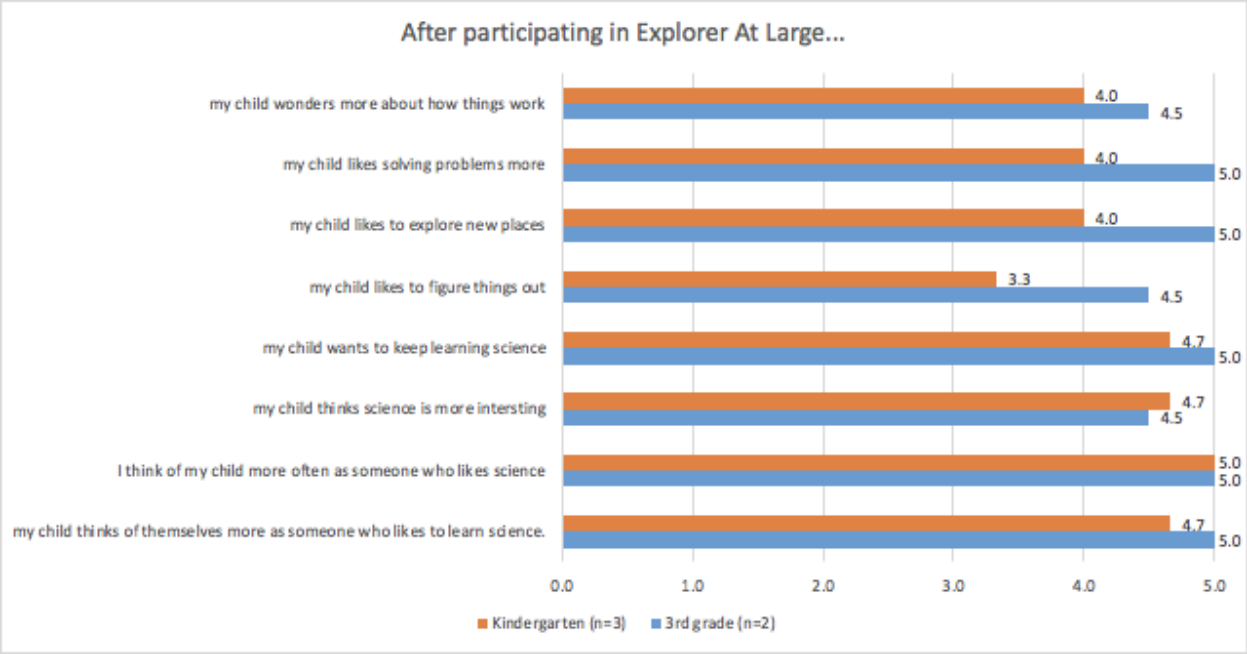


Figure 9. *Parent post-survey outcomes ratings*

Family Learning

Of the eleven families surveyed only four families, all of them families of 3rd graders, participated in Family Moments activities with their child. When rating the extent to which the activities were engaging for their child on a scale of 1 "not at all engaging" to "10" very engaging"**,** caregivers gave the Family Moments activities an average score of 5.5, suggesting that the caregivers did not found the activities to be engaging. When asked to rate on a scale of 1 "not at all likely to 10 "very likely" the likelihood of participating in additional Family Moments activities if they were offered, caregivers responded with an average rating of 6.6, showing that they might consider further engagement, though this rating was relatively low. This represents an area for continued development in future XAL scale-up efforts, including raising awareness of parents to XAL activities, encouraging uptake of activities, and further refining data collection efforts to gather parents' feedback and understand family outcomes following engagement with the materials.

Study Conclusions and Recommendations

The complementary, mixed methods study implemented by the OSU team allows us to draw conclusion regarding the success of the XAL pilot implementation and understand the outcomes for teachers, students, and their families. The study was designed as a proof of concept exercise and to gain an initial understanding of what participants take away from the XAL implementation and gather information to guide the refinement of the materials and future scale-up efforts.

Overall, the findings from the study for the XAL pilot implementation phase offered promising results regarding the potential of the videos and activities as instructional resources for supporting science in elementary classrooms. The study findings support the conclusion that teachers were able to use the videos and associated instructional materials in their classrooms and in ways that were generally effective, resulting in positive outcomes for students. Specifically, the results of the study suggest the following conclusions:

- Teachers self-reported high levels of satisfaction with the materials and indicated that they found the materials valuable for supporting student engagement with science concepts and practices. They also noted that their participation in XAL resulted in changes to their instructional practices, including implementation of a problem-based learning approach, hands-on activities, and deeper engagement with science concepts;
- Through implementing the materials and participating in the professional learning opportunities supported by the PAST Foundation, teachers reported greater self-efficacy or confidence for teaching science in ways that align with problem-based learning and the science and engineering practices outlined in the NGSS;
- The videos and instructional materials were particularly successful at motivating students. There was conclusive evidence to suggest that the videos were highly engaging to students and inspired a sense of enjoyment and fun for learning science, resulting in shifts in their attitudes toward science.

- Students demonstrated cognitive and affective learning gains including learning science concepts, engagement with the process and practices of science, and developing an identity as a learner of science;
- Although the changes related to exploration were limited, there was initial evidence of students developing positive associations with being an explorer, noting it would be "cool" and "fun" to explore;
- The materials demonstrated initial limited success at developing aspects of persistence and growth mindset in students;
- A few of the parents/caregivers of students in the study developed awareness of the XAL materials and noted the excitement of their students. Some even completed activities at home and indicated on the survey a potential chance of continued engagement if additional activities are offered. However, the ratings from parents/caregivers regarding the Family Moment activities suggested that there was minimal uptake and when families completed the activities, they generally provided low ratings suggesting the activities were not engaging for families.
- According to the Kindergarten teachers, some of the videos were not developmentally appropriate for younger students. Although the videos were not intentionally designed for this particular age group, it is worth considering how to design videos to meet the needs of young learners in future scale-up efforts;

While on the whole, the research study demonstrated that the XAL materials were implemented successfully during the pilot implementation in Central Ohio, there were a number of suggestions that emerged from across the various data collection strategies that we encourage the teams to consider in future scale-up efforts. Based on compiling this feedback, we suggest the following recommendations:

- **Continue to build on the success of the pilot implementation:** The data from the study offers evidence to demonstrate that teachers were able to implement the materials in their classrooms effectively and in ways that resulted in outcomes for students. The materials were particularly effective at engaging and motivating students which resulted in positive changes in their attitudes and identities as learners of science. Teachers' also self-reported changes to their instructional strategies and their self-efficacy for using a problem-based learning approach. We recommend moving forward with scale-up efforts, using the findings from the study to make data-informed decisions for improving the videos and building out the ecosystem of learning opportunities.

- **Pursue additional research efforts:** The findings of this pilot implementation study represent a proof of concept exercise in the Central Ohio region. We recommend scaling and implementing in 2-3 additional cities in the scale-up. This will help us to understand how the sociopolitical context influences implementation and whether the XAL materials can be adapted and used effectively in other contexts. For example, can the materials be implemented in schools with different standards and curriculum, or with

teachers who have less familiarity with problem-based learning? A scale-up study will also allow us to continue advancing the knowledge base on the use of videos in classrooms and tied to a broader ecosystem of learning opportunities designed around the media.

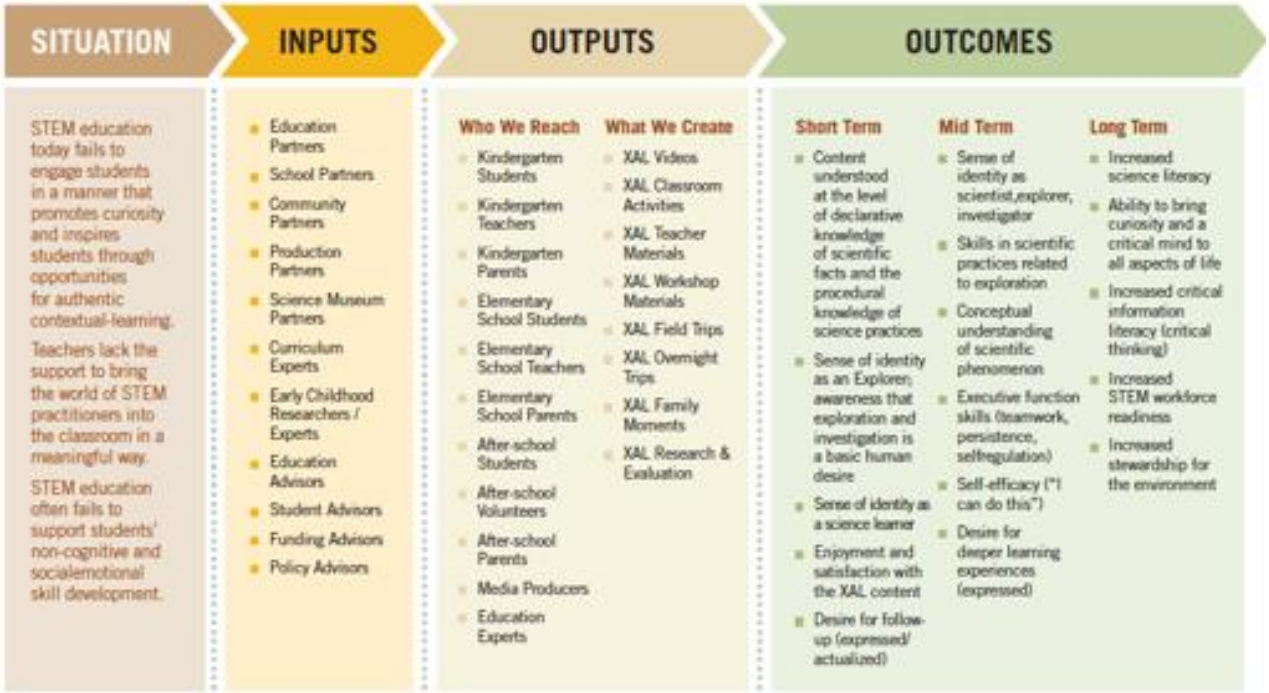
- **Build out the learning ecosystem:** While the pilot placed emphasis on designing and implementing materials in the classroom, we recommend continuing to build the learning ecosystem including the Family Moments and out-of-school opportunities. The data from the few families who did complete activities indicated that the materials were not engaging and this might also account for the limited uptake among families. We speculate that what works in the classroom may not work for families or out-of-school educators. We recommend that these activities be designed to meet the specific needs and affordances of these contexts while also inspiring curiosity and exploration through activities such as getting outside or exploring in the backyard.

- **Consider kindergarten teachers' recommendations for making the videos more developmentally appropriate for younger students.** The teachers noted that some of the videos had content that was too complicated for younger students to comprehend. The videos were not developed with this particular age level in mind. However, we recommend developing future videos in scale-up efforts with their feedback in mind.

- **Alignment to NGSS standards:** In future scale-up efforts, it might help to consider aligning the activities and the design cycle language with NGSS guidelines and specifically, the science and engineering practices. Although teachers self-reported engagement with the science practices, there was limited evidence of this in the classroom observations. This likely is a result of different definitions of what it means to implement the practices. Nonetheless, this discrepancy suggests that teachers might need more support for engaging students in science practices through additional professional learning opportunities and teacher supports (e.g., suggested prompts, tips).

- **Identify strategies for teachers to enhance and further model curiosity and exploration.** There was limited evidence of changes in students' curiosity and sense of exploration. In light of this finding, we suggest thinking of additional strategies that could be integrated in the classroom activities as well as the broader learning ecosystem that might help to further enhance curiosity and exploration. Additional activities that encourage students to generate and pursue their own questions, for example, might help to foster curiosity. Family Moments that encourage families to explore in their backyard, neighborhood, or local park could further model what it means to explore.

Appendix A: Project Logic Model



Appendix B: Key Performance Indicators for Students

OUTCOME	THEORY OF ACTION	KEY PERFORMANCE INDICATORS	MEASURES
Short-Term			
Content understood at the level of declarative knowledge of scientific facts and the procedural knowledge of science practices	XAL Videos contain information that will lead to changes in students' knowledge of scientific content XAL Videos will introduce students to scientific practices (such as questioning) through modeling by Josh and scientists in the videos The content of XAL Videos will connect with classroom Activities and Field Trips developed by the PAST Foundation related to each video. The Instructional Unit will also encourage practices such as questioning, solving problems, and scientific reasoning	Percentage of students who perform on embedded assessments based on science and engineering practices as proficient or highly proficient The number and quality of instances during classroom observations when students engage with scientific practices Ratings by teachers indicating the degree to which the Instructional Units as a whole, and their individual elements (e.g., XAL Videos, classroom activities etc.) support cognitive and procedural STEM learning in their students Positive comments by teachers about Instructional Unit's capacity to lead to student academic performance	Students performance on assessments Classroom observations Teacher surveys and focus groups
Sense of identity as an explorer; awareness that exploration and investigation are basic human desires.	XAL Videos will feature Josh and scientists/engineers exploring and addressing challenges driven by curiosity, adventure, and exploration. Josh and the scientists represent different identities and model exploration and adventure in ways that influence students' notions of exploring and adventure in ways that will shape their sense of identity as explorers themselves.	Significant increases in students' ratings from the pre- to post-survey regarding the value of questioning and exploration (awareness and attitudes), and their self-efficacy and identity as someone who is allowed to, is able to and will be asking questions about the world (identity as explorer and discoverer). Significant increase from the pre- to post-surveys in teachers' ratings of their students' awareness and sense of identity as explorers. The number and quality of teachers' comments indicating the XAL Videos and content supported students' awareness and improved sense of identities as explorers. Significant increase from the pre- to post-surveys in parent/caregivers'	Student pre-post surveys with comparison to a control group of students. Teacher post surveys and focus groups. Parent/caregiver post survey.

		ratings of their children's awareness and sense of identity as explorers.	
Sense of identity as a science learner	Josh and the scientists explore scientific topics in ways that are novel from how science is likely approached in their classrooms. XAL Videos and associated Activities and Field Trips will introduce new models of science learning that will influence students' ideas about what science is and who does science.	Significant increases in students' ratings from the pre- to post-survey on questions about their identity as a science learner (only 3rd and 5th grade). The number and quality of teachers' comments indicating the XAL Videos and content supported students' identities as science learners Significant increase from the pre- to post-surveys in parent/caregivers' ratings of their children's sense of identity as a science learner	Student pre-post surveys with comparison to a control group of students Teacher surveys and focus groups Parent/caregiver survey
Sense of identity as a science learner	XAL Videos and related Activities and Field Trips will introduce students to science in ways that are driven by curiosity, adventure, and exploration. The presentation of science content in these novel ways will influence students' enjoyment and satisfaction with the content.	Percentage of youth on the post-survey who indicate high levels of satisfaction with the XAL Experience Average rating of satisfaction with XAL Experience	Student pre-post surveys
Enjoyment and satisfaction with the XAL content	XAL Videos and related Activities and Field Trips will introduce students to science in ways that are driven by curiosity, adventure, and exploration. The presentation of science content in these novel ways will influence students' enjoyment and satisfaction with the content.	Percentage of youth on the post-survey who indicate high levels of satisfaction with the XAL Experience Average rating of satisfaction with XAL Experience	Student pre-post surveys

Desire for follow-up & sharing with others (expressed/actualized)	By experiencing XAL content in unique and engaging ways, students will be interested in and seek follow-up opportunities through additional activities (e.g., at home, at school, in the community) and sharing with others (e.g., peers, family) in Family Moments.	Percentage of youth on the post-survey who indicate interest in watching additional videos or completing additional XAL Activities Percentage of youth on the post-survey who indicate they have shared or watched videos, or completed additional XAL Activities with their peers or family members The number of self-reported comments made by teachers indicating that students' have asked for additional XAL Videos or Activities in the classroom	Student surveys Parent/caregiver survey Teacher self-report (e.g., surveys, focus groups)

Appendix C: Data Collection Instruments

Default Question Block

Pilot Teacher Pre-Survey
- Explorer at Large Pilot Study -

Hello, and thanks again for participating the in the Explorer At Large Pilot Study! This survey will help us get to know more about you and your experience as a teacher. Before you take this survey, we need to ask for your consent as a research subject. Please review the following information.

Purpose: You are being asked to take part in a research study during spring of 2018 as part of the Explorer At Large pilot program. We will ask you to test Explorer At Large pilot program materials in your classroom and to provide feedback through questionnaires, focus groups, and classroom observations. We will also ask your students to complete surveys before and after implementation to understand any positive outcomes that result.

Activities: We will ask you to review and test Explorer at Large instructional design units in your classroom and to provide feedback through questionnaires, focus groups and classroom observations. Some classes and some field trips will be observed.

Confidentiality: Other people may learn that you participated in this study but the information you provide will be kept confidential to the extent permitted by law. We may share de-identified versions of your responses to questions with school officials, or with our project partners at Explorer at Large and the PAST Foundation so that we may jointly interpret the results. During focus groups we will ask members of the focus group to maintain the confidentiality of comments made during the discussion. However, there is still a risk that comments you make during the discussion may be shared outside of the group. All study related data and documents will be stored by the researchers and destroyed after three years. None of this data will be used or distributed for further research studies.

Voluntary: Participation in this study is voluntary. Whether or not you participate will not impact your employment situation.

Study contacts: If you have any questions about this research project, please contact Dr. Kelly Riedinger (Kelly.riedinger@oregonstate.edu).
If you have questions about your rights or welfare as a participant, please contact the Oregon State University Human Research Protection Program (HRPP) office, at (541) 737-8008 or by email at IRB@oregonstate.edu.

Having read the information above, do you agree to participate in this study?

○

Yes

○ No

To maintain your confidentiality on survey responses, we will ask you a series of questions to self-generate a study code. Your responses to these questions should create a four character code that you will enter in the textbox below.

1. How many sisters do you have? (enter 0 if you do not have any siblings)
2. How many brothers do you have?
3. What is the first initial of your mother's first name?
4. What is the first number in your street address?

What questions can we answer for you about the research study?

In what grade level will you be implementing the XAL modules?

○ Kindergarten

○ 3rd Grade

How many years have you been a teacher (not including this academic year)?

○ This is my first-year teaching

○ 1-2

○ 3-5

○ 6-10

○ 11-20

○ More than 20 years

What is the total combined number of students in your class(es)?

Please estimate the number of students in your class(es) this academic year (2017-2018) who:

- o Are English Language Learners
- o Qualify for free or reduced lunch
- o Are identified as special needs or special education students

Have you ever participated in a PAST Foundation professional development workshop or online meeting prior to this project?

- ○ Yes
- ○ No

In all, how many PAST Foundation workshops or meetings have you participated in prior to this project?

Problem-based learning is the ongoing act of learning multiple subjects at the same time through the guided identification, research, development, and proposed resolution of a real-world problem. How much prior experience would you say you have had implementing problem-based learning strategies in the classroom before you started Explorer at Large? Please rate your level of prior experience on a scale from 1 to 7 where "1" is "no experience" and "7" is "very experienced."

1 - No Exerience	2	3	4 - Moderate Experience	5	6	7 - Very Experienced
○	○	○	○	○	○	○

For each of the items below, please rate your current level of confidence on a scale from 1 to 7 where "1" is "Cannot do at all" and "7" is "Highly certain I can do it."

	1 - Cannot do it at all	2	3	4	5	6	7 - Highly certain I can do it
Implement problem-based learning strategies with students in the classroom	○	○	○	○	○	○	○

	1 - Cannot do it at all	2	3	4	5	6	7 - Highly certain I can do it
Engage students in stating problems	○	○	○	○	○	○	○
Help students brainstorm solutions	○	○	○	○	○	○	○
Help students design solutions	○	○	○	○	○	○	○
	1 - Cannot do it at all	2	3	4	5	6	7 - Highly certain I can do it
Help students build solutions	○	○	○	○	○	○	○
Help students evaluation solutions	○	○	○	○	○	○	○
Help students modify solutions	○	○	○	○	○	○	○
Help students share and communicate solutions	○	○	○	○	○	○	○

For each of the items below, please rate your current level of confidence on a scale from 1 to 7 where "1" is "Cannot do at all" and "7" is "Highly certain I can do it."

	1 - Cannot do it at all	2	3	4	5	6	7 - Highly certain I can do it
Engage students in asking questions	○	○	○	○	○	○	○
Engage students in scientific practices	○	○	○	○	○	○	○
Encourage students to be persistent	○	○	○	○	○	○	○
Motivate students	○	○	○	○	○	○	○
Foster students' curiosity	○	○	○	○	○	○	○

	1 - Cannot do it at all	2	3	4	5	6	7 - Highly certain I can do it
Encourage students to explore	○	○	○	○	○	○	○
Encourage students' creativity	○	○	○	○	○	○	○
Encourage students to think critically	○	○	○	○	○	○	○
Help students take control of their learning	○	○	○	○	○	○	○

Start

Pilot Module Feedback and Reflection Form

- For Teachers -

Now that you've implemented one of our modules, we'd like to hear about your experience. This form should take no longer than 20 minutes to complete.

For which instructional module are you providing feedback?

Please note: we'll need you to fill out one survey per module. If you need to provide feedback on more than one module today, you can do so by finishing this survey and hitting the 'refresh' button in your browser.

- ○ Waterways
- ○ Orchids
- ○ Nutrition and Poop

In what grade did you implement the ${q://QID2/ChoiceGroup/SelectedChoices} module? (Please select all that apply.)

- ☐ Kindergarten
- ☐ 3rd grade

Over how many days did you implement the ${q://QID2/ChoiceGroup/SelectedChoices} module with your students?

0 Days

Which of the following videos from the ${q://QID2/ChoiceGroup/SelectedChoices} module did you use with students?

- ☐ SI Gardens
- ☐ Orchids
- ☐ Lion Nutrition
- ☐ Lion Poop
- ☐ Panda Nutrition
- ☐ Panda Poop

- ☐ Poop Analysis
- ☐ Electrofishing
- ☐ Catfish Surgery
- ☐ Crab Tagging
- ☐ Seining
- ☐ I didn't use any videos from this module

Video Feeback

When did you use the ${lm://Field/1} video during your implementation of the module?

- ○ At the beginning of the module
- ○ In the middle of the module
- ○ At the end of the module
- ○ I used it continuously throughout the module

How did you use the ${lm://Field/1} video as you were implementing the module? Please select all that apply.

- ☐ To introduce a topic
- ☐ To motivate or excite students
- ☐ To explain a concept
- ☐ As a way to summarize the ${q://QID2/ChoiceGroup/SelectedChoices} module
- ☐ As an assessment tool
- ☐ To prompt student reflection
- ☐ As a way to continuously engage students in the topic
- ☐ Other (please describe)

End

Overall, how satisfied were you with the ${q://QID2/ChoiceGroup/SelectedChoices} module? Please use a scale from 1 to 10 where "1" is "Not at all satisfied" and "10" is "Very satisfied."

1	2	3	4	5	6	7	8	9	10

How likely are you to use the ${q://QID2/ChoiceGroup/SelectedChoices} module in the future? Please use a scale from 1 to 10 where "1" is "Not at all likely" and "10" is "Very likely."

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

How likely are you to recommend the ${q://QID2/ChoiceGroup/SelectedChoices} module to a colleague? Please use a scale from 1 to 10 where "1" is "Not at all likely" and "10" is "Very likely."

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

In what ways, if at all, do you think your students benefited from your implementation of the ${q://QID2/ChoiceGroup/SelectedChoices} module?

Which of the following science and engineering practices did students engage with as a result of implementing the ${q://QID2/ChoiceGroup/SelectedChoices} module?

- ☐ Asking questions and defining problems
- ☐ Developing and using module solutions
- ☐ Planning and carrying out investigations
- ☐ Analyzing and interpreting data
- ☐ I do not think students engaged in any science or engineering practices
- ☐ Using mathematical and computational thinking
- ☐ Constructing explanations and designing solutions
- ☐ Engaging in argument from evidence
- ☐ Obtaining, evaluating, and communication information

Please explain or share an example of how the ${q://QID2/ChoiceGroup/SelectedChoices} helped you address the science and engineering practice(s)?

To what extent do you agree with the following statement:

The ${q://QID2/ChoiceGroup/SelectedChoices} module helped students learn key scientific concepts.

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
○	○	○	○	○

Please elaborate or share an example of how the ${q://QID2/ChoiceGroup/SelectedChoices} helped students learn the science concepts.

To what extent do you agree with the following statement:

The ${q://QID2/ChoiceGroup/SelectedChoices} was engaging for my students.

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
○	○	○	○	○

Please elaborate or share an example of how the ${q://QID2/ChoiceGroup/SelectedChoices} engaged your students.

To what extent do you agree with the following statement:

The ${q://QID2/ChoiceGroup/SelectedChoices} developed students questioning skills (e.g., asking questions that are open-ended and have multiple answers, asking questions that lead to an investigation or exploration)?

Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
○	○	○	○	○

Please elaborate or share an example of how the ${q://QID2/ChoiceGroup/SelectedChoices} helped students with their questioning skills.

Overall, what did you think was particularly effective or successful about the ${q://QID2/ChoiceGroup/SelectedChoices}? Why?

Did you participate in a brainstorming session for this ${q://QID2/ChoiceGroup/SelectedChoices} module?

- Yes
- No

To what extent do you agree that it helped you feel more confident in implementing the module activities with your student?

- Strongly agree
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree

Please elaborate or share an example:

If at all, how was your instruction using the modules different from what you would normally do in your classroom?

Did you experience any technical issues while implementing the modules?

- Yes
- No

Please indicate what issues you experienced (select all that apply):

- Video wouldn't load
- My school blocked the video content

- [ ] Video froze during viewing
- [ ] Video play was slow
- [ ] Other (Please specify):

What recommendations do you have for improving the ${q://QID2/ChoiceGroup/SelectedChoices}?

Is there anything else that you would like to tell us about the ${q://QID2/ChoiceGroup/SelectedChoices} that would help other teachers use the resources?

Observation Details

Teacher's Name

Date of Observation:

Grade Level

- Kindergarten
- 3rd

Number of Students

	0	5	10	15	20	25	30	35	40	45	50
Students											

Name of Module Observed

- Orchids
- Waterways
- Nutrition & Poop

Overall description of the lesson:

Activities Observed

Evidence of Science & Engineering Practices: Which of the following science and engineering practices did the teacher address when using the module resources during the observed lesson? (Please select all that apply.)

- ☐ Asking questions and defining problems
- ☐ Developing and using models
- ☐ Planning and carrying out investigations
- ☐ Analyzing and interpreting data
- ☐ Using mathematical and computational thinking
- ☐ Constructing explanations and designing solutions
- ☐ Engaging in argument from evidence
- ☐ Obtaining, evaluating, and communication information
- ☐ I do not think students engaged in any science or engineering practices

(If practice(s) is/are selected) Describe or share an example of how students engaged in the science and engineering practices using the module resources.

Please approximate the percentage of students that appear engaged (paying attention, interested, follow-up comments or questions about the video) with the video content and related activities.

	0	10	20	30	40	50	60	70	80	90	100
% of students engaged											

Please elaborate on students' engagement

Did you see any evidence of students learning key science concepts or engaged in discussions around key science concepts?

- Yes
- No

(If yes) Please share an example or two of how the resource(s) supported students' discussion of, or learning of, key scientific concepts.

Overall, what do you think was particularly successful about the implementation of the module resources during this observation?

What challenges, if any, did you observe for the students or the teacher? Please include any technology issues, content issues, implementation issues, or pedagogical issues that you observed.

Based on this observation, what recommendations do you have for improving the module resources?

Post-Observation Questions

How representative was the observed lesson of a typical science lesson in your classrooms?

How, if at all, was the observed lesson different from what you would normally do with videos in your classroom?How do you know or what evidence do you have?

To what extent do you think your students were engaged with the activities?

Is there anything you would have done differently from the lesson today?

XAL Teacher Focus Group Protocol

1. Now that you have reviewed and implemented the videos and instructional modules in your classrooms, please reflect on the overall quality and usefulness of the materials. What was good and should be kept or used as the basis for future videos and modules? What do you think needs to be improved or modified?

2. How do you think your experience with the project – including the professional development workshops with PAST and implementing the videos and instructional modules – impacted your students? What evidence did you see that makes you say this?

- How well do you believe the materials helped you engage your students in exploration of scientific concepts? Can you elaborate or share any examples?

- How well do you believe the materials helped you develop students questioning skills (e.g., ask questions that are open-ended and have multiple answers, ask questions that lead to an investigation or exploration)? Can you elaborate or share an example?

3. How, if at all, has your participation in the XAL project influenced how you think about teaching science?

4. In what ways, if at all, will the professional learning opportunities you have participated in with PAST influence your instructional approach and practices moving forward?

5. In what ways, if at all, will your experience implementing the videos, instructional modules, and field trips with students influence your instructional approach and practices moving forward?

6. Do you have any final comments or ideas that you would like to discuss before we conclude our conversation? Any final words of wisdom for us?

Default Question Block

Pilot Teacher Post-Survey

- Explorer at Large Pilot Study -

Hello!

Thank you again for participating in the Explorer At Large pilot study. This short survey is your last task and should take you at most 10 minutes to complete. Some of these questions may look familiar. We are trying to gauge how your experiences have changed now that you've participated in Explorer At Large.

To maintain your confidentiality on survey responses, we will ask you a series of questions to self-generate a study code. Your responses to these questions should create a four character code that you will enter in the textbox below.

1. How many sisters do you have? (enter 0 if you do not have any siblings)
2. How many brothers do you have?
3. What is the first initial of your mother's first name?
4. What is the first number in your street address?

How valuable were the instructional modules as a collection of resources to your science teaching? Please use a scale from 0-10 where "0" is "not at all valuable" and "10" is "highly valuable."

Not valuable at all										Highly valuable
0	1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○	○

How likely are you to use the XAL materials in the future? Please use a scale from 0 to 10 where "0" is "Not at all likely" and "10" is "Very likely."

Not at all likely										Very likely
0	1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○	○

How likely are you to recommend the XAL materials to a colleague? Please use a scale from 0 to 10 where "0" is "Not at all likely" and "10" is "Very likely."

Not at all likely										Very likely
0	1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○	○

In what ways do you think your students were impacted or benefitted from the use of the XAL videos and instructional materials in your classroom? Please elaborate or share an example of how your students benefitted.

For each of the statements below, please rate whether you believe you can do them on a scale from **1** to **7** where "**1**" is "Cannot do at all" and "**7**" is "Highly certain I can do it."

	1 - Cannot do it at all	2	3	4	5	6	7 - Highly certain I can do it
Implement problem-based learning strategies with students in the classroom	○	○	○	○	○	○	○
Engage students in stating problems	○	○	○	○	○	○	○
Help students brainstorm solutions	○	○	○	○	○	○	○
Help students design solutions	○	○	○	○	○	○	○
	1 - Cannot do it at all	2	3	4	5	6	7 - Highly certain I can do it
Help students build solutions	○	○	○	○	○	○	○
Help students evaluate solutions	○	○	○	○	○	○	○
Help students modify solutions	○	○	○	○	○	○	○

	1 - Cannot do it at all	2	3	4	5	6	7 - Highly certain I can do it
Help students share and communicate solutions	○	○	○	○	○	○	○

From the pre- and post-assessments you completed for each of the instructional module, what percentage of your students met the learning objectives?

	0	10	20	30	40	50	60	70	80	90	100
Orchids Module											
Waterways Module											
Nutrition & Poop											

For each of the statements below, please rate whether you believe you can do them on a scale from **1** to **7** where "**1**" is "Cannot do at all" and "**7**" is "Highly certain I can do it."

	1 - Cannot do it at all	2	3	4	5	6	7 - Highly certain I can do it
Engage students in asking questions	○	○	○	○	○	○	○
Engage students in scientific practices	○	○	○	○	○	○	○
Encourage students to be persistent	○	○	○	○	○	○	○
Motivate students	○	○	○	○	○	○	○
Foster students' curiosity	○	○	○	○	○	○	○

	1 - Cannot do it at all	2	3	4	5	6	7 - Highly certain I can do it
Encourage students to explore	○	○	○	○	○	○	○
Encourage students' creativity	○	○	○	○	○	○	○
Encourage students to think critically	○	○	○	○	○	○	○
Help students take control of their learning	○	○	○	○	○	○	○

To what extent do you agree or disagree with each of the statements below regarding the XAL project which included the teacher workshops, instructional modules, videos, and (for some of you) field trips?

"The XAL project helped me to ... "

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
... implement problem-based learning strategies with students in the classroom.	○	○	○	○	○
... engage students in critical thinking.	○	○	○	○	○
... engage students in asking questions.	○	○	○	○	○
... engage students in scientific practices.	○	○	○	○	○
... encourage students to be persistent.	○	○	○	○	○
... motivate students.	○	○	○	○	○
... foster students' curiosity.	○	○	○	○	○

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
... encourage students to explore.	○	○	○	○	○
... encourage students' creativity.	○	○	○	○	○
... help students take control of their learning.	○	○	○	○	○
... help students solve problems.	○	○	○	○	○

Default Question Block

Explorer At Large Post-Survey
- For 3rd Graders -

Hello, again!

Now that you've done some of our activities, we'd like to hear more about what you think. Some of these questions will look familiar. Just like before, please be honest when answering the questions. You will not be graded on your answers, and your answers will not be shared with your family, friends, or teachers.

First, tell us your student identification number. Then you can click the arrow button to get started.

What is your student identification number?

When you answer the questions, simply click the box that best shows how you feel. We have 5 ways for you to agree or disagree.

Let's start with an example:

	Totally Disagree	Somewhat Disagree	Not Sure	Somewhat Agree	Totally Agree
	☹☹	☹	😐	☺	☺☺
I understand how to answer these questions.	○	○	○	○	○

Read the text in each line below and mark the answer that best shows how you feel.

	Totally Disagree	Somewhat Disagree	Not Sure	Somewhat Agree	Totally Agree
	☹☹	☹	😐	☺	☺☺
I like science	○	○	○	○	○
My teachers think that I like science	○	○	○	○	○
My friends think that I like science	○	○	○	○	○
My family thinks that I like science	○	○	○	○	○

Read the text in each line below and mark the answer that best shows how you feel.

	Totally Disagree	Somewhat Disagree	Note Sure	Somewhat Agree	Totally Agree
	☹☹	☹	😐	☺	☺☺
Science is interesting	○	○	○	○	○
I like learning science	○	○	○	○	○
I want to study more science in school	○	○	○	○	○
I am good at science	○	○	○	○	○
I want to study more science outside of school	○	○	○	○	○

Read the text in each line below and mark the answer that best shows how you feel.

	Totally Disagree	Somewhat Disagree	Note Sure	Somewhat Agree	Totally Agree
	☹☹	☹	😐	☺	☺☺
I like to figure things out	○	○	○	○	○
I like to explore new places	○	○	○	○	○
I like solving problems	○	○	○	○	○
I wonder a lot about how things work	○	○	○	○	○
I like to come up with new ideas	○	○	○	○	○

Read the text in each line below and mark the answer that best shows how you feel.

	Totally Disagree	Somewhat Disagree	Note Sure	Somewhat Agree	Totally Agree
	☹☹	☹	😐	☺	☺☺
I don't give up easily	○	○	○	○	○
I am not afraid to fail	○	○	○	○	○
I am good at tackling problems	○	○	○	○	○
I am good at taking on a challenge	○	○	○	○	○
I work harder to solve really difficult problems	○	○	○	○	○
If I put in enough effort, I can succeed in science	○	○	○	○	○

Did the Explorer at Large video and activities make...

	Yes	Not Sure	No
... science more interesting for you?	○	○	○
... learning science more fun?	○	○	○
... you want to study more science in school?	○	○	○
... you be better at science?	○	○	○
... you want to study more science outside of school?	○	○	○
... you want to figure things out?	○	○	○
	Yes	Not Sure	No
... you want to explore new places?	○	○	○
... you want to solve problems?	○	○	○
... you wonder more about how things work?	○	○	○
...you want to come up with new ideas?	○	○	○
...you want to not give up easily	○	○	○
....you not want to fail	○	○	○
	Yes	Not Sure	No
...you want to tackle problems	○	○	○

	Yes	Not Sure	No
....you want to take on challenges	○	○	○
...you want to work harder to solve difficult problems	○	○	○
....you want to put in effort to succeed in science	○	○	○

1. You watched the XAL videos. What do you remember from the video?

2. What did you learn about from the videos?

3. What did you like the most about the videos?

4. When you watched the videos, did you have any questions that you wanted to ask? (If yes) What questions did you want to ask? What questions do you still have?

5. What do you remember doing in your class after you watched the video?

6. What do you think it means to be an explorer? Do you feel like an explorer after watching the video? Why or why not?

7. Did you do any XAL Activities at home with your family (Raise your hand)? What do you remember doing with your family? What do you remember learning?

8. Did you go on the field trip to [insert field trip location] (Raise your hand)? What do you remember from the field trip? What do you remember learning? What did you like about the field trip? What did you dislike?

Default Question Block

Explorer At Large Post-Survey

- For Parents -

Hello! You might remember we are conducting a research study to understand whether instructional videos that encourage discovery, curiosity, and questioning, along with educational activities and field trips to local settings, result in positive outcomes for students. Through this survey, we'd like to know more about what you've seen and thought about the program. Before you take this short survey, we need to ask for your consent to be part of this project. Please review the following information.

Purpose: You are being asked to take part in a research study during spring of 2018 as part of the Explorer At Large program which is being piloted in schools throughout the Columbus, Ohio region. You are also being asked if your child can participate in this study. The purpose of this research study is to understand how instructional videos that encourage discovery, curiosity and questioning, along with educational activities and field trips to local settings, result in positive outcomes for students.

Activities: Should you decide to not involve your child in the study, they will still be allowed to participate in all activities related to the program. With your consent and your child's assent, we will ask your child to answer questions about themselves on surveys or in focus groups. We may also visit and observe their teacher and classroom activities, or a field trip your child might be taking part in. In addition, we will ask you to answer some questions on a survey or to participate in a focus group at the end of the testing period.

Confidentiality: Other people may learn that you and your child participated in this study but the information you provide will be kept confidential to the extent permitted by law. We may share de-identified versions of your and child's responses to questions with school officials, or with our project partners at Explorer at Large and the PAST Foundation so that we may jointly interpret the results. All study related data and documents will be stored by the researchers and destroyed after three years. None of this information will be used or distributed for further studies.

Risks: There are no foreseeable risks to participating in this study. By not participating in the research component of the study, yours or your child's relationship to the teacher will not be impacted.

Benefits: There are some direct benefits to you for participating in the study, including learning more about your child and your child's science instruction.

Voluntary: Participation in this study is voluntary. Your child will still be in the program and will be allowed to take part in all activities, even if you opt not to participate in the research. If

you do NOT WISH TO PARTICIPATE, just email, call or text Kelly Riedinger (kelly.riedinger@oregonstate.edu, or (757) 630-2258), and we will remove you and/or your child from the research portion of the pilot project.

Study contacts: If you have any questions about this research project or if you do not want your child to participate in the study, please contact Dr. Kelly Riedinger (kelly.riedinger@oregonstate.edu).

If you have questions about your rights or welfare as a participant, please contact the Oregon State University Human Research Protection Program (HRPP) office, at (541) 737-8008 or by email at IRB@oregonstate.edu.

Parents, please be aware that under the Protection of Pupil Rights Act. 20 U.S.C. Section 1232(c)(1)(A), you have the right to review a copy of the questions asked, or materials that will be used with your students. If you would like to do so, you should contact Kelly Riedinger at kelly.riedinger@oregonstate.edu or at (757) 630-2258 to obtain a copy of the questions or materials.

Do you agree to participate in this study?

- ○ Yes
- ○ No

What questions can we answer for you about the research study?

What grade is your child currently in?

- ○ Kindergarten
- ○ 3rd grade

Are you familiar with the Explorer at Large project that your child took part in at school?

- ○ Yes
- ○ No

Did you talk with your child at home about Explorer At Large videos?

- ○ Yes

○ No

What kind of things did your child tell you about the videos?

Did you complete any of the Explorer At Large "Family Moment" activities at home with your child?

○ Yes

○ No

Overall, approximately how long did you and your child engage in the Family Moment activities at home? Roughly estimate the number of minutes you spent engaged with the activities.

To what extent did you find the activities to be engaging for your child? Please rate on a scale from 1 to 10 where "1" is "not at all engaging" and "10" is "very engaging."

Not at all engaging	2	3	4	5	6	7	8	9	Very Engaging
○	○	○	○	○	○	○	○	○	○

In what ways, if at all, do you think your child benefitted from doing the Explorer At Large " Family Moment" at home?

How likely is it that you would complete additional Explorer At Large Family Moment activities with your child if they were offered?

Not at all likely	2	3	4	5	6	7	8	9	Very likely
○	○	○	○	○	○	○	○	○	○

Did your child participate in any field trips?

- Yes
- No

Which site(s) did they visit?

- Batelle Darby Creek
- Columbus Zoo and Aquarium
- Franklin Park Conservatory

Did you child talk about it with you?

- Yes
- No

What did your child share with you?

To what extent do you agree with each of the following statements? Please use a scale from 1 to 5 where 1 is "strongly disagree" and 5 is "strongly agree."

After participating in Explorer At Large ...

	Totally Disagree	Somewhat Disagree	Not Sure	Somewhat Agree	Totally Agree
My child thinks of him/herself more as someone who likes to learn science					
I think of my child more often as someone who likes science					

	Totally Disagree	Somewhat Disagree	Not Sure	Somewhat Agree	Totally Agree
My child thinks science is more interesting	○	○	○	○	○
My child wants to keep learning science	○	○	○	○	○

After participating in Explorer At Large, my child ...

	Totally Disagree	Somewhat Agree	Not Sure	Somewhat Agree	Totally Agree
...likes to figure things out more	○	○	○	○	○
...likes to explore new places more	○	○	○	○	○
...likes solving problems more	○	○	○	○	○
...wonders more about how things work	○	○	○	○	○

XAL aims at helping kids ask questions about how the world works. Did you notice any questions your child may have had as a result of taking part in Explorer At Large activities in school, during the field trip, or at home? If so, please share some of them here:

Is there anything else you would like to share about the Explorer At Large project?