

**TEACHER PROFESSIONAL DEVELOPMENT: ASSESSMENT ON
TEACHERS' PERCEPTIONS OF NASA'S ONLINE STEM PROFESSIONAL
DEVELOPMENT**

A Record of Study

by

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ABSTRACT

Data were collected from 32 teachers using mixed methods to investigate teachers' perceptions of online professional development (PD) offered through a school-community partnership. The partnership between multiple school districts nationwide and National Aeronautics and Space Administration (NASA) provided teachers with an online Science, Technology, Engineering and Mathematics (STEM) PD course called MicroGX. A thorough analyses of data from two surveys, observations, and documents were used to answer the primary questions: 1) What components of MicroGX are deemed effective from the teachers' perspective? 2) How does the effectiveness of MicroGX compare with other online PD from the teachers' perspective? The data from this study provide evidence that subjects perceive MicroGX as a positive experience with many effective components that are more effective than participation in other online PD.

Survey data show a majority of the subjects feel the MicroGX course was more of a positive than negative experience. All subjects would recommend this course to another teacher and overall, subjects were most satisfied with the interaction with others, resources, support, content, and content delivery. Ninety-seven percent of subjects were satisfied with the course. Ninety-four percent of subjects would participate in the course again and consider participating in more online PD offered by NASA. Seventy-one percent of subjects feel that MicroGX was more effective than other online PD in which

they have participated. Effective components include content knowledge, student impact, resources, and support.

All subjects agree this experience has inspired them to bring NASA content into the classroom, influenced them to make changes to their teaching activities, do not disagree they can immediately apply what they learned from this experience to their teaching about STEM, and do not disagree they will be more effective in teaching STEM introduced in this experience. All subjects do not disagree that the resources will be effective in increasing their students' interest in STEM topics and that this experience provided ideas for encouraging student exploration, discussion and participation. Based on the finding of this study, recommendations were made to aid future development of online PD and assist K-12 leaders in selecting future PD for their teachers.

DEDICATION

To my wife, Alissa, for years of unconditional love and support. You have held my hand through every challenging moment and always found ways to celebrate each step of accomplishment along the way. You have allowed me to live in our home office for the past 4 years and always delivered snacks and words of encouragement when needed. You have managed our family and home finding ways to keep the children from crying, dog from barking, doorbell and phone from ringing, and vacuum from roaring. Finally, no matter how many degrees I have, you will always be the most intelligent educator in the house.

To my son, Benjamin (3) and daughter, Abigail (1); daddy worked hard to accomplish his degree before missing soccer games and dance recitals; however managed to miss many moments of Lego building, cuddles on the couch, bath time, book reading, and rocking you to sleep. I'm looking forward to many moments in the future and will cherish each one.

To our big dog, Yuri. I owe you many walks, playtime, and cuddles. No more waiting outside the office door or at the bottom of the steps. Both of us will now exercise more often.

To my parents, Ken, Judy, and Ray, thank you for instilling in me the competitive nature to do my best in education and the drive to always learn more. Mom, thank you for introducing me to my life-long career as an educator. Your positive motivation has always been recognized and appreciated.

ACKNOWLEDGEMENTS

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I would also like to thank my management at NASA and Oklahoma State University including Dr. Steve Marks, Richard Adams, Cindy McArthur, and Ed Pritchard. Thank you for your support and guidance throughout many years.

Thank you to all my colleagues at NASA and Oklahoma State University for your flexibility and time. This study required many resources that would not be obtainable without your support.

Thank you again to my family for your strength and finally, thank you God for all your blessings in life.

NOMENCLATURE

0g	Microgravity
D2L	Desire2Learn
ED OPEPD	U.S. Department of Education, Office of Planning, Evaluation, and Policy Development
EPD	Education Professional Development
ESL	English as a Second Language
IESD	Interactive Educational System Design
IRB	Institutional Review Board
KSU	Kansas State University
MicroGX	MicroGravity eXperience
NASA	National Aeronautics and Space Administration
OEPM	Office of Education Performance and Measurement
OSU	Oklahoma State University
PD	Professional Development
PDS	Professional Development Schools
STEM	Science, Technology, Engineering, and Mathematics
TEDP	Test Equipment Data Package

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CHAPTER I

INTRODUCTION

Problem

Educational leaders in K-12 public schools are constantly faced with the need for providing professional development (PD) for their faculty. However, they are often challenged with inadequate funding and time to implement effective PD programs (Interactive Education Systems Design, 2011). President Obama's Race to the Top Program encourages states to develop effective teachers and inform them on how they can improve their instruction (U.S. Department of Education, 2009). Advances in technology have allowed schools to take advantage of the benefits offered by online learning communities. The online resources help to reduce the PD time needed during the regular school hours and allow flexibility with time, but often require funding that may not exist (IESD, 2011). School-community partnerships have allowed schools to benefit from free resources including face-to-face PD provided by their community, but usually take time that may not be available (IESD, 2011). Implementing free online PD through school-community partnerships can allow educational leaders to reduce time and funding needed to develop and implement PD resources for their faculty. For the purpose of this study, a school-community partnership is defined as any formal arrangement between a school and community organization including federal, public, private, and commercial institutions or individuals for the purpose to provide a service or resource that will help support student achievement (Chadwick, 2004).

Existing research literature provides strong evidence that online learning communities are effective for PD. The Center for Technology in Learning prepared an evaluation of evidence-based practices in online learning for the U.S. Department of Education, Office of Planning, Evaluation, and Policy Development (ED OPEPD). ED OPEPD's evaluation of evidence-based practices in online learning in a meta-analysis of online learning studies found that learning content in an on-line setting was more effective than learning the same content in a face-to-face setting (U.S. Department of Education, Office of Planning, Evaluation and Policy Development, 2010). Other results showed effect sizes were larger for studies in which an instructor-directed and a collaborative approach were used (ED OPEPD, 2010). Research literature also shows that online learning communities for PD can reduce teacher isolation and support sharing, foster reflection on practice, influence teaching practice, and support formation of communities of practice (Barnett, 2002; Matusov, Hayes, & Pluta, 2005). Many studies show no significant differences in learning when comparing online PD to face-to-face PD (Castle & McGuire, 2010; Fisher, Schumaker, Culbertson, & Deshler, 2010; Harlen & Doubler, 2004; Schmidt, 2002). Research findings support theory that online PD can replace face-to-face PD without jeopardizing effectiveness, but there are few studies related to PD delivered online by school-community partnerships.

Research literature on school-community partnerships provides examples of using interviews and surveys with stakeholders and a qualitative analysis to identify common and emerging themes that contribute to the success of partnerships. Themes identified as keys to success of school-community partnerships include 1)

communication, 2) shared decision making, 3) shared resources, 4) expertise and credibility, 5) sufficient time to develop and maintain relationships, 6) champions, 7) being present, 8) flexibility, 9) shared orientation, and 10) recognition of other partners' priorities (Bosma et al., 2010; Lachman & Wlodarczyk, 2011; Lee, Zhang, & Yin, 2011; Monroe, Blackwell, & Pepper, 2010; Sanders, 2012). Such research findings are beneficial to guide the development of school-community partnerships, but do not address findings related to PD delivered online by school-community partnerships.

Purpose

Although prior research provides theory on effectiveness and stakeholders' perceptions on topics of school-community partnerships and online PD separately, there is a lack of existing research on PD delivered online by school-community partnerships. This study, therefore, merged the two and completed an assessment of teachers' perceptions of school-community partnered online professional development. The goal of this study was to identify and assess perceptions from teachers, which could reduce time and funding and aid in successful development of future online PD delivered by school-community partnerships.

Context

The study involved online PD delivered by school-community partnerships between grade K-12 schools nationwide and the National Aeronautics and Space Administration (NASA). At no cost to schools, NASA delivers online PD to multiple school districts nationwide via multiple programs and courses. The MicroGravity eXperience (MicroGX) course is one of the PD courses offered and was selected for the

study based on numerous characteristics including a manageable number of participants and timeline that coincides with the study. All 32 teachers involved with the 2013 MicroGX course was invited to participate in the study. All 32 accepted the invitation. The 32 participants were located at various school districts around the nation and participated in the MicroGX course via Desire2Learn online learning community software. The MicroGX course began in March 2013 and ended in October 2013.

Field-Based Mentor

The field-based mentor was Dr. Steve Marks. Dr. Marks is a professor in the Oklahoma State University (OSU) College of Education, Director of OSU NASA Education Projects, and Principal Investigator for six NASA cooperative agreements including NASA Teaching From Space, NASA Digital Learning Network, NASA Explorer Schools, NASA Education Resource Center, NASA Strategic Education Alliance, and NASA Interdisciplinary National Science Project Incorporating Research and Education Experience.

Setting

The setting for this record of study is two-fold. First, it occurred at multiple school districts at multiple states across the nation that are participating in MicroGX via the Desire2Learn online learning community software. Second, it took place in the NASA Education Office at NASA Johnson Space Center in Houston, Texas for 1 week during face-to-face interactions in July 2013.

Researcher Background

The researcher currently has 16 successful years of education experience managing, leading, and delivering quality programming for public schools, NASA K-12 projects, and Higher Education Programs. The researcher is currently an Academic Dean of Trades and Industry at St. Cloud Technical and Community College in St. Cloud, Minnesota where he currently manages 51 faculty and staff, 25 academic programs, \$4.5M budget, and multiple facilities. Prior to this position, he managed NASA education professional development (EPD) at Johnson Space Center. The NASA position was provided by a cooperative agreement between NASA and Oklahoma State University. The researcher led efforts in the development of national online and face-to-face EPD. He has multiple years of experience with Desire2Learn, Blackboard, and Moodle online learning management systems as well as Adobe Connect, SharePoint, Salesforce, and various wikis. In addition, he has 8 years of experience developing global partnerships to deliver innovative education programming. He has lead the efforts in developing partnerships between NASA and Oklahoma State University, U.S. Department of Education, LEGO, Disney, Sesame Street, YouTube, Google, Lockheed Martin, Canadian Space Agency, Japanese Space Agency, European Space Agency, Public Broadcasting Service, American Chemical Society, American Physical Society, National Institute of Aerospace, National Science Teachers Association, and the International Technology and Engineering Education Association.

The researcher has conducted over 120 high quality professional development workshops to a variety of audiences from pre-k students to senior citizens including astronauts, engineers, scientists, teachers, and higher-education faculty.

Accolades have occurred on many different levels and with a wide variety of projects. He was National Technology Teacher of the Year, NASA Johnson Space Center Innovator of the Year, D2L Desire2EXCEL Finalist, conducted video programming with NASA International Space Station and Space Shuttle, CBS Sports, Sesame Street, and LEGO which helped his team earn an Emmy. His research interests include online learning communities, educator PD, school and community partnerships, pre-service teachers, and inquiry-based teaching/learning. Given the researcher's previous experience and core competencies, he is confident in his ability to collaborate, lead, and deliver high quality research on the topic of teacher PD and assess teachers' perceptions of school/community-partnered online PD.

Summary

In summary, the researcher's professional experience with online curricula, professional development, and multiple positions as an educational leader; coupled with the lack of research on the topic of online STEM PD delivered by school-community partnerships have provided the catalyst for this study. Therefore, this study aims to identify and assess perceptions from participants in online PD offered by a school-community partnership. The findings of this study may aid future development of online PD and assist K-12 leaders in selecting future PD for their teachers.

CHAPTER II

LITERATURE REVIEW AND BACKGROUND

A review of literature reflects studies aimed to increase effectiveness of professional development through school-community partnerships and online learning technology tools. Figure 1 represents three topics of research literature identified and the focus of this record of study. The three topics researched provide a balanced foundation to support the focus. The balanced foundation is complemented by a layer of research, which specifically targets the topic of online PD delivered through school-community partnerships. Table 1 provides an overview of literature reviewed and is coded by topic to coincide with Figure 1.

Figure 1. School/Community-Partnered Online PD for Teachers

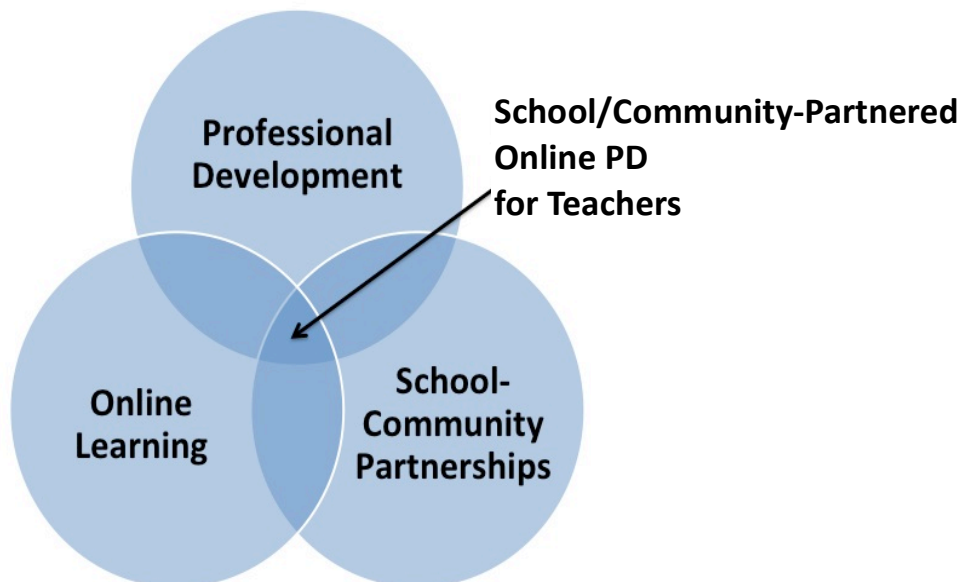


Table 1. Literature Reviewed

Topic	Citation	Method	Lessons Learned
Professional Development	Avalos, B. (2010). Teacher professional development in Teaching and Teacher Education over ten years. <i>Teaching and Teacher Education</i> , 27(1), 10-20.	Study reviewed articles in the Journal of Teaching and Teacher Education over ten years (2000-2010) regarding teacher professional development.	A variety of articles on PD studies was reviewed for common themes including results on effectiveness and issues. The variety of studies provided ideas on methods and instruments to use as well as reinforced the need for additional research.
Online Learning Professional Development	Barnett, M. (2002). <i>Issues and Trends Concerning Electronic Networking Technologies for Teacher Professional Development: A Critical Review of the Literature</i> . Paper presented at the American Educational Research Association, New Orleans, LA.	Literature review identified 24 pre-service and in-service professional development studies based on specific criteria including qualitative and quantitative empirical data. A constant comparative method was used to identify common themes within the studies. Four common thematic issues were identified within the 24 studies. Each study was also analyzed for quality including good empirical research. Each thematic issue identified was discussed with its supporting research base followed by a critique including interpretive commentary. The commentary explained the research findings.	All four major thematic themes identified is promising for educational leaders who are interested in developing and/or implementing new technological tools, which can be used to support both pre-service and in-service teacher professional development. Networking technologies can be used to assist with coaching and mentoring techniques by reducing teacher isolation and supporting sharing of resources. Networking technologies can

Table 1. continued

Topic	Citation	Method	Lessons Learned
			also foster reflection on practice and ultimately influence teacher practice by providing a mechanism to support the formation of communities of practice.
Professional Development Online Learning School-Community Partnerships	Dominguez, P.S., Nicholls, C., & Storandt, B. (2006). Experimental methods and results in a study of PBS Teacherline math courses. <i>External evaluation</i> . Retrieved from http://www.hezel.com/AERA_PBS_TL_Final.pdf	An experimental study was conducted to address the question of whether or not PD delivered by PBS online impacted teachers' attitudes, instructional practices, and student achievement.	The results show positive gains for teachers' attitudes, which is encouraging to my record of study; however, there appears to be no change in instructional practice and student achievement. It appears that validity of instructional practice and student achievement results are impacted by large contextual differences across the districts involved. These impacts will need to be addressed in my record of study to increase validity.
Online Learning Professional Development	Harlen, W., Doubler, S. (2004). Can teachers learn through inquiry online? Studying	The case study examined the learning processes and outcomes over two years of an online professional development course	The results of the study provide guidance on what some of the pros and cons can be when offering the

Table 1. continued

Topic	Citation	Method	Lessons Learned
	<p>professional development in science delivered online and on-campus. <i>International Journal of Science Education</i>. 26(10). 1247–67.</p>	<p>compared to a face-to-face course. Both courses were developed for elementary and middle school science teachers. Multiple instruments were used to collect data including surveys, interviews, videos, and an online database. Multiple methods were used during the two-year study to analyze data. The methods included analyzing pre and post course surveys, in-person interview answers, online postings, videos, and notes from a trained observer in each class. The data were categorized and summative results were determined.</p>	<p>same content or course online versus face-to-face. The study is not intended to research what method of course delivery is more effective. As stated in the study, it is challenging to research what method of course delivery may be more effective due to multiple variables.</p>
<p>Professional Development Online Learning School-Community Partnerships</p>	<p>Lemke, C. (2012). Intel Teach: Jumpstarting 21st Century Learning. External evaluation by Metiri Group. Retrieved from http://download.intel.com/education/teach/public/IntelTeach_Jumpstarting21stLearning_Paper.pdf</p>	<p>An external evaluation conducted on Intel Teach online professional development program assessed data received from online surveys provided to teachers after completing the course. Evaluation of the data and outcomes is motivating, but the validity of the evaluation is questionable. Intel commissioned the evaluation.</p>	<p>Intel Teach has reached over 10 million educators in 10 years in 70 countries around the world. Survey results from 13 countries show that 93.9% of teachers who participated in the online Teach Essentials PD course realigned their teaching to focus more on problem solving, critical thinking,</p>

Table 1. continued

Topic	Citation	Method	Lessons Learned
			and collaboration through technology.
Professional Development School-Community Partnerships	Sandholtz, J.H. (2002). Inservice training or professional development: Contrasting opportunities in a school/university partnership. <i>Teaching and Teacher Training, 18</i> (7), 815-830.	Mixed methods were used. All teachers at partners' schools participated in surveys. Six teachers from each site were selected for in-depth interviews, structured tasks, and informal observation.	The study provided me with ideas on instruments and methods to use with my similar study.
School-Community Partnerships	Schroyer, G., Yahnke, S., Bennett, A., & Dunn, C. (2007). Simultaneous renewal through professional development school partnerships. <i>The Journal of Educational Research, 100</i> (4), 211-224.	Kansas State University Professional Development Schools (KSU PDS) conducted a multifaceted, longitudinal study to examine the process and impact of change on all three partnering organizations. Each partnering organization used an evaluative case study design to gather a wide variety of quantitative and qualitative data. PDS teachers, administrators, K-12 students, KSU faculty, and KSU students participated in surveys and interviews. Numerous institutional and project documents and records; and student-assessment data were also evaluated.	The study provides information that could be beneficial to many different PDSs. The study provides informative content on how PDSs work and collaborate with local school districts to deliver education to students, pre-service teachers, and in-service teachers. The study is relevant to organizations aiming to provide professional development for in-service and pre-service teachers through collaborations. The research can be used to guide the

Table 1. continued

Topic	Citation	Method	Lessons Learned
			design and implementation of such programs, as well as, provide ideas on how to evaluate such programs.
Online Learning	U.S. Department of Education, Office of Planning, Evaluation, and Policy Development (2010)	Meta-analysis reviewed over a thousand online learning studies that were published between 1996 and July 2008. The evaluation team identified 50 independent studies that qualified for the meta-analysis.	Overall, the meta-analysis and review of online learning studies provide guidance to educational leaders. Educational leaders can consider the key findings when designing and implementing effective instruction and professional development for an online learning environment. Details on this particular study are provided in depth following Table 1.

Stakeholder Input

Beneficial input on the design of this study has been collected from a variety of professionals including professors, classmates, workplace colleagues, workplace management, and teachers. Feedback from professors suggested narrowing the original topic of research and problem. The topic was too broad for the record of study timeline. Classmates encouraged a mixed methods study as it would provide more integrity. Workplace colleagues agreed that the record of study would benefit multiple areas of their work. Workplace management expressed interest in using the results of the study in multiple evaluations and reports. Past teacher participants in MicroGX stated that this study can be used to enhance the program for the future as well as enhance similar programs offered by school-community partnerships. All feedback was considered and used to revise the study.

Proposed Solution

The goal of this study is to identify, assess, and report teacher perceptions of online PD delivered by school-community partnerships. The results of the study could possibly aid in successful development of future online PD delivered by school-community partnerships.

Subjects

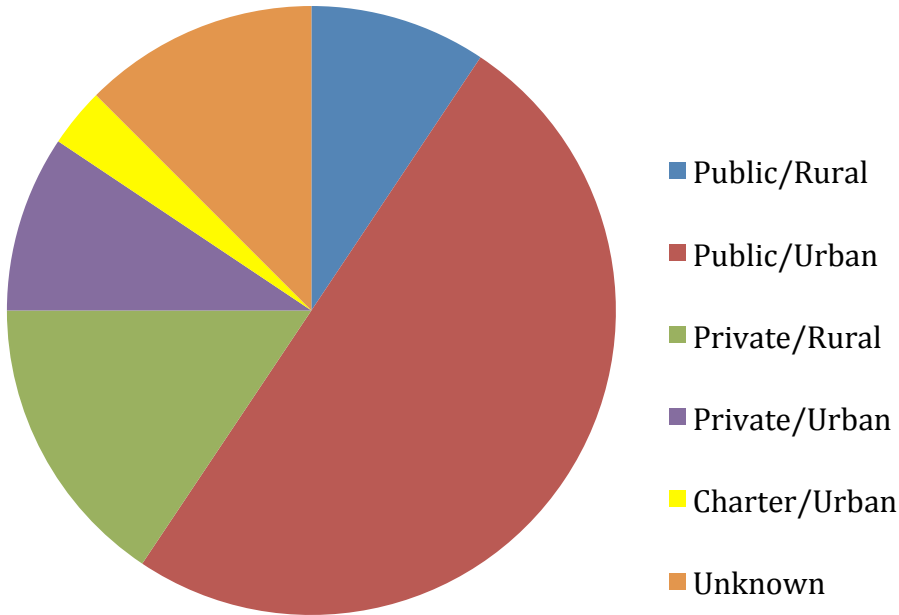
All subjects in the study are teachers who applied to participate in the NASA MicroGX course in January of 2013 and were selected during an internal review of their proposals in the spring 2013. Their proposals involved an online application including background information and intent on how the NASA content would be applied in the classroom. The MicroGX course began in March 2013 and ended in October 2013. The 32 subjects are located at various school districts around the nation and participated in the MicroGX course via Desire2Learn online learning community software. Figure 2 provides location of subjects.

Figure 2. Location of Subjects



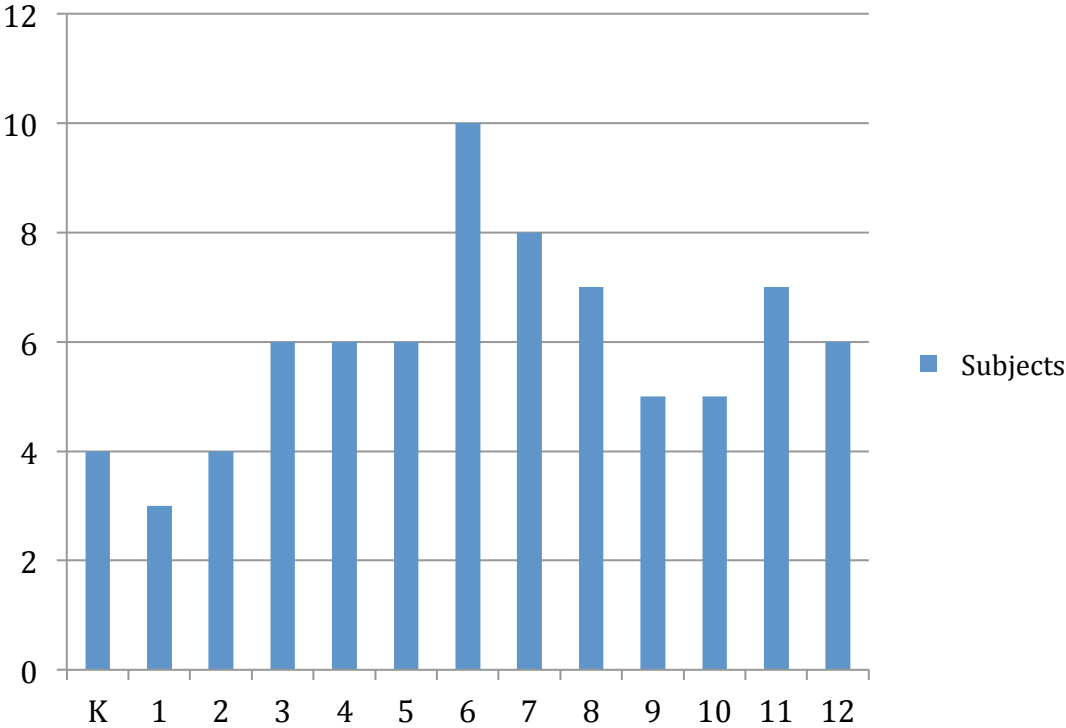
The schools are located in multiple states from the east coast, midwest, and west coast including Arizona, Florida, Georgia, Illinois, Indiana, Minnesota, New Mexico, North Carolina, Texas, and Washington. The majority of subjects' schools can be described as public and urban (16), followed by private and rural (5), public and rural (3), private and urban (3), and charter and urban (1). Four subjects did not respond to this question. The pie chart in Figure 3 represents the location types.

Figure 3. Location Type



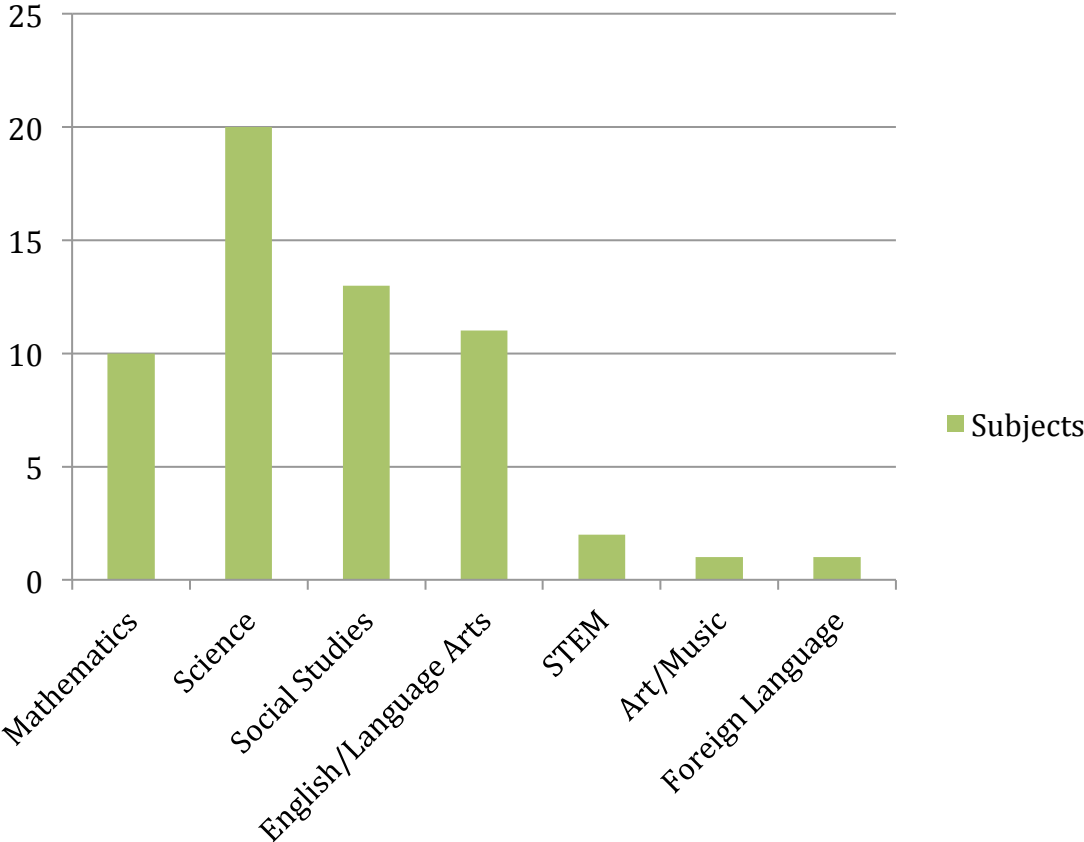
Subjects represent every grade level between kindergarten and twelfth grade. Many of the subjects teach multiple grades. The largest representations of grade levels occur at the middle school level. Ten of the subjects teach sixth grade, eight teach seventh grade, seven teach eighth grade. Figure 4 represents the variety of grade levels taught by subjects.

Figure 4. Grade Levels Taught by Subjects



Subjects cover multiple content areas at their schools. The content areas covered include mathematics, science, social studies, English/language, STEM, art/music, and foreign language. A majority of the subjects teach science (20). Individual subjects, especially at the elementary school level, teach multiple content areas. Figure 5 represents the number of subjects who teach each content area during their school year.

Figure 5. Content Areas Taught by Subjects



Summary

In summary, the literature review provided an extensive foundation of existing studies and data which aided in the development of this study. Stakeholder input complemented the results of the literature review and confirmed the need for this study. The background on subjects provides an understanding of how they were identified, their locations, their content areas, and their grade levels. The next chapter will discuss the process involved in implementing all study methods and achieving results.

CHAPTER III

METHODS AND RESULTS

A mixed methods study was used to collect and analyze data (Creswell, 2007). Teachers involved with the 2013 MicroGX course were invited to participate in the study and all 32 accepted the invitation. Participants were informed about the study during one of the synchronous MicroGX webinars. All participants received an information page and informed consent form. Declining to participate in the research study would not have impacted their participation in the MicroGX experience. Three data collection strategies were utilized to provide reliability and strengthen the validity of the study. Data were collected using observation, two surveys, and document analyses. Pseudonyms were used for subjects participating in the observations and document analysis. Surveys were conducted anonymously.

Observations were collected during synchronous and archived MicroGX webinars. Document analysis included experiment design documents, discussion board posts, and news/print media articles about the 2013 MicroGX course.

An existing NASA Office of Education Performance and Measurement (OEPM) survey was used to obtain baseline data and subject demographics (Appendix A). The NASA OEPM survey contains a variety of questions that are both quantitative and qualitative. Subjects were sent an email asking them to take an online survey housed in a secure database. The database is protected by two-factor identification (RSA token and password). Feedback housed in the NASA OEPM database is anonymous and cannot be associated with an individual. Subjects completed the survey in August 2013. The

second survey was sent to subjects via email (Appendix C). An e-mail was sent out in September 2013 and subjects were given approximately two weeks to complete the survey. All subjects returned the survey. After completing the survey, e-mails were sent thanking the individuals for their participation and providing them with contact information for the researcher should they have any additional questions.

Data analyses were conducted on both the qualitative and quantitative questions. Qualitative questions were analyzed using open coding. Open coding is a free-coding process in which researchers develop and use a coding scheme to classify or manage data (Patton, 2002). This process involves examining, in detail, the data gathered and identifying, categorizing, and classifying the patterns (Patton, 2002). After the use of open coding techniques, analytic statements were used to further examine the data. This approach is based on a technique demonstrated by Emerson, Fretz and Shaw (1995) in which ethnographers, following the open coding process, make marginal notes on their data following the open coding process, which can be used to identify related or unrelated information. Open coding and analytic statements allowed the researcher to identify potential themes in the data set. Themes were identified by identifying like statements. Lessons learned were interpreted and reported during the final phase of analysis (Lincoln & Guba, 1985). Figure 6 provides a graphic representation of the steps involved in this research process.

Figure 6. Research Process

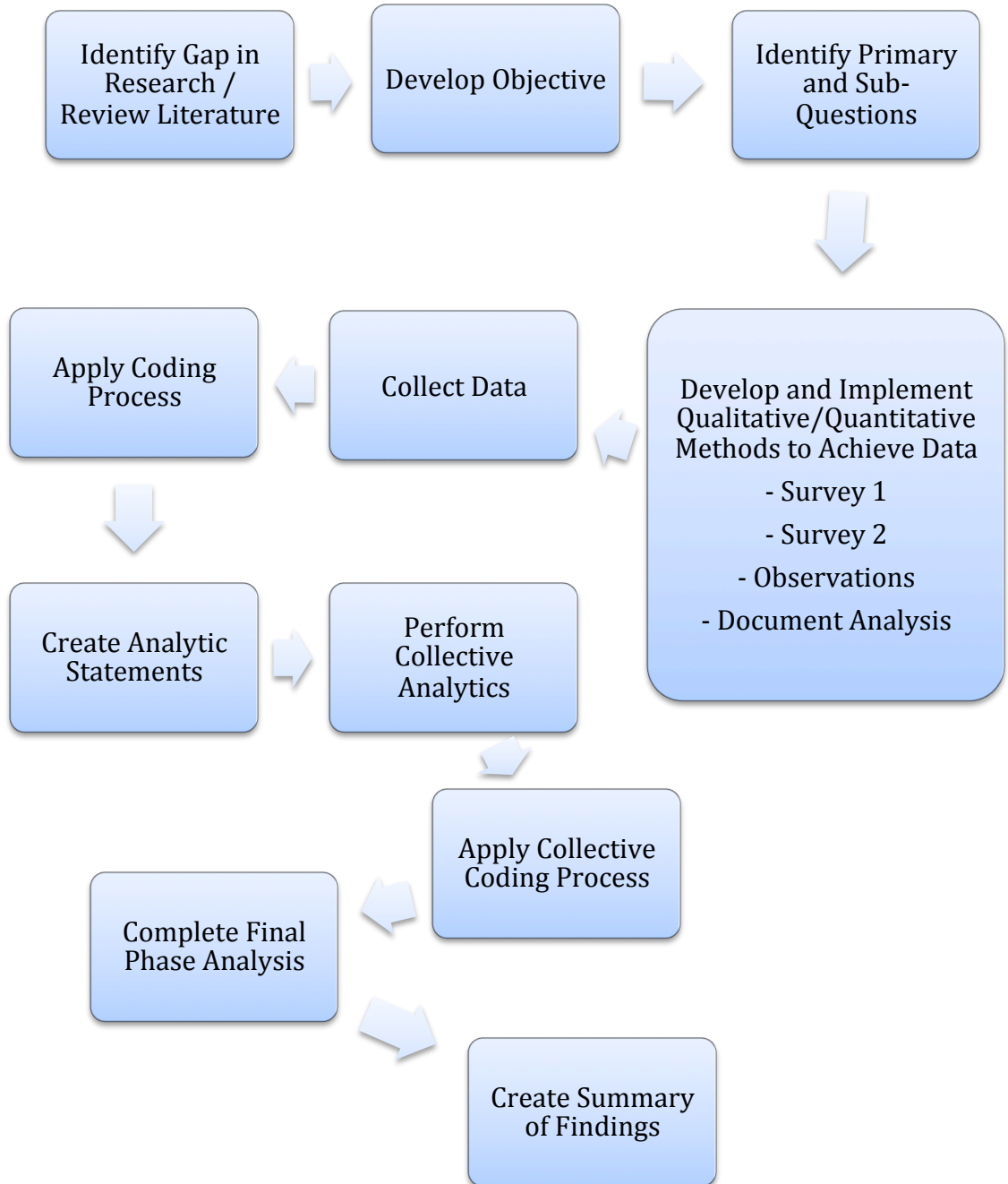


Table 2 contains the primary and sub-questions, methods, and rationale for each.

Table 2. Research Questions/Methods

Questions	Methods	Methods Rationale
<p>Primary Question: What components of MicroGX are deemed effective from the teachers' perspective?</p>	<p>1. Survey 1 (Appendix A)</p> <p>2. Observation (Appendix B)</p>	<p>A mixed methods study was used to collect and analyze data (Creswell, 2007). A variety of methods were chosen as self-report data from teachers can lead to inaccurate reports, based directly on teachers' understanding of the program.</p> <ol style="list-style-type: none"> 1. The NASA OEPM survey was conducted anonymously and achieved baseline data. 2. Observations achieved baseline data. Observations were completed during synchronous Micro GX webinars. 3. A second survey was used to achieve more specific data related to the MicroGX course and research study. 4. Document analysis included submitted assignments, discussion board posts, and news/print media articles about the 2013 MicroGX.
<p>Sub-Questions: What elements of the online PD do teachers feel are most effective? What elements of the online PD do teachers feel are least effective? What are the characteristics that make teachers interested and successful? What are the benefits to the teachers who participate? What are the barriers to teachers' participation? (timeline, technology, timeframe –summer vs. school year, other) How do teachers overcome the barriers?</p>	<p>3. Survey 2 (Appendix C)</p> <p>4. Document Analysis</p>	
<p>Primary Question: How does the effectiveness of MicroGX compare with other online PD from the teachers' perspective?</p>		
<p>Sub-Questions: In what online PD programs have the teachers participated? Do teachers deem the other online PD programs as effective? How does MicroGX compare to non-school-community online PD programs from the teachers' perspective?</p>		

Table 3 provides a description of how data were collected and analyzed.

Table 3. Data Collection and Analysis

Data Sources	Collection	Analysis
Survey 1 (Appendix A)	The OEPM survey was conducted anonymously and achieved baseline data. Pseudonyms were used for subjects.	Qualitative questions were analyzed using open coding. Open coding is a free-coding process in which researchers develop and use a coding scheme to classify or manage data (Patton, 2002). This process involves examining, in detail, the data gathered and identifying, categorizing, and classifying the patterns (Patton, 2002). After the use of open coding techniques, analytic statements will were used to further examine the data. This approach is based on a technique demonstrated by Emerson, Fretz and Shaw (1995) in which ethnographers, following the open coding process, make marginal notes on their data which can be used to identify related or unrelated information. The open coding process and analytic statements allowed the researcher to see potential themes in the data set. Lessons learned were interpreted and reported during the final phase of analysis (Lincoln & Guba, 1985).
Observation (Appendix B)	Observations achieved baseline data. Observation data was collected during synchronous Micro GX webinars and during the face-to-face meeting. Pseudonyms were used for subjects.	
Survey 2 (Appendix C)	A second survey was used to achieve more specific data related to the MicroGX course and research study.	
Document Analysis	Document analysis includes submitted assignments, discussion board posts, and news/print media articles about the 2013 MicroGX.	

Table 4 provides a timeline of the research study.

Table 4. Research Study Timeline

Major Task	Date
Committee Review of ROS Proposal	April 17-May 1, 2013
IRB Submission	May 1, 2013
ROS Defense via Skype	May 6-17, 2013
Meeting with ROS Field Mentor	June 3, 2013
Meeting with MicroGX Project Manager	June 10, 2013
Introduction of ROS to MicroGX subjects during synchronous MicroGX webinar Distribute and collect consent form	June 24-28, 2013
Meeting with ROS Field Mentor	July 1, 2013
Data Collection: Distribute and collect Survey 1	August, 2013
Analyze survey	August-September, 2013
Meeting with ROS Field Mentor	September, 2013
Observations of online MicroGX environment and teacher interaction	September-October, 2013
Data Collection: Survey 2	October, 2013
Data Analysis: Analyze results from Survey 2	November, 2013
Meeting with ROS Field Mentor	November, 2013
Data Analysis: Analyze all data	December, 2013
Finalize study	December, 2013-January, 2014
Meeting with ROS Field Mentor	January, 2014
Meeting with MicroGX Project Manager	January, 2014
Presentation of ROS Results to MicroGX Subjects	January, 2014
Submit Draft ROS to Doctoral Committee	January, 2014
Revise Draft ROS as needed	February, 2014
Submit Final ROS and defend via Skype	February, 2014

Overview of Results

Observations of the MicroGX course, completion of two surveys for all subjects, and document analysis were conducted to obtain data related to the primary and sub-questions.

Survey Results

- Method = Survey 1
- Table 5 = Subject response using Likert Scale. Number of subject responses were multiplied with the score added to each answer and totaled.
- Table 6 = Analytic Statements

Table 5. Survey 1/Likert Scale Responses

Survey 1	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)	Total
Question 1 This NASA Experience has inspired me to bring NASA content into my classroom.	28x5= 140	4x4= 16	0	0	0	156
Question 2 I can immediately apply what I learned from this NASA experience to my teaching about STEM.	26x5= 130	3x4= 12	3x3= 9	0	0	151
Question 3 I will be	26x5= 130	4x4= 16	2x3= 6	0	0	152

Table 5. continued

Survey 1	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)	Total
more effective in teaching STEM concepts introduced in this NASA experience.						
Question 4 Based on my NASA experience, I will make changes to my teaching activities.	19x5= 95	13x4= 52	0	0	0	147
Question 6 The NASA materials used in this experience align well with what I teach.	15x5= 75	12x4= 48	4x3= 12	1x2= 2	0	137
Question 7 These resources will be effective in increasing my students' interest in STEM topics.	23x5= 115	5x4= 20	4x3= 12	0	0	147
Question 8 The NASA experience provided ideas for	24x5= 120	7x4= 28	1x3= 3	0	0	151

Table 5. continued

Survey 1	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)	Total
encouraging student exploration, discussion and participation.						
Question 9 I received activities, ideas or resources that could be used to involve families in their children's STEM education.	13x5= 65	10x4= 40	9x3= 27	0	0	132
Question 10 I plan to use the family ideas suggested.	9x5= 45	11x4= 44	11x3= 33	1x2= 2	0	124
Question 11 I think the resources suggested will be effective with families.	11x5= 55	9x4= 36	11x3= 33	1x2= 2	0	126

Table 9. continued

Subject Response	Researcher analysis
all types of teachers to participate in such events as these. As a language arts teacher, it allowed me to open up my classroom to science using grammar and writing.”	
“A science colleague at school.”	Colleague
“I thought it was a unique experience to be involved in as a teacher.”	Unique experience
“Learned about it during another experience at NASA.”	Another NASA experience
	No response
	No response
“The opportunity to work with NASA again.”	Another NASA experience
“An experience I could share with my students and other teachers.”	Unique experience
“Love of space.”	Love of space
“The opportunity to conduct my students’ experiment in 0g.”	0g
	No response
“The potential to perform an experiment in microgravity and involve students in the engineering process.”	0g
	No response
“The connection with NASA for my students.”	NASA with students
“The chance to learn more about NASA, to bring knowledge and experience back to my students, and of course to get to experience microgravity.”	NASA with students and 0g
	No response
“The opportunity to share the love of science and technology with my students is what attracted me to NASA’s Microgravity experience.”	Love of science and technology and students
“I participated in this program 2 years ago and thought it would be very special to do it again.”	Another NASA experience
	No response
“The opportunity to experience	0g

Table 9. continued

Subject Response	Researcher analysis
microgravity.”	
“The experience of travelling to Houston and experiencing microgravity.”	0g
“Getting as close to space without donning life support.”	0g
“My team lead sent out an email requesting volunteers for a unique experience with NASA.”	Colleague
“The chance to feel what weightlessness feels like while linking with student experiments and engineering designs. Plus, it’s NASA!”	0g/students/NASA
	No response
“I like that it required cooperation between a group of applicants and was focused on an interesting topic that I didn’t have a lot of experience with.”	Unique experience
“The idea of doing something unusual that could get my students excited.”	Unique experience and students
“My fellow teacher asked me to participate.”	Colleague
“Our school is a NASA Explorer School, and the students at all grade levels enjoy learning about space. The idea of having our students help us design an experiment that we could test in zero g was appealing on multiple levels. We knew the students would be excited to partake in a project like this, and their enthusiasm was overwhelming.”	Students and unique experience
	No Response
“It was a once in a lifetime experience. To not only fly in microgravity, but also get to work with NASA. I think this experience really helped me inspire my students in the classroom.”	Unique experience, students, 0g, NASA

Table 10. Survey 2/Question 1 Coding Process

Code	Category
	NASA Involvement
	Microgravity Experience
	Student Opportunity
	Unique Experience
	Colleague Influence
	Love for Space, Science, or Technology
	No Response

Table 11. Survey 2/Question 1 Analytic Statements

Analytic Statements – Survey 2/Question 1
28% of subjects were attracted to the course because NASA was involved
25% of subjects were attracted to the course because it involved an experience with microgravity
22% of subjects were attracted to the course because of what it would offer for their students
19% of subjects were attracted to the course because it offers a unique experience
9% of subjects were influenced by colleagues to participate in the course
6% of subjects were attracted to the course because of their love for space, science, or technology

- Method = Survey 2
- Question 2 = What elements of the online PD do teachers feel are most effective?
- Table 12 = Subject responses
- Table 13 = Coding Process
- Table 14 = Analytic Statements

Table 12. Survey 2/Question 2 Responses

Subject Response	Researcher Analysis
“The live chats w/ microGX and zerog personnel was helpful and informative. The info shared was useful in the classroom, as well as with preparation for the Houston experience.”	Live chats
“The many resources I was able to learn about and be able to bring back into my classroom.”	Content resources
“The ability to talk with interested parties live online. The NASA sites were incredible and all new to me. Very helpful and information was readily available.”	Live chats/NASA website resources
	No response
“I thought the online community meetings every two weeks were very effective. I especially enjoyed learning from individuals who had already been through the program.”	Live chats
“I really enjoyed the live discussions and hearing what other teachers had to share. I learned a lot from others. Insider videos were cool.”	Live discussions
	No response
“The NASA website.”	NASA website
“Video chats”	Video chats
“The easy navigation and use was most effective for me with regards to the online PD.”	Easy navigation
	No response
	No response
“I enjoyed the special guests that taught us and gave us ideas about classroom experiments and speakers that gave us support during process.”	Live chats
“Bimonthly classes to get updates and learn about resources.”	Live chats
	No response
“The live discussion about what to	Live chat discussion about Houston

Table 12. continued

Subject Response	Researcher Analysis
expect in Houston. Very helpful-photos, PPT, information about what we needed to do.”	
	No response
“The live video class presentations.”	Live video class presentations
“The knowledge of NASA resources and opportunities.”	NASA resources
“I liked to learn about other ways that are used to create or simulate a weightless environment. It was nice to have someone to see and hear in person because during my previous MicroGX cycle we did not have any of this. I really think it has improved setting it up as a class.”	Live chats
The various video clips and lessons found online were the most effective for me-they allowed me to view them at my own pace, and was able to use quite a few of them for my students throughout the school year (and plan on using them in the future).”	NASA website resources
	No response
“The online resources and learning about the equipment used to prepare the astronauts to live on ISS.”	NASA website resources
“It was nice to be able to see faces and names when presenting and having questions answered immediately instead of waiting for email response. The video calls were great to get to know the instructor.”	Live video chats
“The live interactions with other teachers and their opinions and experiences that they brought to the table. It was great to be able to relate what we as adults were learning to what our students were learning and including them along the way.”	Live interactions with others and relevant content
“It was to know ahead of time what to expect and to have each step along the way made easy.”	Structure of course

Table 12. continued

Subject Response	Researcher Analysis
	No response
	No response
“The live interaction with participants allowing for questions and answers.”	Live interaction
“Ways to incorporate teaching about gravity and microgravity in ways I could use it with elementary students.”	Relevant content
	No Response
“Live interaction with the other teams.”	Live Interaction with others

Table 13. Survey 2/Question 2 Coding Process

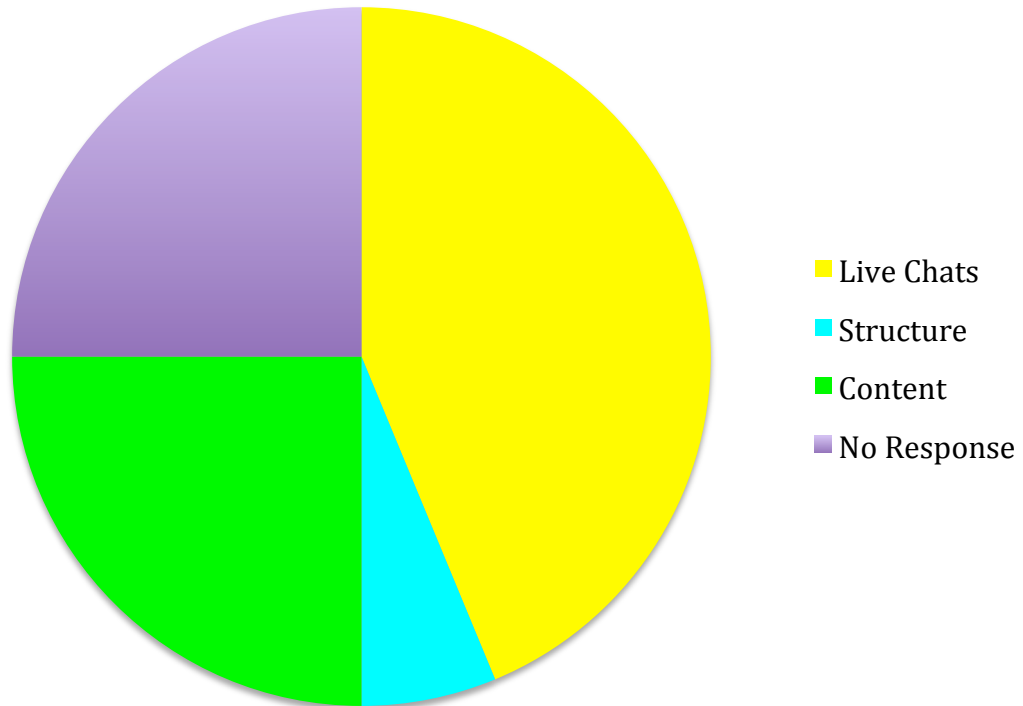
Code	Category
	Live Video Chats
	Content
	No Response
	Structure

Table 14. Survey 2/Question 2 Analytic Statements

Analytic Statements – Survey 2/Question 2
44% of subjects feel live video chats were the most effective part of the course
25% of subjects feel that the content of the course was most effective
25% of subjects did not respond
6% of subjects feel that the most effective part of the course was the way it was structured

Figure 7 provides a pie chart depicting the most effective elements of the course.

Figure 7. Most Effective Element of Course



- Method = Survey 2
- Question 3 = What elements of the online PD do teachers feel are least effective?
- Table 15 = Subject responses
- Table 16 = Coding Process
- Table 17 = Analytic Statements

Table 15. Survey 2/Question 3 Responses

Subject Response	Researcher Analysis
“The discussion boards were posted and we replied to them but they were not revisited.”	Facilitation of discussion boards

Table 15. continued

Subject Response	Researcher Analysis
	No response
“The discussion boards were a good idea, but I thought it was a lot of repetition. They were not a beneficial as they could have been. There was just a wide variety of teachers and experiences that made it difficult.”	Facilitation of discussion boards
“For me as a non-science teacher, I drifted out of the online spaghetti tower nights.”	Relevance of content on specific lesson
“I did not think the class discussion board questions were very effective.”	Discussion board
“Nothing.”	Nothing
“The length of time of online course. The return on investment of my time in the online course wasn’t very high. A large portion of what was delivered through the online portion of the PD could have been done without a mandatory meeting. Also many resources that were shown were advertised as being available to us, I already known about or had used. I think most of the people in the course also had the experience.”	Length and time of course
“Navigating the site and finding content.”	Navigation of site
“NA”	Nothing
“None”	Nothing
“I felt the discussion-based questions could have been a little more open ended. Often times, it seemed like there was one best answer.”	Facilitation of discussion board
	No response
“The lack of interaction on the discussion boards was a bummer. I think if our questions had been more focused on how we were sharing the experiments in our schools, it might have been more helpful.”	Facilitation of discussion board
“I didn’t get much from the discussion boards. After the first few answers,	Facilitation of discussion board

Table 15. continued

Subject Response	Researcher Analysis
new ground doesn't really seem to get broken and the same things get repeated. In courses like this I would rather see smaller groups working on questions and presenting info back to the whole group."	
"The discussion boards felt like forced conversations."	Facilitation of discussion board
"There was one speaker that went way over. We are busy teachers and family is super important to us."	Length of specific presentation
	No response
"So many of the online discussions were yes/no answers, or very closed-ended questions, which made true discussions difficult. I was looking forward to the opportunity to do collaboration with peers around the country, but the discussion questions did not lend themselves to that situation. If we were to share lessons, or even possible ways concepts could be addressed in the classroom (to inspire lessons), would be more beneficial."	Facilitation of discussion board
"I enjoyed all elements of the professional development."	Nothing
"Spaghetti man took almost whole class time when it was a project many of us already done with our students. It was a challenge to get home from work on time because of time differences especially when daylight savings time ended."	Length of time and relevance of one specific presentation
"I think sometimes the time constraints got in the way of some of the meetings and some content was lost. However having the archive was great if we missed something or needed to refresh something."	Time constraints
	No response
"I think sometimes the discussion	Facilitation of discussion board

Table 15. continued

Subject Response	Researcher Analysis
questions could have been a little more opinion based in order to develop actual dialogue/discussions between participants.”	
“The meetings were sometimes difficult to schedule around.”	Time constraints
	No response
“Some of the presentations were a little long and not as pertinent to our needs.”	Length of time and relevance of some presentations
“None”	None
	No response
“I thought the discussion boards were good, however, I felt like people were repeating the same idea over and over again. The discussion questions, in my mind, did not facilitate a discussion. I would suggest them to be more open-ended, which would lead to discussion.”	Facilitation of discussion board
	No response
	No response
“The marshmallow lesson was a complete waste of time.”	Relevance of specific presentation

Table 16. Survey 2/Question 3 Coding Process

Code	Category
	None, Nothing, or No Response
	Discussion Boards
	Length/Time of Course
	Relevance of Some Content
	Navigation of Online Course

Table 17. Survey 2/Question 3 Analytic Statements

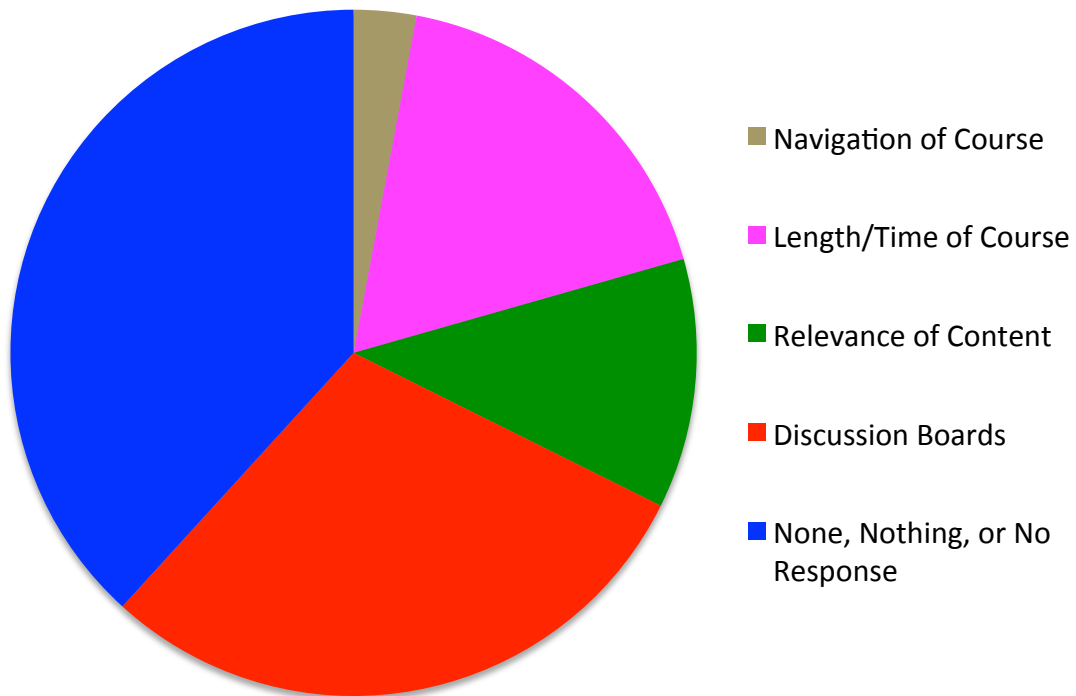
Analytic Statements – Survey 2/Question 3
41% of subjects did not respond to this question
31% of subjects feel that the least effective part of the course were the discussion boards

Table 17. continued

Analytic Statements – Survey 2/Question 3
19% of subjects feel that the least effective part of the course was the length/time of the course
13% of subjects feel that the relevance of the content was the least effective part of the course
3% of subjects feel that the least effective part of the course was the navigation of the online course

Figure 8 provides a pie chart depicting the least effective elements of the course.

Figure 8. Least Effective Element of Course



- Method = Survey 2
- Question 4 = How did this experience connect with your curriculum?
- Table 18 = Subject responses
- Table 19 = Coding Process
- Table 20 = Analytic Statements

Table 18. Survey 2/Question 4 Responses

Subject Response	Researcher analysis on whether or not experience connected with subject's curriculum
"Inquiry and scientific method and real world applications"	Yes
"It didn't...I teach early American History"	No
"Bring more science into choir. Sounds, vibrations, pitches. Science is everywhere."	Yes
"Engineering and design. Astronomy. Real life experiences."	Yes
"Magnets."	Yes
"Not directly connected to my biology curriculum, however great example of experimental design."	Yes
"Content did not relate, but the inquiry process did. The experience gave me the freedom to hit standards that normally would not be covered."	Yes
	No response
"Scientific process. Experiment design. Scientific investigations."	Yes
"International relations in space and on Earth."	Yes
	No response
"Involving STEM topics."	Yes
"Climate including tornadoes."	Yes
"Absorbency, pollution, forces, gravity."	Yes
"Classification and characteristics of water."	Yes
"6 th grade science standards related to sound, amplitude, frequency Scientific design, testing, analyzing."	Yes
"Cohesion adhesion, surface tension, and capillary action"	Yes
"Gravity"	Yes
"Not standards, but real life experiences with science and engineering"	Yes
"Convection"	Yes
"Nature of science including building models and conducting experiments."	Yes
	No response

Table 18. continued

Subject Response	Researcher analysis on whether or not experience connected with subject's curriculum
"Nature of science and the properties of liquids."	Yes
"Scientific and engineering process in real way."	Yes
"Fluid dynamics."	Yes
"Part of curriculum at all grade levels involved."	Yes
"Observe matter in a variety of states."	Yes
"Variable g environments and physics"	Yes
"Research background for experiment"	Yes
"Connected to lab in AP biology"	Yes
"Scientific processes and methods"	Yes
"Dewey decimal system, research"	Yes

Table 19. Survey 2/Question 4 Coding Process

Code	Category
	Yes
	No
	No Response

Table 20. Survey 2/Question 4 Analytic Statements

Analytic Statements – Survey 2/Question 4
88% of subjects feel that the course connected to their curriculum
3% of subjects feel that the course did not connect to their curriculum

- Method = Survey 2
- Question 5 = When you look back on MicroGX a few years from now, what do you think will be most memorable, what will you still be talking about?
- Table 21 = Subject Responses
- Table 22 = Coding Process
- Table 23 = Analytic Statements

Table 21. Survey 2/Question 5 Responses

Subject Response	Researcher Analysis
“The experience with the people including other teachers, students, NASA personnel.”	People
“The most memorable portion will be doing the experiment in 0g. Not many people say they get the chance to participate in such a project.”	Microgravity
	No response
“The other teachers I met and 0g experience.”	People/ Microgravity
“The flight and flight week gave me memories for a lifetime.”	Microgravity
“Floating in MicroG.”	Microgravity
	No response
“The flight. I get to tell the story of experience.”	Microgravity
	No response
“The flight itself.”	Microgravity
“The experience and excitement of being a student again will be memorable. The unknown and energy of something new. The flight.”	Overall experience/ Microgravity
The moment we reached 0g.	Microgravity
“Floating in microG while testing an experiment.”	Microgravity
“The connection with my team and students.”	People
“The experience itself and the amazing NASA employees and other teachers in the project with me.”	People
“When I look back I think the experience in Houston as a whole will be memorable. Specifically, the people we met during the experience, the places we visited, and, of course, the flight itself.”	People
“We had an amazing team and made the best memories. The events and opportunities leading up to it were just as fun as the flight itself.”	People

Table 21. continued

Subject Response	Researcher Analysis
“Working for hours and not being able to fly due to my pregnancy.”	Overall experience
“The whole experience. The whole thing was just amazing.”	Overall experience
“That all the hard work was worth it. Spending time with friends.”	People
“The experience itself. I will hold onto my connections/network hopefully. I love still being in contact with the family we formed during the process/experience.”	Overall experience/People
	No response
“The flight, learning with students, and being part of an amazing team will all be ingrained in my memory for a lifetime.”	Microgravity /People
	No response
	No response
“Meeting all the astronauts.”	People
“The flight and the data/experiments.”	Microgravity
“My experiences in Houston and seeing how large the engines were on the Saturn spacecraft. Also, the mock up facility and how it is used to train the astronauts.”	Overall experience
	No response
“Flying in zero g. I, along with many other people, have had a hard time verbalizing just exactly what it was like. It was truly a once in a lifetime experience, and I enjoyed it even more than I thought I would.”	Microgravity /People
	No response
“Flying.”	Microgravity

Table 22. Survey 2/Question 5 Coding Process

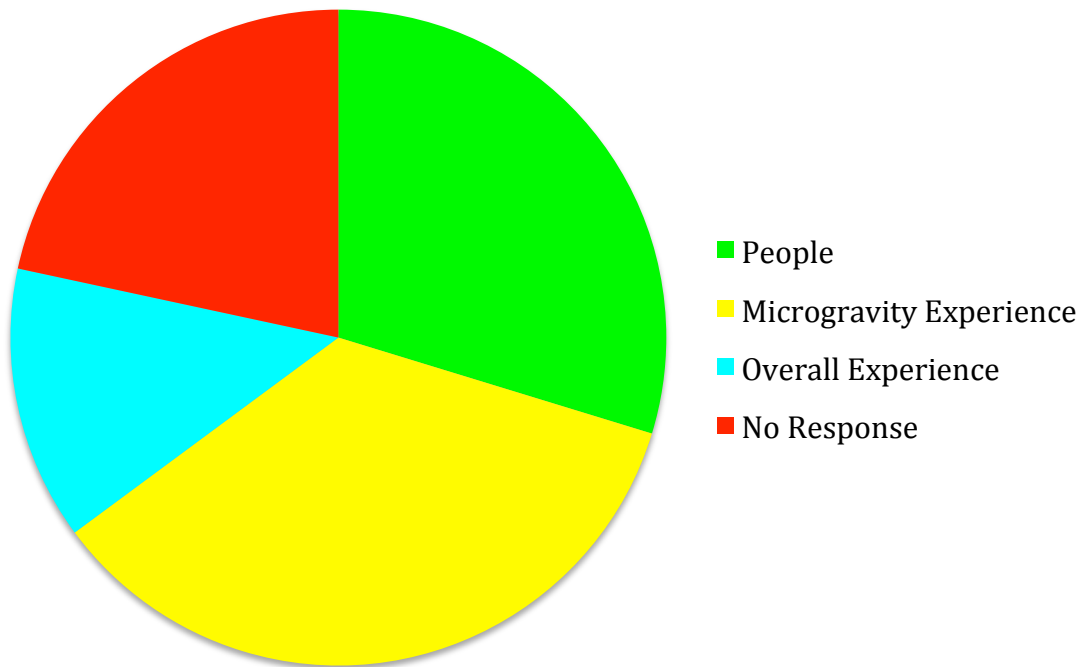
Code	Category
	Microgravity
	People
	No Response
	Overall Experience

Table 23. Survey 2/Question 5 Analytic Statements

Analytic Statements – Survey 2/Question 5
41% of subjects feel that the most memorable element of the course was experiencing microgravity
34% of subjects feel that the most memorable element of the experience are the people involved
25% of subjects did not respond to this question
16% of subjects feel that the overall experience is most memorable about the course

Figure 9 provides a pie chart depicting the most memorable elements from the online course.

Figure 9. Most Memorable from Experience



- Method = Survey 2
- Question 6 = What do you wish you could forget?

- Table 24 = Subject responses
- Table 25 = Coding Process
- Table 26 = Analytic Statements

Table 24. Survey 2/Question 6 Responses

Subject Response	Researcher Analysis
“Puking.”	Sick
“Sick.”	Sick
“Heat in Houston.”	Weather
“Making pasta towers.”	Content
“Doctor physical.”	Physical
	No Response
	No Response
	No Response
“The months of online course. I liked the people, but the course was monotony at times.”	Length of course
“Nothing.”	Nothing
“Nothing.”	Nothing
“The moment my friend got sick.”	Sick
“Nothing.”	Nothing
“The experiences in the course that seemed vaguely tied to what we were doing.”	Content
	No Response
“None of it-the experience as a whole was complete and wonderful.”	None
“I wish I could forget about throwing up.”	Sick
“Nothing. Everything was important to me personally.”	Nothing
“Nothing.”	Nothing
	No Response
“Nothing.”	Nothing
“Breaking down after being told I had to do some medical test at the last minute.”	Physical
	No Response
“The heat.”	Weather

Table 24. continued

Subject Response	Researcher Analysis
“The dry mouth feeling after taking the medicine for the flight.”	Sick
	No Response
“None.”	None
“The nausea and dry mouth of meds.”	Sick
“Hot rainy days.”	Weather
	No Response
	No Response
“I wish the weather cooperated with us so we could all take part in the video conference with our school. I realize this is something that you have no control over, though.”	Weather

Table 25. Survey 2/Question 6 Coding Process

Code	Category
	Getting Sick
	Content
	Weather
	Length of Course
	Medical Reason/Physical
	None, Nothing, or No Response

Table 26. Survey 2/Question 6 Analytic Statements

Analytic Statements – Survey 2/Question 6
2 subjects are not pleased with some of the content presented
1 subject is not pleased by the length of the online course
12 subject responses related to microgravity flight week and not the online course. Suggest revising this question for future studies.
Majority of subjects responded with “nothing”, “none”, or left the answer blank.

- Method = Survey 2
- Question 7 = How did you overcome any of the challenges with the course?
- Table 27 = Subject responses
- Table 28 = Coding Process

- Table 29 = Analytic Statements

Table 27. Survey 2/Question 7 Responses

Subject Response	Researcher Analysis
“I relied on my team captain as well as our advisor.”	colleagues
“I listened and talked with my coworkers. I emailed and asked questions to our teachers.”	colleagues
“I asked many questions to instructor and she was very helpful. Whole support system was incredible.”	instructor
“The office was helpful with questions.”	instructor
“Looked at NASA websites, and Google.”	internet
“I pushed through it. Discipline. The end justifies the means.”	self-discipline
	no response
“Team and NASA support”	colleagues/instructor
“The time away from my two young children was only challenge. Husband was gracious during online sessions.”	family
	no response
“Some technical difficulties occurred during presentations, so my team drove back to school during the evening to attend the online course with video access.”	colleagues
“I tried to think of creative ways to answer the discussion-based questions.”	self-discipline
“I adjusted my schedule and made time.”	self-discipline
“No real challenges.”	none
“The support of my team helped through any challenges.”	colleagues
“Good communication with our team helped us be more effective.”	colleagues

Table 27. continued

Subject Response	Researcher Analysis
<p>“The timing of the course was difficult, being on the west coast, but I overcame it by having my husband cook dinner on class nights. I would also talk with my teammates constantly on how we could use the information gleaned in class for our classrooms, which was beneficial.”</p>	<p>family/colleagues</p>
<p>“It was just late for Eastern time, from 8-9, but my husband put our child to bed during class nights, so it worked out fine.”</p>	<p>family</p>
	<p>no response</p>
<p>“I had to bring home with me to get things done and prepared for my students the next day. I could watch an archived class if I could not attend.”</p>	<p>self-discipline</p>
<p>“Asked questions of other teachers and the instructor. Some of the content was above my head and I had to think like my ESE students and bring it down to my level.”</p>	<p>colleagues/instructor</p>
<p>“Worked with my team.”</p>	<p>colleagues</p>
<p>“Teamwork.”</p>	<p>colleagues</p>
<p>“I don’t think there were any major challenges.”</p>	<p>none</p>
	<p>no response</p>
	<p>no response</p>
<p>“Organization and time management.”</p>	<p>self-discipline</p>
<p>“There really no challenges except remembering to be available to log on.”</p>	<p>self-discipline</p>
<p>“The biggest challenge was the time. Being an elementary teacher and a parent makes my biggest hurdle being time.”</p>	<p>self-discipline</p>
	<p>no response</p>
<p>“If I encountered a challenge, I could usually solve it by asking one of my team members to explain something</p>	<p>colleagues/internet</p>

Table 27. continued

Subject Response	Researcher Analysis
to me or by finding the answer on the internet.”	
“NA.”	none

Table 28. Survey 2/Question 7 Coding Process

Code	Category
	Colleagues
	Self-discipline
	Instructor
	Family
	Internet
	None, Nothing, or No Response

Table 29. Survey 2/Question 7 Analytic Statements

Analytic Statements – Survey 2/Question 7
34% of subjects relied on colleagues to help overcome challenges
28% of subjects responded with none, nothing or did not respond at all
22% of subjects relied on self-discipline to help overcome challenges
13% of subjects relied on the instructor to help overcome challenges
9% of subjects relied on family to help overcome challenges
6% of subjects relied on the Internet to help overcome challenges

- Method = Survey 2
- Question 8 = How can NASA improve the course for teachers?
- Table 30 = Subject responses
- Table 31 = Coding Process
- Table 32 = Analytic Statements

Table 30. Survey 2/Question 8 Responses

Subject Response	Researcher Analysis
“Possibly by matching up a former teacher participant to advise new	Teacher mentor

Table 30. continued

Subject Response	Researcher Analysis
teams of the more personal and less technical aspects of the experience.”	
“Express to teachers how much down time there is during flight week and when giving dimensions of glove box, give the inside dimensions, not outside.”	Provide more details/support
“Less wall picture and more scrolling room on the reading area.”	Change Structure of course site
	No response
“I think in addition to having a NASA mentor, teams would benefit from having a teacher mentor who had already been through the program.”	Teacher mentor
“Use past teachers as mentors. Some teachers did not utilize the social media and lacked team spirit.”	Teacher mentor
“Streamline the online portion.”	Change structure of course site/timeline
“Make it a shorter flight week. Would be easier to find funding.”	Shorter timeline
“Nothing.”	Nothing
	No response
“Be understanding when school starts in August. It’s a very busy month.”	Timeline
	No response
	No response
“Shorten length of stay in Houston to 1-week.”	Shorter timeline
“Make the course discussion relevant to building the experiments.”	Change discussion topics
“More interaction (maybe through homework rather than discussion boards) with teachers from other schools before the trip so we can get to know each other better before Houston.”	Change discussion purpose
“The TEDP was an absolutely overwhelming undertaking. More support with the TEDP would be helpful for teachers in the future.”	More support for paperwork
	No response

Table 30. continued

Subject Response	Researcher Analysis
	No response
<p>“The press in my hometown stinks. Anything NASA can do with this would be great.”</p>	<p>Help with local media/support</p>
	No response
<p>“The timing was difficult – while the actual experience was during the summer, I didn’t get out of school until June 21st. Meaning I was working on MicroGX in addition to the end of the year fiascos. And started again in August.”</p>	<p>Timeline</p>
<p>“I’m not sure.”</p>	Nothing
	No response
<p>“Be aware as the school year ends there is a lot of work to be done and there was a ton of stuff to do for microg that overwhelmed us at the last minute.”</p>	<p>Timeline</p>
<p>“None.”</p>	None
<p>“I think it would be great to have another dinner/social event after the presentations. I was a little sad that after presenting our flight data and outreach, we all just said goodbye and left for our separate ways. A dinner right after would have been a great way to have a gradual goodbye.”</p>	<p>Change closure of course</p>
<p>“None.”</p>	None
<p>“More behind the scenes during tours.”</p>	<p>More stuff during tour</p>
<p>“I really loved the whole experience and I think everything worked great.”</p>	Nothing
<p>“It would be helpful if you have provided examples of the work that needed to be submitted.”</p>	<p>Provide more support</p>
<p>“Offer college credit for the course.”</p>	<p>Offer college credit for course</p>

Table 31. Survey 2/Question 8 Coding Process

Code	Category
	Timeline
	More NASA Support
	Teacher Mentor
	Relevant Discussion Board Topics
	Course Structure
	More Eventful Closure to Course
	More Resources During NASA Tour
	Offer College Credit for Course
	None, Nothing, or No Response

Table 32. Survey 2/Question 8 Analytic Statements

Analytic Statements – Survey 2/Question 8
19% of subjects feel that the timeline should change
13% of subjects feel that NASA could provide more support
9% of subjects feel that a teacher mentor could help
6% of subjects feel that the discussion board topics should be more relevant
3% of subjects feel that the structure of the course could be improved
3% of subjects feel that the closure of the course should be more eventful
3% of subjects feel that more resources should be shared during the NASA tour
3% of subjects feel that NASA should offer college credit for the course

- Method = Survey 2
- Question 9 = What School-community and non-school-community partnership online PD programs have you participated?
- Table 33 = Subject responses
- Table 34 = Coding Process
- Table 35 = Analytic Statements

Table 33. Survey 2/Question 9 Responses

Subject Response	Researcher Analysis
“I assist with running the PD program at my school. Since returning from Houston, our team, have presented at the district symposium, and will continue to educate teachers on the use of our device and the data we collected on the trip.”	yes
“None.”	no
“None.”	no
“I received two degrees through online programs at Concordia University.”	yes
“Lots of music programs, but no science programs.”	yes
“This is the first online PD program I participated in.”	no
“Many other NASA PD experiences.”	yes
“Online graduate courses, online teacher training, online mentoring.”	yes
“None.”	no
“Many courses.”	yes
“Took ESOL course online.”	yes
“None.”	no
“NA.”	no
“College courses, eLearning for teachers.”	yes
“My Master’s Degree was online. I currently run online coaching and instruction for other elementary teachers in my district, and have taught online EdTech classes. I have attended other NASA and NSTA online courses.”	yes
“None.”	no
	no response
	no response
“Other NASA, NOAA classes.”	yes
“Master’s Degree online.”	yes
“None.”	no
“Global climate change NASA class.”	yes
“ESOL classes...boring.”	yes
“I’ve not been involved in many	yes

Table 33. continued

Subject Response	Researcher Analysis
official PD programs online. I did one for NASA and it was pretty cool.”	
“Mostly just MOOCs.”	yes
“None.”	no
	no response
“Reading endorsement trainings.”	yes
“I have taken a few classes online when completing my master’s degree.”	yes
“None.”	no
	no response
	no response

Table 34. Survey 2/Question 9 Coding Process

Code	Category
	yes
	no

Table 35. Survey 2/Question 9 Analytic Statements

Analytic Statements – Survey 2/Question 9
53% of subjects have participated in other online PD programs or courses
28% of subjects have not participated in other online PD
16% of subjects did not respond to this question

- Method = Survey 2
- Question 10 = Do you deem the other online PD programs as effective as MicroGX? More? Less?
- Table 36 = Subject responses
- Table 37 = Coding Process
- Table 38 = Analytic Statements

Table 36. Survey 2/Question 10 Responses

Subject Response	Researcher Analysis
“MGX was a hands on (feet off) experience and there are few other PD programs that can compare.”	less

Table 36. continued

Subject Response	Researcher Analysis
	no response
“No. Both provided many resources that can be used for many different subject areas.”	same
“NA.”	NA
“NA.”	NA
“Less, because of the flight experience.”	less
“More, because I didn’t learn anything.”	more
“Less, because they are more prescriptive.”	less
“Less effective due to dullness and my lack of interest.”	less
“NA.”	N/A
“NA.”	N/A
“Less, it’s not easy to have a great online course-MicroGX did a great job!”	less
	no response
	no response
	no response
“The fact that MicroGX had such a concrete outcome (the trip and flight) focused the course made it very effective!”	less
“N/A.”	N/A
“I think this was great. It can be overwhelming like the others. There is plenty of time to get things done and meetings are consistent.”	same
	no response
	no response
	no response
“Not more effective, just different effective. Knowing a lot of what we were going through would make sense in Houston was more effective. But quite a bit of the activities/lectures that we went through seemed not as effective, as we could not use the information.”	same

Table 36. continued

Subject Response	Researcher Analysis
“N/A.”	N/A
“I liked the face-time with staff which we did not get with the other class. It was just opening and closing and sending documents.”	less
“Less, you don’t get to connect with other people like we were able to do in MicroGX.”	less
I think the microGX was very effective because we had so much along the way to help us be prepared for our experience in Houston.	less
This was really a hybrid because it wasn’t just online. I really don’t have anything else to compare it to.	less
“MicroGX was the most effective by far. Nothing else compares.”	less
“Less effective because there was no live feed with my instructor or other classmates.”	less
“The websites that my classes used were easier to navigate then this one.”	more
“NA.”	NA
	no response

Table 37. Survey 2/Question 10 Coding Process

Code	Category
	More Effective
	As Effective
	Less Effective
	Nothing

Table 38. Survey 2/Question 10 Analytic Statements

Analytic Statements – Survey 2/Question 10
71% of subjects feel that MicroGX was more effective than other online PD that they have participated
19% of subjects feel that MicroGX was as effective as other online PD they have participated

13% of subjects feel that other online PD have been more effective than MicroGX

- Method = Survey 2
- Question 11 = What are your perceptions of the course?
- Table 39 = Subject responses using Likert Scale
- Figure 10 = Chart showing total scores
- Table 40 = Analytic Statements

Table 39. Survey 2/Question 11 Likert Scale Responses

Element	Very Dissatisfied 1	Dissatisfied 2	Neutral 3	Satisfied 4	Very Satisfied 5	Total Score
MicroGX Course		1 2		11111111 32	1111111 1111111 1111111 11 115	149
Desire2Learn software		1 2	11 11 12	1111111111 1111111111 1 84	111111 30	128
Course structure			11 6	1111111111 1111111111 1 84	1111111 11 45	135
Course navigation		11 4	11 11 12	1111111111 1111 56	1111111 11111 60	132
Content delivery			1 3	1111111111 1111111 68	1111111 1111111 70	141
Content provided			1 3	1111111111 1111111	1111111 1111111	142

Table 39. continued

Element	1 Very Dissatisfied	2 Dissatisfied	3 Neutral	4 Satisfied	5 Very Satisfied	Total Score
				64	1 75	
Support provided				1111111111 111111 64	1111111 1111111 11 80	144
Interaction with other teachers			1 3	1111111111 1 44	1111111 1111111 111111 100	147
Frequency and length of class meetings		1 2	1 3	1111111111 111111 64	1111111 1111111 70	139
Resources			1 3	1111111111 1111 52	1111111 1111111 1111 90	145
Discussion boards		1 2	11 11 12	1111111111 111 48	1111111 1111111 1 75	137
Dates/times of meetings		1 2	11 6	1111111111 1111 56	1111111 1111111 1 75	139
Length of course		1 2	11 1 9	1111111111 11111 56	1111111 1111111 70	137

Figure 10 provides a bar chart depicting subjects' perception of the course. Data was gathered from the previous Likert Scale questions and table.

Figure 10. Perception Likert Scale - Subjects' Total Scores

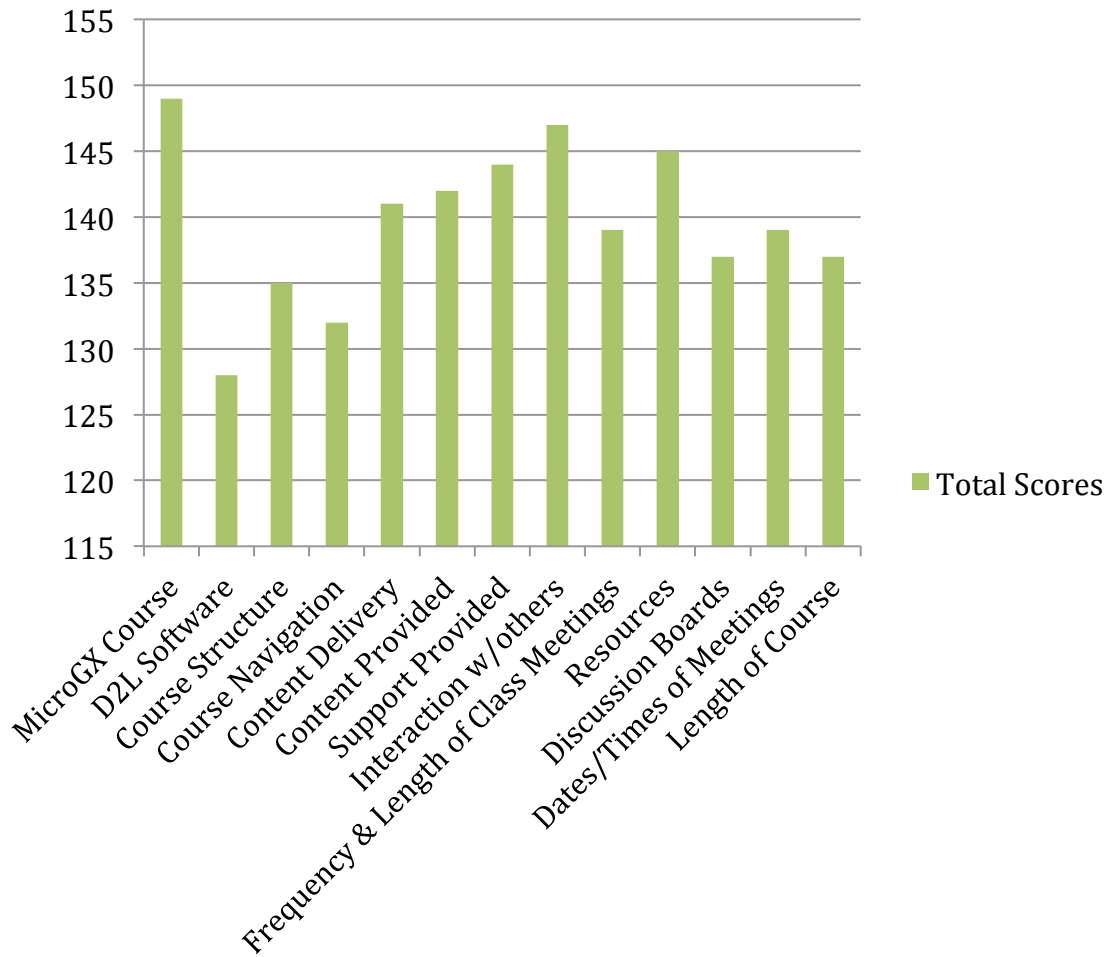


Table 40. Survey 2/Question 11 Likert Scale Analytic Statements

Analytic Statements – Survey 2/Question 11 Likert Scale
100% of subjects were satisfied with the support provided
97% of subjects were satisfied with the MicroGX course
Overall, subjects were most satisfied with the interaction with others, resources, support, content and content delivery.
Overall, subjects were least satisfied with the D2L software; course navigation; course structure; discussion boards; length of course; dates and times of meetings; frequency and length of class meetings.

- Method = Survey 2
- Questions 12-15
- Table 41 = Subject responses using Likert Scale
- Table 42 = Analytic Statements

Table 41. Survey 2/Questions 12-15 Responses

Questions	Subject Response Yes	Subject Response No
Question 12: Are you planning to apply for future NASA online PD courses?	30	2
Question 13: Would you recommend this course to another teacher?	32	0
Question 14: Would you participate in this course again?	30	2
Question 15: Will you use more NASA education resources in the future?	32	0

Table 42. Survey 2/Questions 12-15 Analytic Statements

Analytic Statements – Survey 2/Questions 12-15
100% of subjects would recommend this course to another teacher
100% of subjects feel they will use more NASA education resources in the future
94% of subjects would participate in this course again
94% of subjects would consider participating in more online PD offered by NASA

Observation Results

The following data were accomplished by observing live and archived video web chats, discussion boards, and social media sites. Assignments submitted by subjects were also reviewed and documented.

Qdugtxcwqp 'S wgnkpu'

Observation Question 1. In what ways are subjects participating in the course?

Are subjects engaged? What is the attendance of subjects?

- Live Video Web chats
 - 14 total sessions
 - attendance completed on 9 of 14 sessions
 - 22 subjects attended all 9 sessions (69%)
 - 31 subjects attended 8 of 9 sessions (97%)
 - 31 subjects attended 6 of 9 sessions (97%)
 - 32 subjects attended 5 of 9 sessions (100%)

- Discussion Boards
 - 10 topics with a total of 978 messages
 - The following 5 topics required participation
 - Topic 4 = 97% of subjects posted/91% of subjects responded
 - Topic 5 = 97% of subjects posted/87% of subjects responded
 - Topic 6 = 100% of subjects posted/94% of subjects responded
 - Topic 7 = 91% of subjects posted/81% of subjects responded
 - Topic 8 = 81% of subjects posted/53% of subjects responded

- Average participation rate of 5 required topics = 87%
- Assignments
 - Each subject had 32 assignments to complete
 - 95% of all assignments (977/1024) were completed
 - 56% (18/32) of subjects completed 100% of the assignments
- Social Media
 - 100% participation in development and facilitation of at least one type of social media (ex: Facebook, Flickr, Twitter, BlogSpot)
- Online Course Visits
 - Data not obtainable

Observation Question 2. What type of feedback is available?

- Instructor Feedback to Subjects
 - Live Web chat discussion
 - Real-time direct feedback
 - Discussion Boards
 - Topic 1 = Instructor responded to 100% of posts
 - Topic 2 = Instructor responded to 100% of posts
 - Topic 3 = Instructor responded to 100% of posts
 - Topic 4 = Instructor responded to 21% of posts
 - Topic 5 = Instructor responded to 25% of posts
 - Topic 6 = Instructor responded to 17% of posts

- Topic 7 = Instructor responded to 0% of posts
 - Topic 8 = Instructor responded to 30% of posts
 - Topic 9 = Instructor responded to 5% of posts
 - Topic 10 = Instructor responded to 0% of posts
- Email
 - Data not obtainable
- Subjects
 - Live Web chat discussion
 - Discussion Boards
 - Email

Observation Question 3. Is the feedback positive or negative?

- Instructor to subject (live video web chats/discussion boards)
 - 100% positive
- Subject to subject (live video web chats/discussion boards)
 - 100% positive
- Subject to instructor (live video web chats/discussion boards)
 - 100% positive

Document Analysis

An analysis of existing documents was accomplished by reviewing news/print/media/articles, social media, and archived versions of subjects' final presentations and reports.

- News print/media/articles
 - 16 published media articles were identified and reviewed
 - 100% expressed more positive than negative content
- Social Media
 - 9 types of subject social media were identified and reviewed
 - 100% of content appears to be more positive than negative
 - Types of social media included
 - 4 Facebook pages
 - 1 Photo book
 - 2 Twitter feeds
 - 2 Blogs
- Subjects' Final Presentations
 - All 7 archived web presentations provided by subjects were reviewed
 - 100% of subjects expressed more positive than negative comments and appeared to be excited by the overall experience

Collective Analytics

Table 43 provides a comprehensive collection of all analytic statements created from the survey results.

Table 43. Collective Analytics

Collective Analytics	Code
Analytic Statements – Survey 1/Likert Scale	
100% of subjects agree that this NASA experience has inspired them to bring NASA content into their classroom.	R, CK
100% of subjects agree that this NASA experience has influenced them to make changes to their teaching activities.	CK
100% of subjects do not disagree with the statement that they can immediately apply what they learned from this NASA experience to their teaching about STEM.	CK
100% of subjects do not disagree with the statement that they will be more effective in teaching STEM concepts introduced in the NASA experience.	CK
100% of subjects do not disagree with the statement that these resources will be effective in increasing their students' interest in STEM topics.	SI
100% of subjects do not disagree with the statement that the NASA experience provided ideas for encouraging student exploration, discussion and participation.	SI
100% of subjects do not disagree with the statement that they received activities, ideas or resources that could be used to involve families in their children's STEM education.	R
38% of subjects did not agree with the statement that they plan to use the family ideas suggested.	R
38% of subjects did not agree with the statement that the resources suggested will be effective with families.	R
16% of subjects did not agree with the statement that the NASA materials used in this experience aligned well with what they teach.	R
Analytic Statements – Survey 1/Question 5	
91% of subjects use subject matter covered at the NASA experience.	R, CK
88% of subjects use technology resources introduced at the NASA experience.	R

Table 43. continued

Collective Analytics	Code
88% of subjects use web resources presented at the NASA experience.	R
53% of subjects use teaching techniques presented at the NASA experience.	R, CK
50% of subjects use printed materials presented at the NASA experience.	R
Analytic Statements – Survey 2/Question 1	
28% of subjects were attracted to the course because NASA was involved	O
25% of subjects were attracted to the course because it involved an experience with microgravity	
22% of subjects were attracted to the course because of what it would offer for their students	SI
19% of subjects were attracted to the course because it offers a unique experience	O
9% of subjects were influenced by colleagues to participate in the course	
6% of subjects were attracted to the course because of their love for space, science, or technology	O
Analytic Statements – Survey 2/Question 2	
44% of subjects feel live video chats were the most effective part of the course	CS, CK
25% of subjects feel that the content of the course was most effective	CK
25% of subjects did not respond	
6% of subjects feel that the most effective part of the course was the way it was structured	CS
Analytic Statements – Survey 2/Question 3	
41% of subjects did not respond to this question	
31% of subjects feel that the least effective part of the course were the discussion boards	CS
19% of subjects feel that the least effective part of the course was the length/time of the course	CS
13% of subjects feel that the relevance of the content was the least effective part of the course	CK
3% of subjects feel that the least effective part of the course was the navigation of the online course	CS
Analytic Statements – Survey 2/Question 4	
88% of subjects feel that the course connected to their curriculum	CK
3% of subjects feel that the course did not connect to their curriculum	CK
Analytic Statements – Survey 2/Question 5	

Table 43. continued

Collective Analytics	Code
41% of subjects feel that the most memorable element of the course was experiencing microgravity	
34% of subjects feel that the most memorable element of the experience are the people involved	O
25% of subjects did not respond to this question	
16% of subjects feel that the overall experience is most memorable about the course	O
Analytic Statements – Survey 2/Question 6	
2 subjects are not pleased with some of the content presented	CK
1 subject is not pleased by the length of the online course	CS
12 subject responses related to microgravity flight week and not the online course. Suggest revising this question for future studies.	
Majority of subjects responded with “nothing”, “none”, or left the answer blank.	
Analytic Statements – Survey 2/Question 7	
34% of subjects relied on colleagues to help overcome challenges	
28% of subjects responded with none, nothing or did not respond at all	
22% of subjects relied on self-discipline to help overcome challenges	
13% of subjects relied on the instructor to help overcome challenges	
9% of subjects relied on family to help overcome challenges	
6% of subjects relied on the Internet to help overcome challenges	
Analytic Statements – Survey 2/Question 8	
19% of subjects feel that the timeline should change	CS
13% of subjects feel that NASA could provide more support	S
9% of subjects feel that a teacher mentor could help	S
6% of subjects feel that the discussion board topics should be more relevant	CK, CS
3% of subjects feel that the structure of the course could be improved	CS
3% of subjects feel that the closure of the course should be more eventful	CS
3% of subjects feel that more resources should be shared during the NASA tour	
3% of subjects feel that NASA should offer college credit for the course	O
Analytic Statements – Survey 2/Question 9	
53% of subjects have participated in other online PD programs or courses	
28% of subjects have not participated in other online PD	

Table 43. continued

Collective Analytics	Code
16% of subjects did not respond to this question	
Analytic Statements – Survey 2/Question 10	
71% of subjects feel that MicroGX was more effective than other online PD that they have participated	O
19% of subjects feel that MicroGX was as effective as other online PD they have participated	O
13% of subjects feel that other online PD have been more effective than MicroGX	O
Analytic Statements – Survey 2/Question 11 Likert Scale	
100% of subjects were satisfied with the support provided	S
97% of subjects were satisfied with the MicroGX course	O
Overall, subjects were most satisfied with the interaction with others, resources, support, content and content delivery.	O
Overall, subjects were least satisfied with the D2L software; course navigation; course structure; discussion boards; length of course; dates and times of meetings; frequency and length of class meetings.	CS, O
Analytic Statements – Survey 2/Questions 12-15	
100% of subjects would recommend this course to another teacher	O
100% of subjects feel they will use more NASA education resources in the future	R
94% of subjects would participate in this course again	O
94% of subjects would consider participating in more online PD offered by NASA	O

Table 44 provides the coding process used to help analyze the data.

Table 44. Collective Analytic Coding Process

Code	Category
	Negative Perception
	Positive Perception
Table 44. continued	Neutral Perception
CK	Content Knowledge
CS	Course Structure
O	Overall
R	Resources
SI	Student Impact
S	Support

For the final phase analysis in Table 45, statements identified with a neutral perception have been removed and the remainder of statements have been categorized and labeled with green and red to distinguish between a positive or negative perceptions.

Table 45. Final Phase Analysis

Overall	
Positive	Negative
100% of subjects would recommend this course to another teacher	13% of subjects feel that other online PD have been more effective than MicroGX
97% of subjects were satisfied with the MicroGX course	3% of subjects feel that NASA should offer college credit for the course
94% of subjects would participate in this course again	Overall, subjects were least satisfied with the D2L software; course navigation; course structure; discussion boards; length of course; dates and times of meetings; frequency and length of class meetings.
94% of subjects would consider participating in more online PD offered by NASA	
71% of subjects feel that MicroGX was more effective than other online PD that they have participated	
34% of subjects feel that the most memorable element of the experience are the people involved	
28% of subjects were attracted to the course because NASA was involved	
19% of subjects were attracted to the course because it offers a unique experience	
19% of subjects feel that MicroGX was as effective as other online PD they have participated	
16% of subjects feel that the	

Table 45. continued

overall experience is most memorable about the course	
6% of subjects were attracted to the course because of their love for space, science, or technology	
Overall, subjects were most satisfied with the interaction with others, resources, support, content and content delivery.	
Content Knowledge	
Positive	Negative
100% of subjects agree that this NASA experience has inspired them to bring NASA content into their classroom.	13% of subjects feel that the relevance of the content was the least effective part of the course
100% of subjects agree that this NASA experience has influenced them to make changes to their teaching activities.	6% of subjects feel that the discussion board topics should be more relevant
100% of subjects do not disagree with the statement that they can immediately apply what they learned from this NASA experience to their teaching about STEM.	2 subjects are not pleased with some of the content presented
100% of subjects do not disagree with the statement that they will be more effective in teaching STEM concepts introduced in the NASA experience.	3% of subjects feel that the course did not connect to their curriculum
91% of subjects use subject matter covered at the NASA experience.	
88% of subjects feel that the course connected to their curriculum.	
53% of subjects use teaching techniques presented at the NASA experience.	
44% of subjects feel live video chats were the most effective part of the course	
25% of subjects feel that the content of the course was most	

Table 45. continued

effective	
Course Structure	
Positive	Negative
44% of subjects feel live video chats were the most effective part of the course	31% of subjects feel that the least effective part of the course were the discussion boards
6% of subjects feel that the most effective part of the course was the way it was structured	19% of subjects feel that the least effective part of the course was the length/time of the course
	19% of subjects feel that the timeline should change
	6% of subjects feel that the discussion board topics should be more relevant
	3% of subjects feel that the least effective part of the course was the navigation of the online course
	3% of subjects feel that the structure of the course could be improved
	3% of subjects feel that the closure of the course should be more eventful
	Overall, subjects were least satisfied with the D2L software; course navigation; course structure; discussion boards; length of course; dates and times of meetings; frequency and length of class meetings.
Student Impact	
Positive	Negative
100% of subjects do not disagree with the statement that these resources will be effective in increasing their students' interest in STEM topics.	
100% of subjects do not disagree with the statement that the NASA experience provided ideas for encouraging student exploration, discussion and participation.	
22% of subjects were attracted to the course because of what it would offer for their students	
Resources	
Positive	Negative

Table 45. continued

100% of subjects agree that this NASA experience has inspired them to bring NASA content into their classroom.	38% of subjects did not agree with the statement that they plan to use the family ideas suggested.
100% of subjects feel they will use more NASA education resources in the future	38% of subjects did not agree with the statement that the resources suggested will be effective with families.
100% of subjects do not disagree with the statement that they received activities, ideas or resources that could be used to involve families in their children’s STEM education.	16% of subjects did not agree with the statement that the NASA materials used in this experience aligned well with what they teach.
91% of subjects use subject matter covered at the NASA experience.	
88% of subjects use technology resources introduced at the NASA experience.	
88% of subjects use web resources presented at the NASA experience.	
53% of subjects use teaching techniques presented at the NASA experience.	
50% of subjects use printed materials presented at the NASA experience.	
Support	
Positive	Negative
100% of subjects were satisfied with the support provided	13% of subjects feel that NASA could provide more support
	9% of subjects feel that a teacher mentor could help

Summary

In summary, this chapter provided an extensive overview of the methods implemented during the study, report on all data, and complete analysis. The next chapter will provide the key findings, implications, and overall conclusion of the study.

CHAPTER IV

FINDINGS, IMPLICATIONS, AND CONCLUSION

This chapter presents the results from the mixed methods study on teacher's perceptions of online PD offered through a school-community partnership. A thorough analysis of data from two surveys, observations, and documents was used to answer the primary questions: 1) What components of MicroGX are deemed effective from the teachers' perspective? 2) How does the effectiveness of MicroGX compare with other online PD from the teachers' perspective? The data from this study provide evidence that subjects perceive NASA's online STEM PD (MicroGX course) as a positive experience with many effective components. The experience is more effective than participation in other online PD.

Overview and Analysis of Key Findings

Effective Components

Overall. Survey data show majority of the subjects feel the MicroGX course was a more positive than negative experience. Subjects were initially attracted to the course because of the unique experience offered, NASA's involvement, experience with microgravity, influence from their colleagues, and the impacts the course would have on their students. All of the subjects would recommend this course to another teacher and overall, subjects were most satisfied with the interaction with others, resources, support, content, and content delivery. Ninety-seven percent of subjects were satisfied with the course. Ninety-four percent of subjects would participate in the course again and consider participating in more online PD offered by NASA. Seventy-one percent of

participants feel that MicroGX was more effective than other online PD in which they have participated. Effective components include content knowledge, student impact, resources, and support.

Content Knowledge. All of the subjects agree this NASA experience has inspired them to bring NASA content into the classroom; influenced them to make changes to their teaching activities; do not disagree with the statement that they can immediately apply what they learned from this NASA experience to their teaching about STEM; and do not disagree that they will be more effective in teaching STEM introduced in this NASA experience. Ninety-one percent of subjects use subject matter covered at the NASA experience. Eighty-eight percent of subjects feel that the course connected to their curriculum.

Student Impact. All of the subjects do not disagree that the resources will be effective in increasing their students' interest in STEM topics and this experience provided ideas for encouraging student exploration, discussion and participation.

Resources. All of the subjects feel they will use more NASA education resources in the future and do not disagree that they received activities, ideas or resources that could be used to involve families in their children's STEM education. Eighty-eight percent of subjects use technology and web resources presented at the NASA experience.

Support. All of the subjects feel they were satisfied with the support provided.

Observation and Review of Documents

Observations of the online course and a review of documents were conducted to collect additional data on subjects' perceptions of the course. Observations and review of documents provide evidence subjects were more engaged than disengaged in the course. The evidence includes high attendance of live video chats; high percentage of completed assignments including final presentations; and participation in discussion boards and social media.

Live video web chats included fourteen total sessions. Attendance was taken by the instructor on nine of the fourteen sessions. Sixty-nine percent of subjects attended all nine sessions. Ninety-seven percent of subjects attended eight of nine sessions.

Each subject had thirty-two assignments to complete during the course in which 977 of the 1024 assignments were completed. This equals ninety-five percent of all assignments. Fifty-six percent of subjects completed all of the assignments. All of the subjects completed the final presentation and report.

Discussion boards included ten topics with a total of 978 messages. Topics 4-8 required participation. The average participation rate of the five required topics was eighty-seven percent.

All of the subjects was involved in the development and facilitation of social media for their experience. Social media may include Facebook, Flickr, Twitter, and BlogSpot.

A review of archived live video chats and final presentations provide evidence that subjects were excited. Other elements of the course appear to be positive as well,

including interaction between subjects, interaction between subjects and instructor, and published media on the MicroGX course and experience.

Course Recommendations

Although the majority of survey responses toward MicroGX were positive, some specific elements reflect negative perceptions indicating a need for improvement in those areas. Subjects were least satisfied with D2L software, course navigation, course structure, discussion boards, length of course, dates and times of meetings, frequency and length of class meetings. Thirty-one percent of participants felt that the least effective part of the course was the discussion boards. A review of archived discussion boards revealed that subjects received a response from the instructor on one-hundred percent of the first three topics and only fourteen percent of the remaining seven topics, including no response from the instructor on two of the topics. The lack of feedback from the instructor may also be the reason why discussion boards received the third lowest category score in the Likert scale data. Other elements of the course received a negative response as well. Survey data show nineteen percent of participants felt that the least effective part of the course was the length/time or timeline of the course; however, frequency/length of class meetings and dates/times of meetings all received satisfactory scores in the Likert scale data. Thirteen percent of participants feel that the relevance of the content was the least effective part of the course and three percent stated that the content did not connect to their curriculum; however, ninety-seven percent of participants felt that the course connected to their curriculum. Three percent of participants feel that the least effective part of the course was the navigation or online

structure which is consistent with the low scores that the course navigation category received on the Likert scale survey questions. The D2L software category also received low scores on the Likert scale survey questions. Subjects overcame the barriers during the course by utilizing self-discipline and collaborating with colleagues, family, and the instructor. Subjects also offered many recommendations on how to improve the online PD course.

Survey data collected provide many suggestions for improving the course. Thirteen percent of participants feel that NASA could provide more support. Nine percent of participants feel that a teacher mentor could help. Six percent of participants feel that the discussion board topics should be more relevant. Three percent of participants feel that the structure of the course could be improved. Three percent of participants feel that more resources should be shared during the NASA tour. Three percent of participants feel that NASA should offer college credit for the course. Three percent of participants feel that the closure of the course should be more eventful. Subjects did not get a chance to elaborate further on course recommendations; future researchers on similar topics may want to consider this.

Recommendations for Further Research

Although prior research provides theory on stakeholders' perceptions of school-community partnerships and online PD separately, there is a lack of existing research on PD delivered online by school-community partnerships. This study merged the two and completed an assessment of teachers' perceptions of school/community-partnered online professional development. The goal of this study was to identify and assess teachers'

perceptions which could reduce time and funding and aid in successful development of future online PD delivered by school-community partnerships. Results from this study may aid in filling the gap in research. Lessons learned may aid in the development and validity of future studies on similar topics.

This study could be improved in many ways. Additional steps to increase validity may include follow-up focus groups or one-on-one discussions with subjects so they can elaborate further on specific elements of the study. If time allowed, the researcher could have been present for all synchronous online sessions including live video web chats and final presentations. It also would have been helpful for the researcher to be present during the face-to-face week at NASA Johnson Space Center. Expanding to additional online PD delivered by school-community partnerships and different types of community partners including state, federal government and non-profit organizations could build upon the existing data and further aid in filling the gap in existing research.

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APPENDIX A

SURVEY 1

NASA OEPM Teacher Survey

Type of institution you teach at (circle all that apply):

Public Parochial Private Charter Rural Suburban Urban Other
(specify) _____

What is (are) the grade(s) of students that you teach? (Check all that apply)

K 1 2 3 4 5 6 7 8 9 10 11 12

What is (are) the subject matter(s) that you teach? Check all that apply.

- Art/Music
- Drama
- Engineering
- English/Language Arts
- Foreign Language
- Guidance
- Health
- Media Specialist/Library
- Mathematics
- Physical Fitness
- Science
- Social Studies
- Technology
- Other. Please

specify _____

To what extent do you agree with the following statements? (Circle one)

1. This NASA experience has inspired me to bring NASA content into my classroom.

Strongly Agree Agree Neutral Disagree Strongly Disagree

2. I can immediately apply what I learned from this NASA experience to my teaching about science, technology, engineering, and mathematics (STEM).

Strongly Agree Agree Neutral Disagree Strongly Disagree

3. I will be more effective in teaching STEM concepts introduced in this NASA experience.

Strongly Agree Agree Neutral Disagree Strongly Disagree

4. Based on my NASA experience, I will make changes to my teaching activities.

- Strongly Agree Agree Neutral Disagree Strongly Disagree
5. Which activities do you plan to add or change to your teaching practices?
(Check all that apply)

- Use printed materials presented at my NASA experience.
- Use subject matter covered at my NASA experience.
- Use technology resources introduced at my NASA experience.
- Use web resources presented at my NASA experience.
- Use teaching techniques presented at my NASA experience.
- Other. Please specify:
-

To what extent do you agree with the following statements? (Circle one)

6. The NASA materials used in this experience align well with what I teach.

Strongly Agree Agree Neutral Disagree Strongly Disagree

7. These resources will be effective in increasing my students' interest in STEM topics.

Strongly Agree Agree Neutral Disagree Strongly Disagree

8. This NASA experience provided ideas for encouraging student exploration, discussion and participation.

Strongly Agree Agree Neutral Disagree Strongly Disagree

9. I received activities, ideas or resources that could be used to involve families in their children's STEM education.

Strongly Agree Agree Neutral Disagree Strongly Disagree
Not Applicable

10. I plan to use the family ideas suggested.

Strongly Agree Agree Neutral Disagree Strongly Disagree
Not Applicable

11. I think the resources suggested will be effective with families.

Strongly Agree Agree Neutral Disagree Strongly Disagree
Not Applicable

APPENDIX B
OBSERVATION ITEMS

1. In what ways are subjects participating in the course?
2. What type of feedback is available?
3. Is the feedback positive or negative?
4. Are subjects engaged?
5. How do the subjects feel – excited, frustrated, happy, bored?
6. What is the attendance of subjects?
7. Do subjects have questions regarding expectations?
8. Do subjects comprehend content delivered?

APPENDIX C

SURVEY 2

1. What attracted you to NASA’s MicroGX course?
2. What elements of the online PD do you feel were most effective?
3. What elements of the online PD do you feel were least effective?
4. How did this experience connect with your curriculum?
5. When you look back on MicroGX a few years from now, what do you think will be most memorable, what will you still be talking about?
6. What do you wish you could forget?
7. How did you overcome any of the challenges with the course?
8. How can NASA improve the course for teachers?
9. What School-community and non-school-community partnership online PD programs have you participated?
10. Do you deem the other online PD programs as effective as MicroGX? More? Less?
11. What are your perceptions of the course?

Element of Course	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
Desire2Learn software					
Course structure					
Course navigation					
Content delivery					
Content provided					
Support provided					
Interaction with other teachers					
Frequency and length of class					

meetings					
Resources					
Discussion boards					
Dates/times of meetings					
Length of course					

12. Are you planning to apply for future NASA online PD courses?
13. Would you recommend this course to another teacher?
14. Would you participate in this course again?
15. Will you use more NASA education resources in the future?

APPENDIX D

INFORMED CONSENT SCRIPT

Information to be provided prior to subjects' agreement to participate:

INFORMED CONSENT SCRIPT

To be read by a researcher to the 2013 MicroGX participants during a synchronous MicroGX class:

Researchers from Texas A&M University are conducting a study to examine teacher perceptions of online professional development. You are being asked to participate in the study as a result of your participation in the 2013 NASA MicroGX experience.

The researchers are Dr. William Rupley and Matthew Keil.

The data we will be analyzing for this study include observations of the synchronous MicroGX course, focus group, an online survey to be completed at the conclusion of the experience, and phone interviews.

Your confidentiality is very important to us, thus we will not associate your name or your school's name with any research finding. The end of event survey will be completed anonymously and you will use a pseudonym during the focus group and follow-up phone interview.

Please read the informed consent information sheet and form. If you would like to volunteer for this study, please sign one copy of the informed consent form and return it to Matthew Keil by U.S. mail.

There is no penalty for declining to participate in this study and you may withdraw from the study at any time without penalty.



IRB NUMBER: IRB2013-0409
IRB APPROVAL DATE: 07/11/2013
IRB EXPIRATION DATE: 06/30/2014

APPENDIX E

PARTICIPANT INFORMATION PAGE

INFORMED CONSENT INFORMATION PAGE

PARTICIPANT INFORMATION TEXAS A&M UNIVERSITY

Title: Teacher Professional Development: Assessment on teachers' perceptions of NASA's online STEM professional development

Investigators: Dr. William Rupley and Matthew Keil (Texas A&M University)

Purpose: The purpose of the research study is to understand how the MicroGX online professional development is working to enrich classroom instruction of science, technology, engineering and mathematics content and to understand how NASA can improve their services. You are being asked to participate in the study as a result of your participation in the 2013 MicroGX experience.

What to Expect: Participation in this study will involve completion of one survey. The survey will ask for information about your participation in the MicroGX experience. You must complete each question before moving on to the next. The survey will take approximately 15 minutes to complete. Additionally, you will be asked to participate in a 30-minute focus group during flight week, during which you will be given an opportunity to share your experiences and offer recommendations for improving the project. Researchers will contact you via phone to ask additional questions or to verify your responses. The phone call is estimated to be 15 minutes in length.

Risks: The principle risks associated with this study are those associated with a breach in confidentiality. To minimize these risks your name and contact information will be disassociated from your survey, focus group, and phone call responses. Your name and contact information will be stored securely in a locked file in the researcher's office.

Benefits: This study is being conducted to help us understand teachers' perceptions of online professional development.

Compensation: There will be no compensation for participating in this research study.

Your Rights: Your participation in this research study is completely voluntary. There is no penalty for refusal to participate, and you are free to withdraw your consent and participation in this study at any time, without penalty.

Confidentiality: All information about you will be kept confidential and will not be released. Research records will be stored securely and only researchers and individuals responsible for research oversight will have access to the records.

Contacts: You may contact any of the researchers at the following address and phone number, should you desire to discuss your participation in the study and/or request information about the results of the study:



IRB NUMBER: IRB2013-0409
IRB APPROVAL DATE: 07/11/2013
IRB EXPIRATION DATE: 06/30/2014

Matthew Keil
Education Manager
NASA Johnson Space Center
2101 NASA Parkway, AD4
Houston, TX 77546
matthew.j.keil@nasa.gov
281-682-5418

William H. Rupley
Professor of Reading Education
Distinguished Research Fellow
Executive Editor Reading Psychology: An International Journal
Regents Fellow
College of Education and Human Development
Department of Teaching, Learning, and Culture 4232
Texas A&M University
College Station, TX 77843
<http://directory.cehd.tamu.edu/view.epl?nid=w-rupley>



IRB NUMBER: IRB2013-0409
IRB APPROVAL DATE: 07/11/2013
IRB EXPIRATION DATE: 06/30/2014

APPENDIX F

INFORMED CONSENT FORM

INFORMED CONSENT FORM

NASA MicroGX

Researchers names: Dr. William Rupley and Matthew Keil
Address: 2101 NASA Parkway, AD4, Houston, TX 77058
Telephone number: 281-682-5418
Email address: matthew.j.keil@nasa.gov

Thank you for agreeing to participate in this research study. This form outlines the purposes of study and provides a description of your involvement and rights as a participant. The purpose of this research study is to understand how Micro GX is working to enrich classroom instruction of science, technology, engineering and mathematics content and to understand how NASA can improve their services. You are being asked to participate in the study as a result of your participation in the 2013 MicroGX experience.

You are invited to participate in this study by participating in an online survey, a focus group and follow-up phone call with a researcher.

As the researchers, we agree to meet the following conditions:

1. We will audiotape and videotape our focus group with your permission and transcribe the tape for the purpose of accuracy. At your request, we will give you a copy of the transcript so that you may see that we have captured your words correctly. At the end of the study, the tapes will be erased or destroyed.
2. We will assign a fictitious name on the transcript or you may choose one yourself. Your real name will not be used at any point of information collection or in reports of study findings.

As participant in this research, you are entitled to know the nature of our research. You are free to decline to participate, and you are free to withdraw from the study at any time. No penalty exists for withdrawing your participation. Feel free to ask any questions at any time about the nature of the research study and the methods we are using. Your suggestions and concerns are important to us. Please contact the researchers at the addresses/email provided above.

Please indicate your willingness to participate in this research process by checking one of the following statements and providing your signature below. The signatures below indicate an acknowledgment of the terms described above.

- I wish to participate in the research described above, have read this consent form, and agree to be audio and video taped during the focus group.
- I wish to participate in the research described above, have read this consent form, but I do not agree to be audio and video taped during the focus group.
- I do not wish to participate in the research described above.

SIGNATURE OF RESEARCH PARTICIPANT

DATE

PRINTED NAME OF RESEARCH PARTICIPANT

PSEUDONYM



IRB NUMBER: IRB2013-0409
IRB APPROVAL DATE: 07/11/2013
IRB EXPIRATION DATE: 06/30/2014

APPENDIX G

EMAIL REQUESTING SURVEY COMPLETION

Copies of flyers, announcements or other forms of recruitment:

E-mail Requesting Survey Completion

Initial Recruitment E-mail

SUBJECT: NASA Micro GX Research Study
TO: All subjects who have signed the informed consent form

Dear 2013 MicroGX Participant,

Thank you for participating in NASA's MicroGX experience this school year and agreeing to provide feedback to help us improve our services for years to come. We would very much appreciate your feedback to let us know if we are on the right track and to help us to continue to improve the MicroGX experience. We understand you are very busy and receive many requests for your time. We have worked to keep our survey brief and estimate it taking about 15 minutes of your time.

Thank you for your time and valuable feedback to help us improve NASA's MicroGX.

Sincerely,
Matthew Keil, NASA Education Manager

Follow-up Recruitment E-mail

SUBJECT: NASA MicroGX Research Study
TO: All Subjects who have signed the informed consent form that have not completed the survey after 1-week

Dear 2013 MicroGX Participant,

Thank you for participating in MicroGX this year. Last week we contacted you requesting your help to improve our services by completing a brief feedback survey. We understand you are very busy and receive many requests for your time. We have worked to keep our survey brief and estimate it taking about 15 minutes of your time.

Thank you for your time and valuable feedback to help us improve the MicroGX experience.

Sincerely,
Matthew Keil, NASA Education Manager



IRB NUMBER: IRB2013-0409
IRB APPROVAL DATE: 07/11/2013
IRB EXPIRATION DATE: 06/30/2014

Survey Completion E-mail

SUBJECT: Thank you for completing the NASA MicroGX Survey
TO: All who successfully submit the survey

Thank you for completing the NASA MicroGX Survey. This information will be used to provide an even more rewarding experience for future MicroGX experiences. If you have any questions about the survey or your participation in this research study, please contact one of the following individuals for more information.



IRB NUMBER: IRB2013-0409
IRB APPROVAL DATE: 07/11/2013
IRB EXPIRATION DATE: 06/30/2014

APPENDIX H

RECRUITMENT EMAIL

NASA MicroGX Research Recruitment Email

Subject Line: NASA MicroGX Research Study

Body:

Hello MicroGX Participants,

Researchers from Texas A&M University are conducting a study on teachers' perceptions of NASA professional development. NASA and Texas A&M have worked together to provide opportunity for you to participate in this study. This email outlines the purposes of study and provides a description of your involvement and rights as a participant. The purpose of this research study is to understand how Micro GX is working to enrich classroom instruction of science, technology, engineering and mathematics content and to understand how NASA can improve their services. You are being asked to participate in the study as a result of your participation in the 2013 MicroGX experience.

You are invited to participate in this study by participating in an online survey, a focus group and follow-up phone call with a researcher.

As the researchers, we agree to meet the following conditions:

1. We will audiotape our focus group with your permission and transcribe the tape for the purpose of accuracy. At your request, we will give you a copy of the transcript so that you may see that we have captured your words correctly. At the end of the study, the tapes will be erased or destroyed.
2. Your confidentiality is very important to us, thus we will not associate your name or your school's name with any research finding. You will create a personal identification code listed on your surveys using your shoe size, birth year, and first two letters of your mother's maiden name. The researchers will not be able to associate your survey responses with your name.

As participant in this research, you are entitled to know the nature of our research. You are free to decline to participate, and you are free to withdraw from the study at any time. No penalty exists for withdrawing your participation. Feel free to ask any questions at any time about the nature of the research study and the methods we are using. Your suggestions and concerns are important to us. Please contact the researchers at the addresses/email provided above.

Please indicate your willingness to participate in this research process by including one of the following statements in a reply back via email by XX/XX/XX.



IRB NUMBER: IRB2013-0409
IRB APPROVAL DATE: 07/11/2013
IRB EXPIRATION DATE: 06/30/2014

1. I wish to participate in the research described above, have read the consent information, and agree to be audio taped during the focus group.
2. I wish to participate in the research described above, have read the consent information, but I do not agree to be audio taped during the focus group.
3. I do not wish to participate in the research described above.

Please don't hesitate to contact us anytime.

Best Regards,

Matthew Keil
NASA Education Manager
Texas A&M Student Researcher
NASA Johnson Space Center
2101 NASA Parkway, AD4
Houston, TX 77546
matthew.j.keil@nasa.gov
281-682-5418

William H. Rupley
Professor of Reading Education
Distinguished Research Fellow
Executive Editor Reading Psychology: An International Journal
Regents Fellow
College of Education and Human Development
Department of Teaching, Learning, and Culture 4232
Texas A&M University
College Station, TX 77843
<http://directory.cehd.tamu.edu/view.epl?nid=w-rupley>



IRB NUMBER: IRB2013-0409
IRB APPROVAL DATE: 07/11/2013
IRB EXPIRATION DATE: 06/30/2014

APPENDIX I

FOLLOW-UP EMAILS

Follow-up emails

SUBJECT: NASA Micro GX Research Study
TO: All subjects who have signed the informed consent form

Dear 2013 MicroGX Participant,

Thank you for participating in NASA's MicroGX experience this school year and agreeing to provide feedback to help us improve our services for years to come. We would very much appreciate your feedback to let us know if we are on the right track and to help us to continue to improve the MicroGX experience. We understand you are very busy and receive many requests for your time. We have worked to keep our survey brief and estimate it taking about 15 minutes of your time.

Thank you for your time and valuable feedback to help us improve NASA's MicroGX.

Sincerely,
Matthew Keil, NASA Education Manager

Follow-up Recruitment E-mail

SUBJECT: NASA MicroGX Research Study
TO: All Subjects who have signed the informed consent form that have not completed the survey after 1-week

Dear 2013 MicroGX Participant,

Thank you for participating in MicroGX this year. Last week we contacted you requesting your help to improve our services by completing a brief feedback survey. We understand you are very busy and receive many requests for your time. We have worked to keep our survey brief and estimate it taking about 15 minutes of your time.

Thank you for your time and valuable feedback to help us improve the MicroGX experience.

Sincerely,
Matthew Keil, NASA Education Manager

Survey Completion E-mail



IRB NUMBER: IRB2013-0409
IRB APPROVAL DATE: 07/11/2013
IRB EXPIRATION DATE: 06/30/2014

SUBJECT: Thank you for completing the NASA MicroGX Survey
TO: All who successfully submit the survey

Thank you for completing the NASA MicroGX Survey. This information will be used to provide an even more rewarding experience for future MicroGX experiences. If you have any questions about the survey or your participation in this research study, please contact one of the following individuals for more information.



IRB NUMBER: IRB2013-0409
IRB APPROVAL DATE: 07/11/2013
IRB EXPIRATION DATE: 06/30/2014

APPENDIX J

NASA CONSENT LETTER

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas
77058



June 25, 2013

Texas A&M University
College of Education and Human Development
Department of Teaching, Learning, and Culture
College Station, Texas 77843

To Whom It May Concern:

I have reviewed the scope of Matthew Keil's research study for Texas A&M University to be conducted with the MicroGX Program and teachers at NASA Johnson Space Center. Matthew Keil may obtain access to the teacher participants, their existing data, and materials generated as part of their participation in the professional development. Mr. Keil may conduct the research including survey, interview, and focus group.

Sincerely,

A handwritten signature in black ink that reads "Edward Pritchard".

Edward Pritchard
Education Manager
NASA Johnson Space Center



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