

VISTA Research and Evaluation Annual Report
Science Education Faculty Academy Extract

Years 1 - 4

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Science Education Faculty Academy Implementation Evaluation (Years 1-4)

Professional development experiences tailored to science education faculty are uncommon. Part of the VISTA initiative was to develop a professional development for university science education faculty. This Science Education Faculty Academy (SEFA) is to support the collaboration of science education faculty statewide. This demographic includes faculty who work with preservice teachers whether they are part of education or STEM departments within their respective universities. In many of Virginia's universities and colleges, the science education faculty consist of a single person, so networking across university lines is crucial (Johnston & Settlage, 2008). Thus, the SEFA provides science education faculty the opportunity to stay current with research and network as part of a state-wide professional learning community. During SEFA, they have opportunities to focus on sharing strategies for science teacher preparation, learning about research related to science teacher preparation and science teaching, and establish a network of support across university lines throughout the state of Virginia.

Description of SEFA Components

The primary purpose of VISTA SEFA was to build the state infrastructure to support effective science teaching and learning and was implemented by a team of 6 facilitators. Facilitators used a community-building problem-solving approach to focus the agenda. The stated objectives of SEFA were that participants would:

1. Collaborate to identify challenges and develop solutions in science teacher education at the licensure and advance levels.
2. Learn about new research related to effective science teacher development and science teaching.
3. Share effective teaching strategies for how to best meet the needs of elementary and secondary science teachers at the licensure and advanced levels through collaborative grant proposals, as well as collaborative syllabi and experiences for implementation in methods courses and teacher professional development seminars.
4. Network to establish an infrastructure of support among science education faculty across the state (Virginia Science Education Professors - VSEP) that augments and supports existing infrastructure for science teachers and coordinators in the state (Virginia Association of Science Teachers – VAST, and Virginia Science Education Leadership Association - VSELA).

Over the 5 days of the Academy, participants engaged in presentations, activities, and discussions that addressed each of these objectives. Additionally, participants submitted an initial reflection (vexation/venture) prior to SEFA and these served as the foundation for discussions during SFEA. Each day began with an overview of the topics and concluded with an exit slip designed to help the participant identify what they learned, how they could apply it in their own setting, and to provide the implementation team with feedback. Integrated throughout each day were opportunities for collaboration and discussion. Common to all years was a focus on PBL, the nature of science (NOS), inquiry, grant writing, and collaboration. There were, however some modifications to the SEFA schedule from year to year. Table 1 provides an overview of the topics and activities each day and the corresponding objectives for Year 1 and 2, while Tables 2, 3 and 4 provide an overview of the topics and activities for Year 3, 4 and 5 respectively.

SEFA included a session called “vexations and ventures” in which participants wrote texts and collaborated with peers to explore a single issue in some depth. This single issue guided later discussions over the remainder of the week and the issue was different each year. Vexation and venture topics included inquiry instruction, nature of science instruction, social justice, standardized testing, and distance learning for Year 1-5 respectively. The vexation and venture model was originally developed by Johnston and Settlege (2008) for use at the *Science Education at a Crossroads* conference.

Table 1. *Overview of the SEFA and Relevant Objectives for Year 1 and 2.*

Day 1	Day 2	Day 3	Day 4	Day 5
Constructing a professional learning community through problem-solving (4)	Exploring NOS (2, 3)	Continuous Improvement (Vexation/Venture) (1)	Grant-writing and Funding (3)	Planning for VAST and VSELA (4)
PBL as a vehicle for inquiry (2, 3)	PBL in methods courses - syllabi sharing (1, 2, 3)	Collaborative planning (4)	Creativity and Reflection (3)	
	PBL scenario development – question mapping (3)	Syllabi sharing – general (1, 3)		
	Effective discourse (3)			

Table 2. *Overview of the SEFA and Relevant Objectives for Year 3.*

Day 1	Day 2	Day 3	Day 4	Day 5
Continuous Improvement (Vexation/Venture) (1)	PBL as a vehicle for inquiry (2, 3)	Exploring the Next Generation Science Standards (2, 3)	Effective discourse (3)	Planning for VAST and VSELA (4)
	PBL scenario development – question mapping (3)	Exploring NOS (2, 3)	Collaborative planning (4)	
	PBL in methods courses - syllabi sharing (1, 2, 3)	Preparing Pre-service Teachers for High-Needs Students (1, 2, 3)	Grant-writing and Funding (3)	

Table 3. *Overview of the SEFA and Relevant Objectives for Year 4.*

Day 1	Day 2	Day 3	Day 4	Day 5
Continuous Improvement (Vexation/Venture) (1)	PBL as a vehicle for inquiry (2, 3)	Exploring the Next Generation Science Standards (2, 3)	Preparing Pre-service Teachers for High-Needs Students (1, 2, 3)	Planning for VAST and VSELA (4)
	PBL scenario development – question mapping (3)	Exploring NOS (2, 3)	Collaborative planning (4)	
	PBL in methods courses - syllabi sharing (1, 2, 3)	Effective discourse (3)	Grant-writing and Funding (3)	
			Engineering design (2)	

Table 4. *Overview of the SEFA and Relevant Objectives for Year 5.*

Day 1	Day 2	Day 3	Day 4	Day 5
Continuous Improvement (Vexation/Venture) (1)	PBL as a vehicle for inquiry (2, 3)	Exploring the Next Generation Science Standards (2, 3)	Collaborative planning (4)	Attend VISTA Elementary Science Institute
	PBL scenario development – question mapping (3)	Exploring NOS (2, 3)		
	PBL in methods courses - syllabi sharing (1, 2, 3)	Grant-writing and Funding (3)		
	Engineering design (2)			
	Effective discourse (3)			

Implementation Analysis

The purpose of this implementation analysis is to examine the extent to which SEFA was implemented as intended and the extent to which program goals for this component of VISTA were achieved. The following implementation questions guided the analysis:

1. Did the participants attend SEFA consistently and regularly?
2. Was the content of SEFA delivered to the participants?
3. Did participants' understanding of key concepts and methods improve as a result of attending SEFA?

Participants and Context

Table 5 indicates SEFA participants' self-reported gender, ethnicity, and position. To maintain confidentiality, all participants were assigned a participant ID.

Table 5. *SEFA Participant Demographic Data*

Year	Total	Gender		Position					Ethnicity ²		
		Female	Male	Assistant Professor Education	Associate or Professor, Education	Assistant Professor, Science Area	Associate or Professor, Science Area	Other (Adjunct, Education and Continuing Studies)	Caucasian	African American	Asian American
1	8	4 (50%)	4 (50%)	2 (25%)	2 (25%)	1 (12.5%)	1 (12.5%)	2 (25%)	6 (75%)	2 (25%)	0 (0%)
2	5 ¹	5 (100%)	0 (100%)	3 (60%)	1 (20%)	0 (0%)	1 (20%)	0 (0%)	2 (40%)	2 (40%)	1 (20%)
3	10 ¹	6 (60%)	4 (40%)	4 (40%)	1 (10%)	2 (20%)	1 (10%)	2 (20%)	9 (90%)	1 (10%)	0 (0%)
4	15 ¹	12 (80%)	3 (20%)	2 (13%)	4 (27%)	1 (7%)	4 (27%)	4 (27%)	12 (80%)	1 (7%)	3 (20%)
5	6 ¹	4 (67%)	2 (33%)	1 (17%)	0 (0%)	0 (0%)	2 (33%)	3 (50%)	4 (67%)	2 (33%)	0 (0%)
Total	44 ¹	31 (70%)	13 (30%)	12 (27%)	8 (18%)	4 (9%)	9 (20%)	11 (25%)	33 (75%)	8 (18%)	4 (9%)

Note: ¹Participants are only included for the first year in which they participated.

²Participants may self identify with more than one ethnicity and percentages may add to >100%.

Data Collection

Data consisted of surveys administered pre- and post-Academy, as well as a delayed post interview one year later. Follow-up interviews were conducted for a subset of participants, and artifacts including planning documents and participant-generated reflections were collected.

SEFA Surveys. The SEFA Perceptions survey, designed to elicit participants' current understanding of key objectives of the SEFA, contained 15 Likert-scale items. Six of the items asked participants to assess their understanding of and proficiency in incorporating instruction associated with PBL, NOS, and inquiry science instruction into their science methods instruction. Additional questions assessed participants' proficiency in supporting research-based science instruction, collaboration, ability to seek out funding, and the frequency with which they attend conferences. The scale ranged from 1 (not very proficient) to 5 (highly proficient). This survey was administered prior to and following the Academy. In addition to the pre-assessment questions, the post-assessment contained 5 additional Likert-scale questions and 4 open-ended questions designed to elicit participants' perceptions of the strengths and weaknesses of the Academy and the quality of the Academy relative to other professional development experiences in which they have participated. Approximately one year after participation in the SEFA, participants completed a follow-up Perceptions survey. In addition to the questions on the pre-/post-Perceptions survey, the follow-up survey asked participants to estimate the broader impacts of SEFA on pre-service and in-service teachers and K-12 students, indicate the extent to which they implemented what they learned in SEFA over the year, and indicate whether they would be interested in a follow-up session in the future.

Interviews. Following analysis of the pre- and post-SEFA survey, participants were purposefully selected for a follow-up semi-structured interview about their experiences. These participants were selected because their pre- and post-survey responses indicated little, moderate, or great changes in their proficiency of the key SEFA objectives following the Academy. Interview questions elicited participants' perspectives on the most and least valuable aspects of the Academy, components of the SEFA they plan to implement, and suggestions for improvement. These interviews also served as a member-check of these participants' survey responses. One year following SEFA, participants were chosen by convenience for follow-up phone interviews.

Artifacts. All planning materials and participant-generated reflections were collected. These artifacts allowed for detailed characterization of the Academy components and triangulated with survey data and interview responses.

Data Analysis

Data from each of the participants' pre- and post-SEFA survey were analyzed using descriptive statistics. For each participant, an overall sum of all of the items and mean scores pre- and post-assessment were calculated along with an aggregate mean score for those survey items assessing inquiry, NOS, and PBL. Changes in participants' scores for pre- and post- Academy were also calculated as overall change, average change, and change for those items assessing inquiry, NOS, and PBL.

Analytic induction, as described by Bogdan and Biklen (1992), was used to analyze the open-ended survey responses, follow-up interviews, and artifacts. Patterns were identified in the data set with the goal of characterizing the experiences of SEFA participants. From these patterns, preliminary categories were developed, which were refined through comparison with the original data set.

Results

Attendance

All iterations of SEFA took place at George Mason University in Fairfax, Virginia. In the first year, SEFA took place May 23-27, 2011. All 8 of the participants attended the Academy in its entirety, for a total of 27 contact hours over the 5 days of the Academy. Overall, the attendance rates were high and consistent. In the second year, SEFA took place May 21-25, 2012. There were 9 total participants, 5 of which were new attendees. All but one participant attended the Academy in its entirety, for a total of 40 contact hours over 5 days. One participant, SEFA1F3, missed the morning of the first day but attended the remainder of the Academy. In the third year, SEFA took place May 20-May 24, 2013. All 10 first-time participants attended the academy for its entirety, for a total of 40 contact hours over 5 days. The 3 returning participants from Year 2 (SEFA2F7, SEFA2F9 and SEFA2F10) did not attend all sessions, and worked as a group to collaborate on future publications during times when prior material was being presented again to those attending for the first time. In the fourth year, SEFA took place May 19-23, 2014. All first-time participants attended the full academy, but SEFA1F4 who was a returning participant was absent for the morning of the second day.

Implementation

In general, the implementation of SEFA occurred as planned and scheduled. The facilitators developed a curriculum and agenda for SEFA, which was followed closely.

Impact on Participants

Quantitative analysis. Table 6 indicates Year 5 first time participants' average pre-assessment and post-assessment scores on selected outcomes. Average scores of Year 5 participants for each construct prior to SEFA ranged from 2.8 to 3.9 with an overall mean score of 3.3. Following Year 5 of SEFA, average scores ranged from 3.0 to 5.0 with an overall mean score of 4.3. Pre- to post- changes were comparable with previous years. The highest Likert values following SEFA were reported for participants feeling networked to other science educators in the state.

Table 7 shows overall means and standard deviations for Years 1-5 for all first-time participants. There was a 100% response rate (n=44) for pre- and post-Perception surveys, and a 66% response rate (n=29) for one-year follow-up Perception surveys. Paired sample t-tests were conducted comparing pre/post and pre/delayed-post means to test for significant differences for selected constructs immediately following SEFA and again after one year. Results showed significant differences among all pre-/post- means at a $p < .05$ confidence level. Pre-/delayed-post- means also showed significant differences except for participants' perceived ability to secure funding.

Table 6. *Impact of VISTA SEFA Year 5 Participants on Selected Outcomes*

	Inquiry	NOS	PBL	Research-based strategies	Seeking funding	Collaborative Interactions	Extent Implement	Networked
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
Pre (n=6, 100%)	3.5 (.8)	2.9 (.8)	3.6 (.5)	3.3 (1.2)	3.5 (1.4)	3.5 (.5)	NA	NA
Post (n=6, 100%)	4.3 (.7)	4.1 (.9)	4.3 (.6)	4.0 (1.1)	4.3 (.8)	4.5 (.8)	4.7 (.5)	4.8 (.4)

Note: Analysis performed on data from participants in their first year of SEFA only.

Table 7. *Overall Impact of VISTA SEFA Participants on Selected Outcomes (Y1-5)*

	Inquiry	NOS	PBL	Research-based strategies	Seeking funding	Collaborative Interactions	Extent Implement	Networked
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
Pre (n=44, 100%)	3.4 (.9)	3.2 (1.0)	3.2 (.9)	3.3 (1.1)	3.1 (1.0)	3.4 (0.7)	NA	NA
Post (n=44, 100%)	4.1* (.8)	4.1* (.7)	4.1* (.8)	4.0* (.9)	4.0* (.9)	4.3* (.8)	4.6 (.7)	4.6 (.8)
Follow-Up (n=29, 66%)	4.1* (.7)	3.9* (.8)	3.9* (.7)	4.2* (.8)	3.3 (1.0)	4.3* (.6)	4.2 (.9)	3.9 (1.0)

Note: Analysis performed on data from participants in their first year of SEFA only.

* = Significantly different from pre-mean (p<.5)

Qualitative analysis. Analysis of qualitative survey and interview data suggested participants valued many components of the SEFA. Most participants perceived SEFA as one the most effective science education focused professional development they had experienced. In the first year, a participant indicated, “This VISTA College Science Academy is by far the best professional Development opportunity I have ever had as a science education professor” (SEFA1F3, Post-Perceptions survey, Year 1). In the second year, participants also appreciated the professional development: “I found the program extremely worthwhile. Thank you for the opportunity” (SEFA2F7, Post-Perceptions survey, Year 2). In the third year participants felt they gained many new insights stating, “This has been an amazing and transformative week. I've been given so many tools and even more to think about. Thank you.” (SEFA3F7, Post-Perceptions survey, Year 3). “I'm glad I went, it was very useful and helpful and I enjoyed being able to spend time with other colleagues as well” (SEFA5F4, Interview, Year 5). Participants planned to continue collaborating with their peers and implement what they learned at their institutions. They also had some suggestions for the future of SEFA.

Effective components of the SEFA.

In all three years, some of the most beneficial aspects of the professional development were discussions of how to seek grant funding, opportunities for networking with peers, the Vexations and Ventures discussion, and learning new definitions related to the core features of the VISTA program.

Grant-writing: Many participants valued the grant writing session as a unique and informative experience. “I think when we were talking about funding and grants were really valuable. And that helps to hear other people’s input and thoughts on the challenges of trying to secure money to support research and support teachers and students with various projects.” (SEFA5M1, Interview, Year 5). Other responses about grant writing gave more nuanced insights into what aspects of this session was most helpful. One participant indicated the most valuable aspects of grant writing were, “How to search for grant opportunities, how to write grants, how to begin building professional portfolio with publications” (SEFA1F1, Post-Perceptions survey, Year 1). However, in the second year of SEFA, another participant indicated that discussing potential grant funding opportunities with other science educators was more helpful:

The actual components of how to write a grant wasn’t as helpful as the scenario on where to find particular grants that might be meeting the needs of your school and having a chance afterwards to get together with folks and say ‘maybe we can partner and do a collaborative grant between our three smaller schools so we could have more of an impact.’ I think if we had surveyed the people in the room, I think most people had actually written grants, maybe not huge grants, but had received state and federal funding in some format or another. (SEFA2F2, Interview, Year 2).

For her, it seemed that participants were already versed in how to write grants so focusing on sources for funding was more helpful. Regardless, participants benefited from the grant-writing component of the SEFA.

Collaboration and networking: Collaboration and networking during SEFA was also a key component participants found beneficial. The participants indicated that the professional development actively encouraged collaboration and did so in specific ways that were useful. For example, SEFA3F8 discussed the networking within one portion of SEFA:

Well I think it just again provided another opportunity to meet people that are interested in doing the same thing. I like the idea – and I do think that’s a strength of this program too, I should have mentioned that – is that one of the strengths was, excuse me, one of the

expectations was, ‘we want you by the end of the week to be thinking with either as an individual presentation, or maybe with a partner or partners, to do a presentation at the VAST conference in November. I think that’s a strength, because again it’s an expectation that, OK, you’re going to collaborate, you’re going to use everything that you’re learning and it’s one of our professional responsibilities anyway is to present. And I appreciate that. So yeah, I do think it continually supports that professional piece. (SEFA3F8, Interview, Year 3)

For this participant, it was helpful that the SEFA team had expectations for collaboration as an explicit component of SEFA. A second year participant discussed opportunities for networking both inside and outside of SEFA:

While we were there [at SEFA] we were discussing collaboration, even when we go out to eat we would sit there and talk about ways to collaborate in the future. So we talked about collaboration throughout the entire week. (SEFA1M4, Interview, Year 2)

These participants were continuing conversations beyond the contact time of SEFA, which further demonstrates how beneficial collaboration is to these participants. SEFA was also reported to be an important supplement to organizations within the state related to science education. Referring to her colleagues at SEFA, one participant said:

Now that I know who they are, and I've had enough time with them to know who I would really like to work with, that's a great thing... If I hadn't [collaborated with colleagues at] VAST, I'd definitely be more likely to do it now because I've been through SEFA. (SEFA 4F5, Interview, Year 4)

The impact of collaboration was still prominent in participants’ minds even after a year following their attendance in the program. In a follow-up interview the impact of collaboration opportunities was evident:

That [collaboration at SEFA] was probably one of the most beneficial things about the experience, is that because I'm in a small institution, I really do not have any other science methods people in the education department. I work very closely with content scientists who are interested in science education and they teach our pre-service teachers and content courses and we talk a lot about pedagogy and they work with me to train teachers in the area. So I have that connection, but I didn't really have connections with other science educators. And so it was really nice to connect with other people who taught my same types of courses and to learn about what they did in their courses, and how they were successful or not successful, and how they kind of were able to maneuver the same waters that I was also maneuvering and how they met those particular challenges as they dealt with some of the road blocks that we face as science educators and then we go out into the schools and teachers are teaching science by reading textbooks and answering questions, not engaged in the nature of science, and so that was very helpful. (SEFA2F9, Interview, Year 3)

Finally, participants valued periods of less-structured time that they could collaborate to work on projects with others. In Year 5, participants were given the most time to do this and it was positively perceived by participants. In year 5, one participant said:

I thought the time on Wednesday or Thursday where we had free time to write. I guess it was Thursday morning. I thought that was really valuable to choose our direction of where we were trying to go and you could sort of team up with someone else if you could or if not, you had some time to work on something as relevant and applicable to what we've been talking about and what you're doing. (SEFA5M1, Interview, Year 5).

Vexation and ventures: Another specific aspect of the SEFA professional development, which appeared to be particularly helpful for the participants was the Vexation and Venture project. Before attending SEFA, participants were asked to write a short paper discussing something they struggle with in science education (vexation) and then a possible solution to this problem (venture). During the SEFA, the participants and implementers work together to discuss each “Vexation and Venture”. One participant discusses the benefits of this project:

I liked beforehand that we had to write a Vexation and Venture ... because it made me think about [what] really bothers me. ... and we took the time to discuss them as a group. I also, I very much liked... I liked being able to have some, essentially free time where we got to discuss things just, and don't be, the times that we... it was very free form and it was a call out or hey I need some help with publishing. Where do we publish stuff? Hey, I need some help with this syllabus, I need some help with... And we could actually interact with one another and I found that very useful, and I found that very useful ... that was really nice, getting ideas from people across the state. Things that they use and that they do. (SEFA1F2, Interview, Year 1)

In general, these in-depth discussions about problems and solutions in science education appear to further facilitate collaboration between participants. With everyone submitting a “Vexation and Venture” paper, including the implementers, these discussions were fruitful for participants. One participant indicated that it was helpful to have a discussion where everyone brings their own expertise and point of view to the table. “I thought was really useful and enjoyed that entire day when we were moving from group to group and talking about everyone’s papers in that structured way. I enjoyed talking with everyone so much and everyone has their own expertise area.” (SEFA5F2, Interview, Year 5). As the topic of the Vexation and Venture changed each year, the degree of consensus around the issues changed as well. In Year 4, the issue of standardized testing had a high degree of consensus among participants:

I think it was just interesting to hear what other people felt about it. Though it generally was consensus, I felt, about the importance that has been placed on standardized testing and how we have devoted so much of the time in the instructional year to preparation for extra forced standardized testing. It is interesting to talk to folks about [this issue] and to know that most of us are right there together. (SEFA4F4, Interview, Year 4)

Participants varied in their consensus around the topics raised during the Vexation and Venture sessions depending on the year, but still generally found the experience to be positive across all years.

Learning new definitions: Many participants commented that they also benefited from working through the definitions of PBL, inquiry, NOS, social justice, engineering, discourse and opportunities to work on how to incorporate these into their future practice, and further appreciated the introduction given to them about The Next Generation Science Standards (NGSS). “The SEFA activities will be used in my math/science methods course with pre-service teachers to help them understand inquiry, hands-on, NOS and engineering design” (SEFA4F4, Post-Perceptions survey, Year 4) One participant describes the benefits of discussing the NGSS as well as the other science-related topics covered at SEFA:

I was not very familiar with NGSS and other standards and where to find the information for these standards but the background and future of these presented was very helpful. I also felt I enhanced my knowledge of PBL and NOS through the various exercises throughout the week which, in turn, made me reflect on my current practices and develop new ones as we were going along. (SEFA3F5, Post-Perceptions survey, Year 3)

With regard to learning new definitions, the PBL components were particularly appreciated. For example:

When she led that discussion with us, it immediately resonated with me was all about taking so many different components and first, there's either the instructor or a very well-informed group of students who come up with a problem based in something that the students could work in, and I just loved the idea behind it. It made me think about what we've learned from like schools in Japan, for example, that they take a problem, for example, 'We need to build a parking garage in the middle of the city because there's not enough parking, and so we need to accommodate that,' and then taking that one simple problem and you think about all of the elements that are involved, so it's not meant to be something that's completed in one class block, but it could take days or weeks or it could be a term project, because there's so many different aspects involved in it. I really like problem-based learning, but it made me think about how it helps the students make it all relevant and how things tie in together. (SEFA3F8, Interview, Year 3)

This indicates participants were thinking critically and thoughtfully about the components of SEFA being presented to them.

Future intentions of participants. One of the most influential aspects of SEFA was the relevance and applicability of topics to the participants' teaching. Many participants looked forward to using what they had learned about discourse. "I will immediately incorporate some strategies of discourse into my content courses next semester. I will also help my students in my methods courses to understand the importance of discourse within the classroom." (SEFA4M1, Post-Perceptions survey, Year 4) SEFA1F2 also discussed the pertinence of the discourse portion of SEFA and how she plans to appropriate it in more detail:

I noticed in my own class, that my students don't necessarily talk to one another, they like to talk to me, so by... She presented [effective discourse] and I was like, oh, now I have some great ideas that I can use so that I can get my students to talk to one another and not just me. Because I really, that as much as I try to promote that, I realize now that I wasn't promoting it effectively. And it's something that I very much need to address in my class. And [the SEFA] gave me the tools to do that. (SEFA1F2, Interview, Year 1)

This participant realized that what she was doing in her methods course was not successfully engaging her students. SEFA provided her the opportunity to reflect and change her practice to include discourse.

In Year 2 of the professional development, SEFA2F2 indicated understanding the explicit NOS has influenced her own teaching:

Well, I hadn't thought about it [NOS instruction]. I hadn't actually...when I am teaching the methods course or teaching – my primary job is teaching biology with biology majors- and we talk about all the time, you know, some of the historical aspects of science. How society impacts science research, how research obviously impacts society. We talk about it all the time, but I never explicitly said, 'okay this is an example of the nature of science'. I've never said that, and I don't think any of the faculty in the department have. One of the things that I am going to be doing is sharing this concept with the department, with the faculty, that we need to kind of add nature of science onto our other list of things that we try to thread through all our courses. Common themes like homeostasis or evolution, adaptation, that kind of thing. We need to explicitly say nature of science because the students aren't making that connection; at least that's what the assumption is. (SEFA2F2, Interview, Year 2)

Not only is this participant going to change her own teaching, she plans to get the whole biology department to incorporate NOS instruction. More importantly, she discusses the need for explicit NOS instruction, which is the targeted goal for effective NOS instruction. Additionally, Participants were also eager to incorporate PBL. “In the next course I teach I’ll incorporate a semester long PBL from the outset, helping students develop the different steps over the course of several classes.” (SEFA5M1, Post-Perceptions survey, Year 5).

Participants also had specific plans to continue to network with peers, which reflected the stated goals SEFA. As a result of continued collaboration, these participants are presenting at conferences, visiting other universities/colleges, implementing research and writing articles. For example, SEFA1M4 indicates the collaboration with colleagues at SEFA has resulted in the following:

Many of us have already begun projects such as writing and submitting articles together and possibly visiting our respective universities to come do some training. For example, I am supposed to go out and do some STEM training as a result of this conference. And so there’s definitely some great collaboration that not only has already begun but it’s been furthered as a result of being there at [the implementation site] during the week.
 Interviewer: Great. Anything you plan on doing in the fall or next spring specifically?
 Participant: Yes. We’re actually going to conduct a study on inquiry learning and we’re actually going to expand it to other universities just to get a nice sample size so we can get a better perspective of when pre-service teachers are considering inquiry based learning. And as a result of receiving proper instruction how their perceptions may change. (SEFA1M4, Interview, Year 2)

Not only is this participant collaborating with peers about his own research, he is implementing research with other SEFA participants. SEFA3F8 indicated that she fulfilled her goal of collaboration with other university faculty:

Well, thankfully, because one of my goals was met that I was able to network with fellow professionals that I do plan to collaborate with those that are near me, within fifty, sixty miles, and that we’ve already made some contacts and hopefully work on some projects together, to talk about how our instruction can improve, how we might want to change some of our course syllabi, things like that. (SEFA3F8, Interview, Year 3)

This shows that she has already begun discussing projects with other education faculty from the conference and that SEFA successfully met her desires for collaboration.

Broader impacts as a result of SEFA. On the follow-up survey, Year 1, 2 and 3 first-time and returning participants described the products that resulted from their participation in VISTA. These included presentations at VAST, journal articles, professional development programs related to PBL for in-service teachers, and summer camps for students that incorporated PBL. Combined, the 20 respondents (68%) reported an estimate of the number of pre-service and in-service teachers and PK-12 students directly and indirectly impacted as a result of these products (Table 8). However, this is probably an underestimate as some participants did not respond to one or more of these questions, or reported impacting “many” without quantifying the value.

Table 8. *Years 1-4 Estimated Impact on In-service Teachers and PK-12 Students.*

Participants	Direct Impact			Indirect Impact		
	Pre-service Teachers	In-service Teachers	PK-12 Students	Pre-service Teachers	In-service Teachers	PK-12 Students
Year 1	105	110	25	55	5	80
Year 2	58	110	3500	545	2600	4100
Year 3	297	234	925	155	555	2000
Year 4	227	200	325	70	278	4625
Year 5	-	-	-	-	-	-
TOTAL	687	654	4775	825	3438	10805

Additionally, all Year 1 participants and most of Year 2 and 3 participants indicated on the follow-up survey that they would be interested in attending a follow-up session to the SEFA in the future. Some of these participants suggested format and content for such a session. For example, two participants suggested one to two day follow-ups. SEFA1F2 suggested another week-long session and indicated the content she perceived would be valuable:

A couple of specific, directed tasks interspersed with free network time. Some tasks could include: designing a unit of study, evaluation of course materials, outlining a research project, identifying misconceptions in a particular topic, or designing/finding assessments to identify misconceptions. Try to involve the concept of Flow. Have at least two 'fun' evening sessions for those of us coming from out of town. Topics may include: use of technology, tips on designing a research project using your classroom, publication of science education research. (SEFA1F2, Follow-up Perceptions survey)

SEFA1F4 indicated that a follow-up focused on PBL would be valuable to her. She noted, "I would like to have PBL dissected even more-- perhaps even focusing on us developing PBLs to use in methods classes as a means of exposing pre-service teachers to this methodology as participants first" (Follow-up Perceptions survey). SEFA2F7 described a possible format for mixing returning and new participants: "I would attend a SEFA follow-up session. I would like to see presentations by SEFA alumni on the implementation of VISTA products at their respective institutions. I would like more time to collaborate with SEFA alumni on research projects, papers and presentations" (SEFA2F7, Follow-up Perceptions survey). It is clear from these responses that participants valued the time together and would be open to more opportunities such as SEFA in the future.

Recommendations for future SEFA. Across all years, participants noted that the structure and administrative aspects (i.e., pacing, timing and number of breaks, length and structure of the sessions) could be improved in the future. In the first year, one participant recommended:

The reason I suggested [rework the schedule, 9-12 work, 10-2 lunch, we need a break in the middle of the day, 2-5 or 6 work] is that we were just exhausted. Because we were discussing things all day long and it was kind of like your brain was on. And it would have been nice to have a little bit of a break where I, where I very much need time to process, so discuss in the morning and then I can have a little break where I could get a little bit of down time where I could process and then come back in the afternoon. And I think some of the sharing we did, it was incredibly useful but I think too it would have been nice to maybe to disperse that with some more structured time. (SEFA1F2, Interview, Year 1)

The daily objectives appear to be as such that the days were packed for the participants. Therefore, this participant felt that more time to process what they were discussing would have

been helpful. Another participant also agreed with the need for processing time of the abundant amount of information presented: “The institute might be just as effective as a 3-4 day workshop. After about 3:00[pm] each day we were all so saturated that our productivity waned” (SEFA1F4, Post-Perceptions survey, Year 1). While this suggestion may not be feasible, the amount of information can seem overwhelming for the participants. Some participants specifically voiced their concern of feeling rushed through material. “Slow down and give participants time to process and absorb/ think of ways to integrate these ideas into their work.” (SEFA4F6, Post-Perceptions survey, Year 5). This participant suggests more time is needed for each topic presented at SEFA. SEFA1M4 seconds this suggestion:

Sometimes some of it I felt a little rushed. I think we could have went into more detail about certain things. Like the next generation science standards, it was just sort of like ‘okay let’s just cover this’, but I would [have] liked to have gone deeper into it. Looking at why is this here. What is the significance in the future versus ‘okay these are the next generation science standards. But let’s talk about why we’re talking about it now. (SEFA1M4, Interview, Year 2)

These participants see the value in the topics covered in SEFA and would like to spend more time understanding the significance of some of these topics. Finding a way to pare down the amount of material may alleviate participants feeling overwhelmed and rushed through SEFA.

Some of the participants returning to SEFA for a second year of training struggled being second year participants in the program. One participant noted:

I like the idea of reframing the experience for those of us who return next year. While it was great to come and brainstorm with old and new faces, it was hard to sit through much of the same stuff two years in a row. Much of what we discussed I had already put into practice so I felt I could have gotten more from the group if a different format was offered. Still, it was worthwhile. Less time for returnees next year---3 days would be perfect! (SEFA1F1, Follow-up Perceptions survey, Year 1)

Because the objectives were the same for both years this participant would like to see a different format for second year participants; however, she does not provide any suggestions for improvement. Others had constructive feedback for how to make the professional development useful for returning participants:

It should be tiered, and let me explain that. First year participants’ format was fine. Participants who come back for a second year, I would divide those folks up and do something differently. What I mean by...I’m going to call them the veterans, the veteran folks – have them design maybe a STEM lesson, inquiry based lesson, or something where the new participants are taking part. Because you have individuals there who have done extensive training in some of those areas that were there such as STEM, inquiry learning as well as problem based learning. And rather than having those folks do something that they did pretty much the previous year, either have it at a tier level where they’re doing something totally different such as spending more time developing a grant or spending more time developing some type of research agenda and have them help facilitate some of the experiments with the new folks. (SEFA1M4, Interview, Year 2)

This participant sees the usefulness of SEFA, but also recognizes returning participants may benefit from being leaders within the professional development. He also seems to recognize that new SEFA participants may also benefit from the input of veteran participants in addition to the program implementers. Another second year participants voiced similar suggestions as well:

Provide opportunities that already have extensive experience in some of the topic areas to

co-present. By surveying the participants, and obtaining very detailed reports, you could gauge the level of potential involvement of SEFA members. (SEFA1M1, Post-Perceptions survey, Year 2)

There seemed to be some accommodation to these requests in Year 3 and 4 of SEFA. One returning participant noted that the activities had been changed and that there were opportunities for returning participants to share their own experiences from the previous year:

As a second year SEFA participant, I appreciate being exposed to new inquiry activities. Also, I think that it was a good idea to include past participants on the agenda to share-out. Since the atmosphere was very relaxed and low key, I did not mind not be informed of my minor role in advance. (SEFA2F7, Post-Perceptions survey, Year 3)

Even with the accommodation for returning participants to share aspects of their practice, participants continued to express a desire to hear more from fellow participants and have greater chance to collaborate and network with one another.

It would have been helpful to have faculty bring one or two tried and true activities so we could have shared out what worked and what did not work. As I found out in the evenings, there were so many talented folks here this week, I would have loved more time to hear from them. (SEFA4F3, Post-Perceptions survey, Year 4)

In general, modifications to SEFA based on participant feedback has been reported by participants as a positive change in the program.

A common complaint that came up only in Year 3 and 4 related to the placement of the Vexations and Ventures piece in the schedule. In the first two years, this piece occurred mid-week, but in Years 3 and 4 it was done on the first day. While it was still helpful to participants, several commented that its placement at the very beginning of the camp was awkward. A common feeling among participants was:

I think scheduling the V & V day for later in the week may be more beneficial. The V & V day was an exhausting day (that was then followed by a long evening of more discussion), and I believe the V & V discussions set the mood for the week with a negative tone. The participants didn't know one another, and we were expected to contribute to discussions (offering ideas) to people with whom we knew nothing about. I found it to be an awkward experience. However, I enjoyed the schedules of the other four days, and as we became more comfortable with one another, conversations flowed more easily, and I found all of the materials/ideas/resources very valuable. (SEFA3F8, Post-Perceptions survey, Year 3)

Particularly in Year 4, participants felt that the Vexation and Venture portion was the most intensive and tiring compared to the rest of the week.

I'm thinking specifically of the Vexation and Venture activity, which I think could have been implemented more efficiently. The topics shared and viewpoints expressed were extremely valuable, and I learned immensely from the activity. However, the day was long; and I noted that the last two presenters in the session that I participated in abbreviated their comments. (SEFA4F4, Post-perceptions survey, Year 4)

This participant recommends that a modified Vexation and Venture format (perhaps fewer presenters per session or more breaks) would allow for higher quality discussions. The feedback on the content of the Vexation and Ventures was positive across all years of SEFA.

Conclusion

From the data presented in this report, it is apparent that the SEFA component of the VISTA program was implemented successfully and to fidelity. Participants were generally present and engaged in the work. The SEFA's goals of promoting collaboration were met based on both quantitative measures and qualitative feedback. The content and instruction of the SEFA were delivered with fidelity to program intentions. Content goals were attained to a satisfactory level and were maintained to a large degree one year after the academy. Participants' comments indicated they had clear plans of how they will implement what they learned in the upcoming academic year and that they would be interested in attending follow-ups to SEFA.

Qualitative data indicated that participants valued the wide range of topics presented at SEFA, with suggestions for improvement focusing on modifying daily schedules and differentiated roles for returning participants. Quantitative data analysis indicated that in addition to positive perceptions about SEFA, participants thinking around SEFA constructs significantly changed following their participation. The fact that most changes remained significant after one year indicates the lasting effectiveness of SEFA over time.

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