
AC 2012-3066: INVESTIGATING UNIQUE ASPECTS OF THE MESA PROGRAM FOR UNDERREPRESENTED STUDENTS

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Investigating Unique Aspects of the MESA Program for Underrepresented Students

Introduction

Co-curricular programs complement the formal curriculum and often have sessions outside of the regular school day. A review of evaluation reports from after school Science Technology Engineering Mathematics (STEM) programs, both co-curricular and extra-curricular, by the Afterschool Alliance found that students attending these programs had improved attitudes toward STEM fields and careers; increased STEM knowledge and skills; and a higher likelihood of graduation and pursuing a STEM career.¹ After school programs can provide a safe place for students to explore a STEM field which contributes to student gains in intellectual skills and temperament to become a scientist.² In general, a longitudinal study that followed a cohort of sixth graders through age 25 found that students who participated in extra-curricular academic clubs were more likely to be enrolled in college at 21 than their non-involved peers.³

The Math, Engineering, Science Achievement (MESA) program utilizes a co-curricular program that supports educationally disadvantaged students by providing pathways for minority students to succeed in science, mathematics and engineering disciplines.⁴ MESA was started in 1970 as an inter-segmental program, administered through the California Public School System, Community College System, and California College System. Because of the success of MESA in California, the program has expanded to seven other states. MESA USA is a partnership of MESA programs in eight states: Arizona, California, Colorado, Maryland, New Mexico, Oregon, Utah and Washington. MESA USA programs are based on the academic enrichment model originating in California. It includes many of the following elements: SAT/ACT preparation, study skills training, hands-on activities, competitions, career and college exploration through field trips and guest speakers, parent leadership development, individual academic plans, and teacher training opportunities. Annually, students in MESA USA programs participate in a national engineering design competition.⁵

An exploratory study funded by the National Science Foundation examines the influences MESA activities have on students' perception of engineering and their self-efficacy and interest in engineering and their subsequent decisions to pursue careers in engineering. The MESA activities included in the study are field trips, guest lecturers, design competitions, hands-on activities, and student career and academic advisement. A survey instrument, the Engineering Self-Efficacy, Interest and Perception Survey (ESIPS) was developed and piloted with 166 students from MESA programs in Utah and California.⁶

Purpose

The results of a pilot study and the accompanying factor analysis provided evidence for the researchers and their advisory committee that more developmental work was needed to unpack the activity variables associated with MESA programs. To create activity components, researchers conducted focus group interviews with MESA students from five different programs throughout the state of California. A grounded theory approach provided a useful way of informing the analysis.⁷ Five groups consisting of seven to ten MESA students were interviewed for approximately one hour. Each group was asked two open-ended questions:

- (1) Can you describe one of the best times you have had in MESA?
- (2) What do you think you are gaining by participating in MESA?

Methods and Methodology

The researchers used a focus group protocol to guide their interview sessions. Focus group interviews are a series of interviews, conducted with five to ten participants, where in the researcher attempts to gain a certain perspective from a particular group.⁸ Focus group interviews are well suited for qualitative studies including grounded theory.⁹ Members of the group are there for member checking, expounding upon participant responses and adding clarity to group responses. Two researchers were responsible for conducting the alternating focus group interviews. The focus group interviews were audio recorded. Notes were taken to ensure that data could be cross-checked with the audio recording. The researchers alternated roles as facilitator and note taker, as both researchers were well versed in conducting qualitative studies.

A total of twenty-eight MESA students from five different schools in the California area participated in the focus group interviews. The student members of the focus group are entitled “participants” in this paper. The interviews took approximately one hour to complete for each focus group. Participants were provided with food and refreshments as remuneration for their participation. The facilitator posed the two open-ended questions. After the first question was posed (Can you describe one of the best times you have had in MESA?), the facilitator asked additional questions stemming from the received answers for the purpose of clarification and confirmation. This allowed the participants to answer a multitude of questions with minimal probing from the facilitator. After a number of supplementary questions had been pulled from the first question, the second main question was then posed as a concluding question (What do you think you are gaining by participating in MESA?). Again the process was repeated with the facilitator listening carefully to answers and pulling additional information through follow-up questions. Due to technical difficulties, the research team was only able to recover four of five recorded interviews. The themes formed are the result of four recorded interviews and notes taken from a fifth interview.

To build a theory of impact and influence relative to MESA activities and underrepresented students, the research team employed a ground theory approach to analyze the focus group results. The grounded theory approach yields themes that are formed from the grouping of codes according to conceptual categories that reflect commonalities among coded data.¹⁰ In this study, researchers looked for emergent themes formed from the focus group participants' responses. This was done by looking at the transcribed recordings and notes that were taken during each interview session. Initial data examination was done independently by each researcher prior to coming together to discuss the themes that were prevalent. Individual researchers reviewed collected responses and gradually went from coding to categories, and eventually theory building which lead to the development of activity components.¹¹ After individual analysis, the researchers came together to identify themes and correlate results in order to establish inter-rater reliability.

Results and Discussion

The results of the grounded theory approach to analyzing the focus group responses produced eight disparate themes including; (a) informal mentoring, (b) makes learning fun (c) time management (d) application of math and science, (e) feelings of accomplishment, (f) builds confidence, (g) comradery, and (h) exposure to new opportunities. Each emergent theme is discussed in more detail below.

A. Informal Mentoring

In the analysis of collected data from the focus groups a surprising theme emerged. Participants talked more about their roles as mentors in informal mentoring settings as opposed to the informal mentoring they received from MESA teachers and advisors. Participants spoke about mentoring not only their fellow underclassmen but also volunteering with local middle and elementary schools:

...instead of doing the competition and competing, we get to volunteer -- we get to help with the um middle schools and um help them make their projects and give them advice. (Group One)

We tutor elementary schools too, so there's a lot of elementary schools around. (Group Three)

Also prevalent was the tutoring and mentoring of other MESA students by returning MESA members who took it upon themselves to assist their fellow underclassman duly noted in this excerpt from Group Four:

...but we've done enough projects between us that we've probably done whatever project the freshman, and juniors, and sophomores are doing, so we can help them. That's kind of what we do. (Group Four)

Informal mentoring from the MESA advisors and teachers was also mentioned:

This is a club that like wants people, us, all of us, to succeed in life going into college, succeeding in that, all the advisors, all the teachers, just want to see you achieve, to your best quality. So they're going to help you out and to be the best you can be in succeeding. (Group Two)

B. Makes Learning Fun

Participants seemed to agree that making learning fun was a key component of MESA's success. They not only spoke of the MESA experiences in reference to learning but also voiced the importance of MESA experiences in changing their perceptions of STEM fields:

It is actually really fun, you don't fall asleep. Um yeah, you don't fall asleep. It's amazing. (Group One)

if we didn't have the fundamental of math -- I mean fun, in between there -- it would be really boring. (Group Two)

That's something that MESA shows you at hand. You actually see people -- actually see engineers and they're just out there doing their thing, and they're just having fun and they're enjoying it. (Group Three)

C. Time Management

Organization and time management emerged as a prevalent theme among the focus groups. When speaking about the benefits of MESA, a participant spoke about the impact of the program stating:

Like MESA, like kind of helped me like I used to be something like get on time, and something like that do some other stuff with MESA and taught me that I should be doing stuff earlier than doing it at the last second...(Group Four)

The competitions also had added benefits of developing time management skills:

You learn that time is of the essence because we're there working, and then once we get to Saturday academies, or regionals, everything has to be on schedule, or we're running late, you have to turn in project at the certain time, so you're running. (Group Two)

MESA advising helped participants with the organization necessary for application to college programs, as noted:

(MESA helps) when, there's so many deadlines and applications you have to turn in as a senior for college. (Group One)

D. Application of Math and Science

The focus group participants expressed an understanding of the importance of having opportunities to apply math and science learned in formal learning environments. One participant explained the integration of the formal and informal learning environments:

So as I would do MESA, I would get more encouraged and be wait, this is what I was learning in class. So where I would learn something in class, I would use it in MESA, and when I would learn something in MESA I would use it back in my class. You're realizing that this isn't just something you're doing for pointless reasons, but you're doing something with it. (Group Two)

Several participants commented on learning the importance of math and science and also the opportunity for transference of knowledge by stating:

Well the best experience I've had in MESA has been just overall learning the value and importance of math and science. Because we -- we put math and science into like -- into all these projects we do. (Group Three)

And MESA really brings out -- really tells you like -- it really gives you an experience of what it's used for. Like here we're doing physics in class, and I'm like what am I going to use this for? You know, how does this apply to me? But then once you do the windmill or something like that... (Group One)

E. Feelings of Accomplishment

MESA provided rewarding opportunities for participants that seemed to be a key component to the program. Below participants voiced feelings about competing and winning competition, stating:

One thing you get is just this immense sense of accomplishment, that you did something and it's not something that you just can't fabricate. (Group Two)

I get an award, I get this medal on to show that I put that much effort into it. And that's something that MESA does for us. Well to me, it makes me feel accomplished like I actually did something, that I put my work into, and I got something out of it. (Group Three)

-we were doing team math, and when we won first place I was, like yes. So it was a good time for me... (Group Four)

F. Builds Confidence

Participants commented on gaining and building confidence from winning competitions and seeing others like them succeed:

I think I've gained a lot of confidence in myself from MESA, because you do a project, or you give a speech, or you take a math test and you kind of think, I don't know I kind of did okay on that... (Group Four)

Well now that I've done it since 7th grade, it's been more easier. Like I'm more calm I know what I'm doing it's just as I go through it I just learned from 7th grade don't be as nervous, just do the best, and just have a little mental power that, you know, I can do it and I can. (Group Two)

Like it make a difference for me because like all my dad, um a lot of his friends from college became engineers, so it's kind of cool because you may of his friends that I've met have been male engineers, and like I go to their companies and it's all like guys working there. So it was kind of cool because like not only was she an engineer, but she was like in charge of many projects. And so like it showed like how it didn't matter so anybody could do -- be in charge. (Group One)

G. Comradery

Although the participants spoke about participation and placing in various competitions, these activities were often times not what kept them coming back. One of the prevalent themes we heard was the comadery formed by working on projects and visiting different schools while participating in different events. Below are a couple of examples from different groups expressing such thoughts:

...like if you're at prelims you just kind of cheer for your school if they win, but when you go to regionals, if your center wins, then you're cheering for them. But it's not like that serious, like at competitions like you want to win of course, that's what you're doing it for but like everyone is kind of you know relaxed, and everything like everyone talks to everyone. It's not like, you know, you don't talk to them because they're your competitor or whatever. It's kind of like oh, you're here too, how did you do this year? (Group One)

And when we're doing the trebuchet, we spent countless hours. We would go to our advisors house, stay there from like eight in the morning, and it would be eight at night. And we'd be trying to build it. It would be all the groups and we help each other. (Group Two)

we interact with other schools, and we're -- and well, you get to meet new people when you're doing the same project as they are, and they get to give you like what Martha said, and everybody else they get to give you hints on what to do on the project, and then besides that, even though you're competing against them, you make new friends that will help you. (Group Two)

The relationships formed among the groups were paramount to why a number of the participants stay in MESA:

Well, I stayed with people I didn't really know during MESA that year that well, because they were juniors and I was just a sophomore. It was kind of fun I stayed with them, got to know each other better, got closer for this year. So that was really fun to like, you know, all hang out there together. (Group One)

...I liked being in a group with them and working, because it was always fun. And I think it helped with like our friendship and bonding and stuff. (Group Four)

It's like a good time to learn from our other older students. If you have troubles in any subject, math, science, or English, anything, they'll help you out, and it's great because if you have no one else in all your other classes that will help you. It's a great place to go to help others if you don't need help, or if you need it back, that's my experience. (Group Three)

H. Exposure to New Opportunities

A number of the participants came from backgrounds that do not afford them opportunities to visit college campuses within their city or outside of their cities or to work on projects outside of their classrooms. MESA provided a bridge to those participants that do not go unnoticed or unappreciated:

MESA, it gives you so many opportunities, that a person like me, would never have had. Like my parents were always -- like they complain about the hours I put in for like my projects, you know, but they're like oh, you should -- you should do that because it gives you the opportunity -- like gives you an opportunity to like see things that we'll never -- that you'll never get to see with us, you know. Because my parents they're not really, like um -- they don't know any English so they can't go anywhere, so they never take me anywhere and they're just like yeah, so you should just like do your best. And join things that would allow you to see others things, you know, give you opportunities. And MESA really does that. (Group One)

And like one thing is like with engineering and stuff, that it -- there's not a club on campus that would allow you to explore that option. There's some for writing and reading, the obvious subjects, but sometimes like engineering is kind of like pushed back because it's math and science, the two most unpopular subjects at a school. And then on top of that, you're asked to do a lot of different projects. And without MESA not a lot of teachers would be willing to have just the fun option of trying this. (Group Two)

-- just this last weekend they took some of us juniors to Chico -- Chico University and this took us Sunday night and we slept over there at an apartment that these girls share. And so it's not just the fact that you're there, but you get this feeling like you belong. And it's um -- you're part of the college. And you get to -- you get to experience that even before you go to college. And it was really nice we were just -- and then we got to visit the dorms we got to visit around school. We saw students, ex-MESA students from this school and they're really happy they say their

classes are super hard, but they're loving it. And it's just really nice. And just MESA we're just like -- we're really united when it comes to. (Group Three)

Conclusions

Co-curricular programs such as MESA provide an opportunity for students traditionally underrepresented in STEM to explore the world of engineering. The preliminary work reported here provides insights into the elements of the MESA program that make it a successful outreach program. The results of the analysis produced eight themes: (a) informal mentoring, (b) makes learning fun, (c) time management, (d) application of math and science, (e) feelings of accomplishment, (f) builds confidence, (g) comradery, and (f) exposure to new opportunities. These eight themes are being incorporated in the development of a survey instrument to support focused work with MESA. These themes might be useful to other co-curricular programs interested in increasing participation of underrepresented students such as the Technology Student Association which recently acquired the Junior Engineering Technical Society as well as FIRST Robotics.

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