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Project FOCIS:

Considering Youths' Interest & Engagement in Science through a Framework for Examining Youths' Learning Activity Preferences

Annual MRSEC Education and Outreach Directors Meeting

University of California, Santa Barbara

September 16, 2013

University of Virginia
Curry School of Education

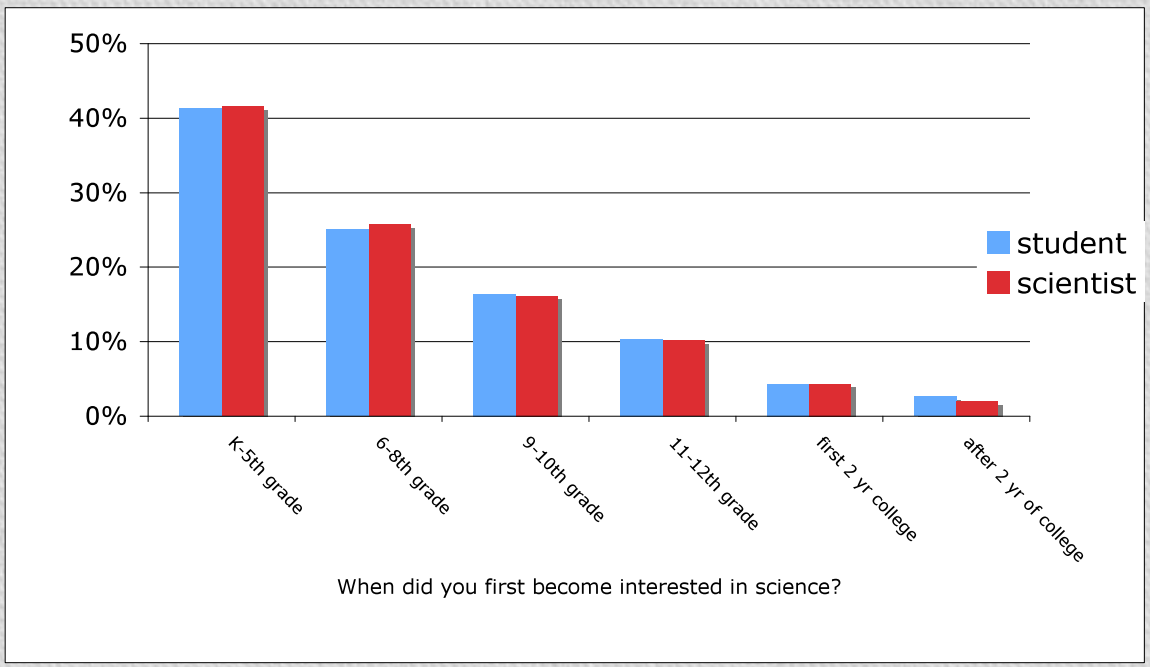
When do scientists and graduate students say they first became interested "science"?

(Scientist n = 3220; Grad students n = 1065)

70% of scientists and 69% of graduate students reported developing their interest in science in Grades K-8

24% of both scientists and graduate students in Grades 9 - 12

6% of scientists and 7% of graduate students in College



*Data from Project Crossover (NSF REC 0440002), PI R. H. Tai, University of Virginia

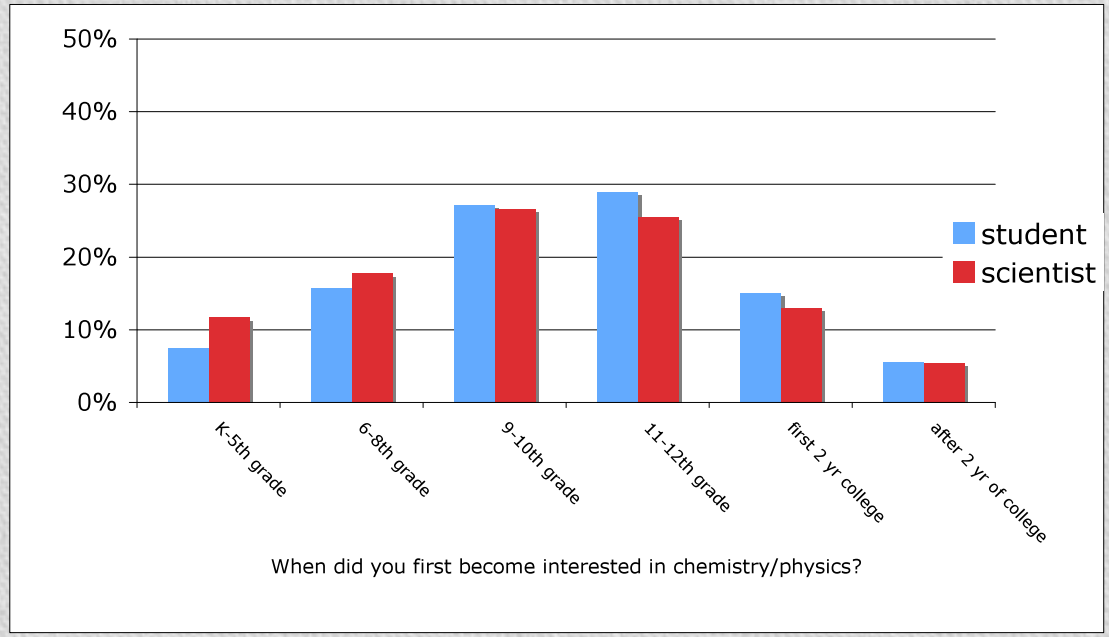
When do scientists and graduate students say they first became interested their career discipline?

(Scientist n = 3220; Grad students n = 1065)

29% of scientists and 23% of graduate students reported developing their interest in chemistry/physics in Grades K-8

52% of scientists and 56% of graduate students in Grades 9-12

18% of scientists and 21% of graduate students in College

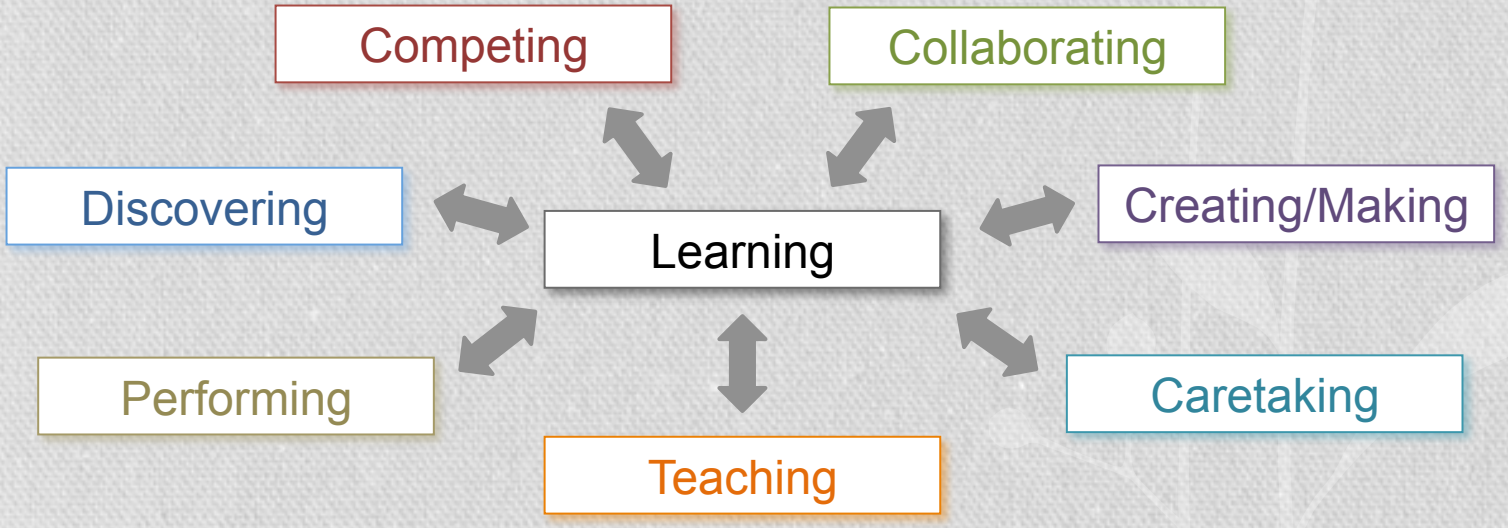


*Data from Project Crossover (NSF REC 0440002), PI R. H. Tai, University of Virginia

How do we hope to engage children's interest?

Through learning activities in both formal and informal settings.

An examination of curriculum and programs led to the development of a ***Framework for Observing and Categorizing Instructional Strategies*** **(FOCIS)** which is a LEARNING ACTIVITY typology.



Learning Activity Type	Survey Questions
Discovering	When I find out that an activity involves... Discovering and learning new things. I like figuring out how things work. I like taking things apart to see what is inside. I like trying different ways to figure things out. I like solving problems.
Creating/ Making	When I find out that an activity involves... Making or building things. I feel like doing projects where I make things. Whenever I can, I make the things I need. I like building things.
Collaborating	When I find out that an activity involves... Being in a group. Working with others is more fun than working alone. I like being part of a team. I learn better when I am working with others.
Competing	When I find out that an activity involves... Being in a competition. I get excited when I hear there will be a competition. I enjoy competing against other people. I like to focus on my own goals, rather than competing with others.
Presenting	When I find out that an activity involves... Presenting in front of lots of people. Performing in front of people is fun. I like telling people about my work. I like presenting my work to my class.
Caretaking	When I find out that an activity involves... Taking care of animals. Having a pet is a big responsibility, but something I like to do. I like to take care of things like plants and aquariums.
Teaching	When I find out that an activity involves... Helping people learn things. Helping others to learn things is fun. I like teaching things to others.

Example: "**Discovering**" Questions

16 **We want to know how you feel about different activities.** ***(Please mark only 1 box for each activity listed below.)***

When I find out that an activity involves...	**I feel...** ☹ **1**	**2**	😐 **3**	**4**	☺ **5**
a. Being in a group,	☐	☐	☐	☐	☐
b. Being in a competition,	☐	☐	☐	☐	☐
c. Making or building things,	☐	☐	☐	☐	☐
d. Discovering and learning new things,	☐	☐	☐	☐	☐
e. Presenting in front of lots of people,	☐	☐	☐	☐	☐
f. Taking care of animals,	☐	☐	☐	☐	☐
g. Helping people learn things,	☐	☐	☐	☐	☐

18 **We want to know what you think about each of the statements below. If you strongly agree, then choose 5. If you strongly disagree, then choose 1.** ***(Please select only 1 number for each statement below.)***

	👎 **1**	**2**	**3**	**4**	👍 **5**
g. I like figuring out how things work	☐	☐	☐	☐	☐
h. I like taking things apart to see what is inside	☐	☐	☐	☐	☐
i. I like trying different ways to figure things out	☐	☐	☐	☐	☐
j. I like solving problems	☐	☐	☐	☐	☐

Data Set

- Large-scale survey of all students in Grades 3-12 in schools from 4 Public School Districts.
- Urban, Suburban, and Rural
- Participating public school districts have strong enrollment numbers of students from minorities groups under represented in STEM (Black 20.9%; Latino/a 23.0%)
- Overall study enrollment (N = 7157)
- Elementary School – Grades 3-5 (n = 2486)
- Middle School – Grades 6-8 (n = 2502)
- High School – Grades 9-12 (n = 2169)
- Female 50.9%; Male 49.1%

INDIANA UNIVERSITY

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CURRY SCHOOL OF EDUCATION

JAMES MADISON UNIVERSITY

Name: **School:**

Grade: **Birthdate:**

We want to know a few things about you. (Please write or mark your answers in the boxes like this:
Examples: ☒ or ■

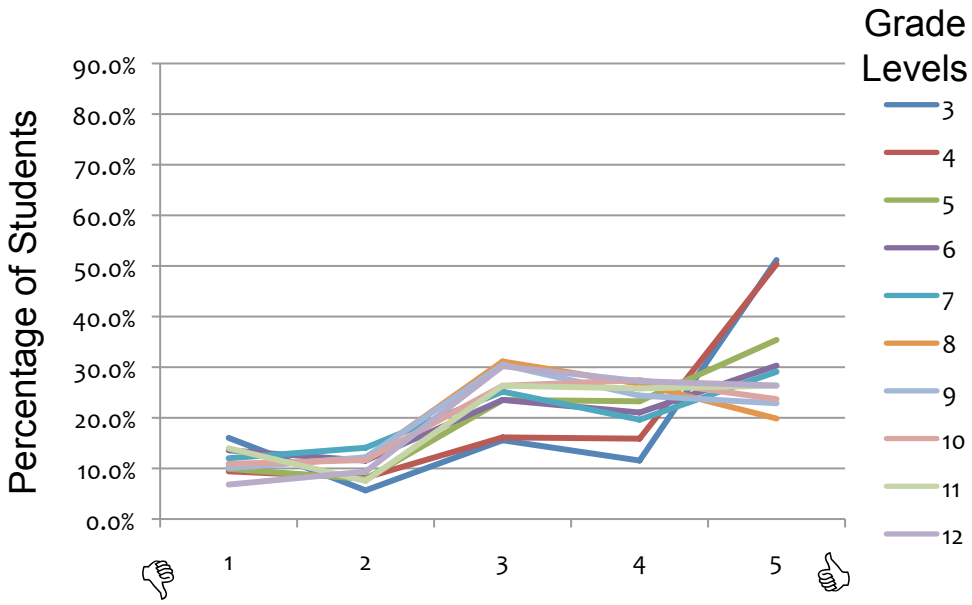
1 Are you a girl or boy?
☐ Girl ☐ Boy

2 Is English the language you usually speak at home?
☐ Yes ☐ No

We want to know if you have attended science or math programs outside of school time.
(Mark all that apply.)

6 Did you ever attend a camp or a program that was mostly or all about science?
☐ No
☐ Yes, during summer

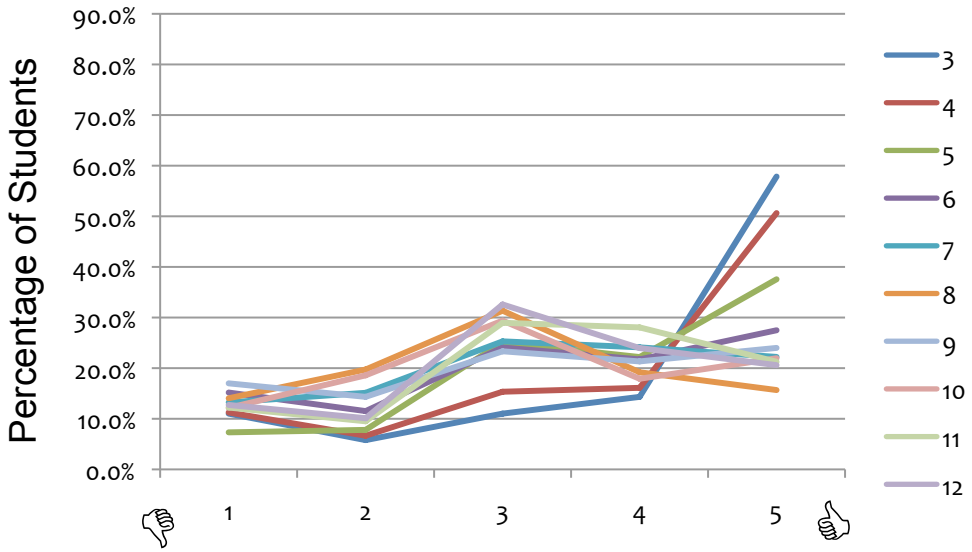
Males



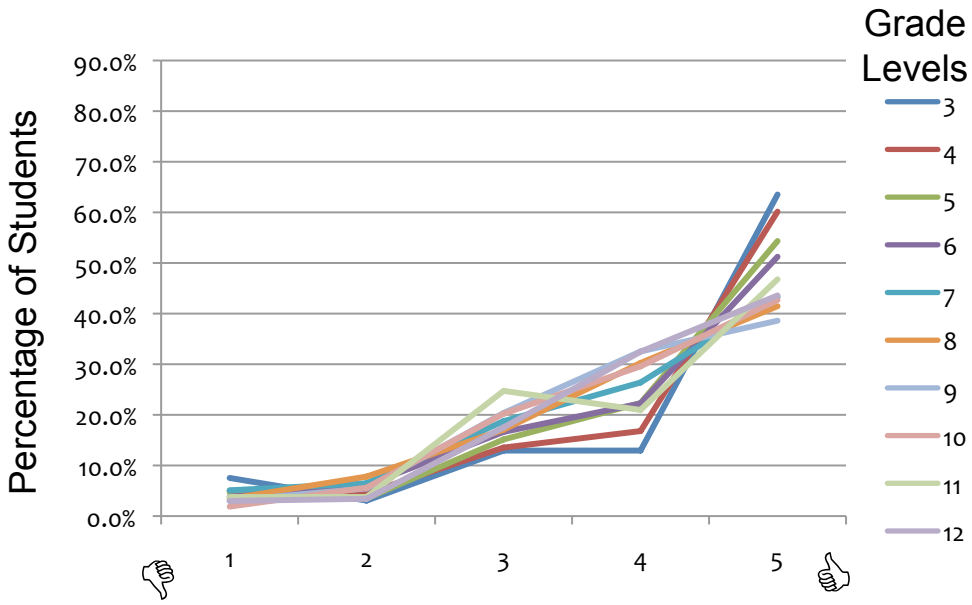
Discovering

Problem Solving

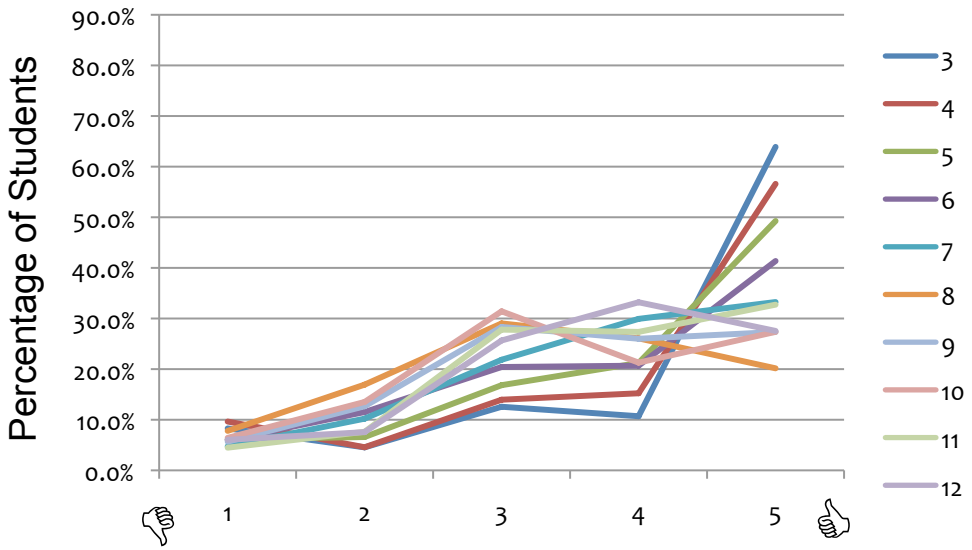
Females



Males



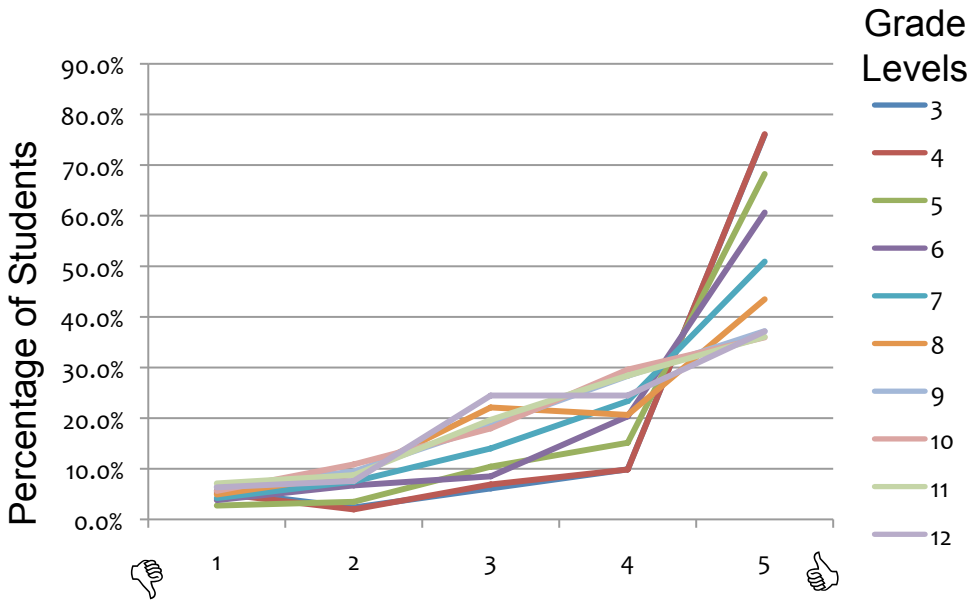
Females



Discovering

Figure Out How Things Work

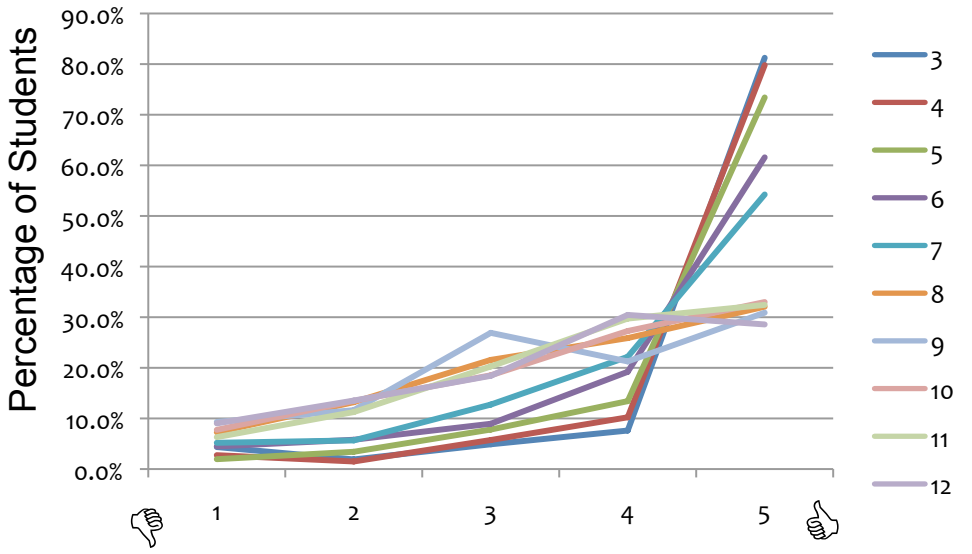
Males



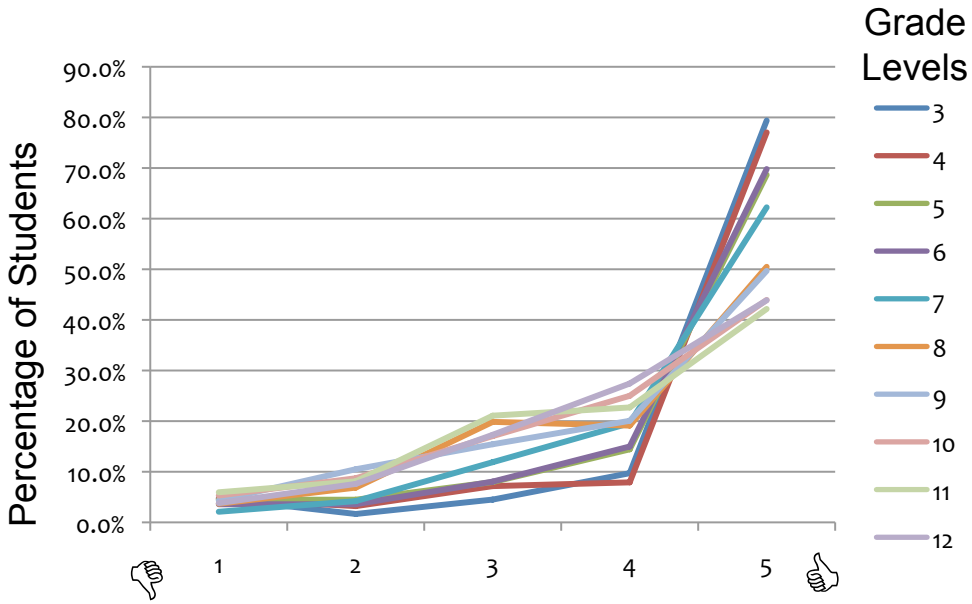
Creating/ Making

"Make" Things

Females



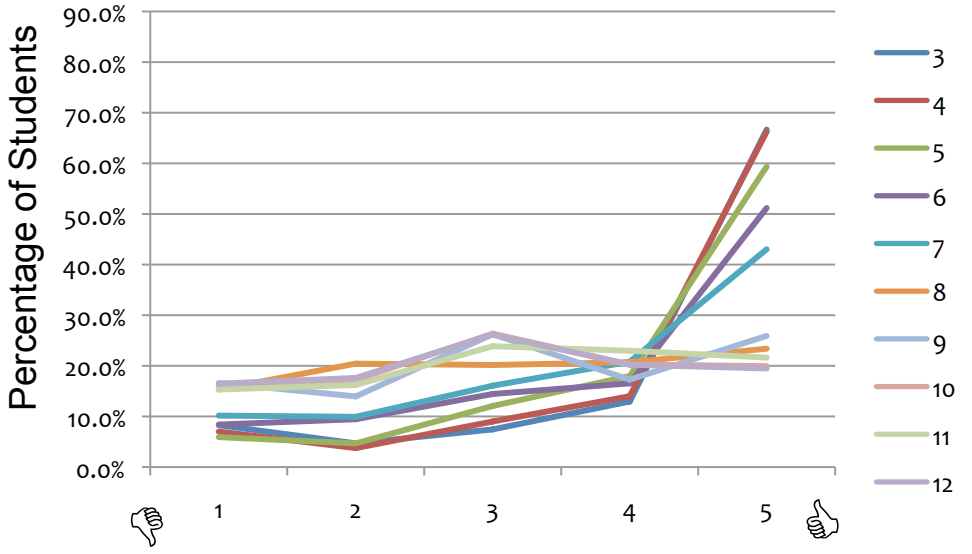
Males



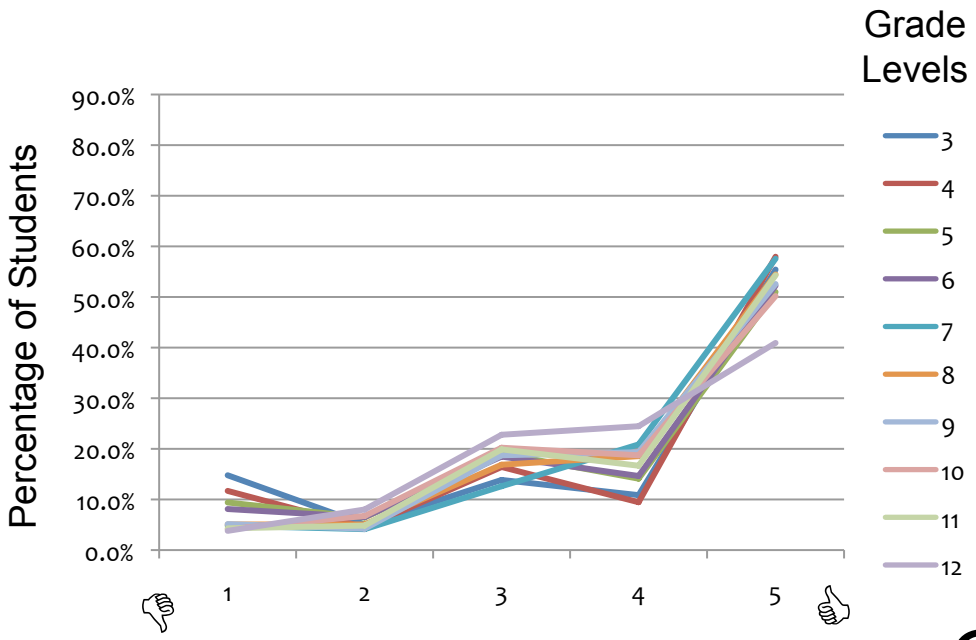
Creating/ Making

"Build" Things

Females

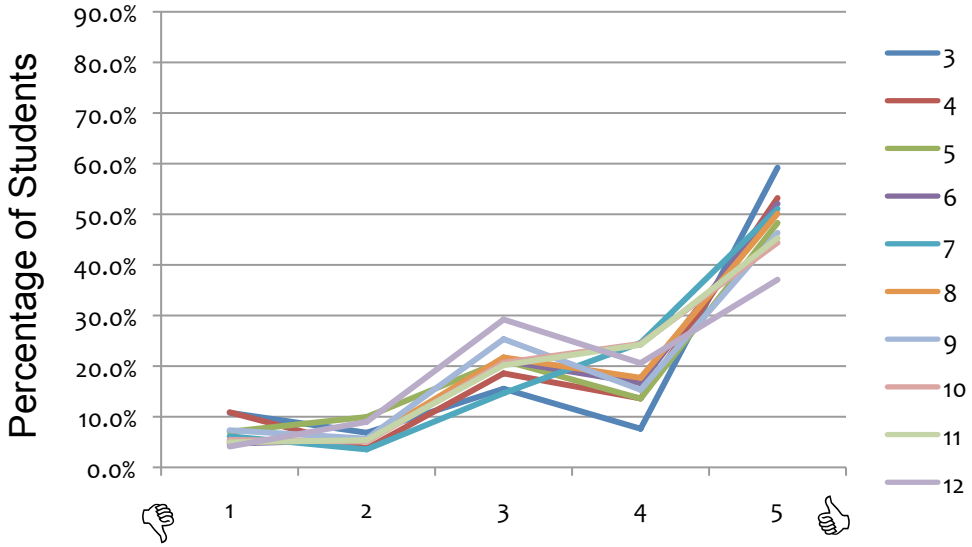


Males

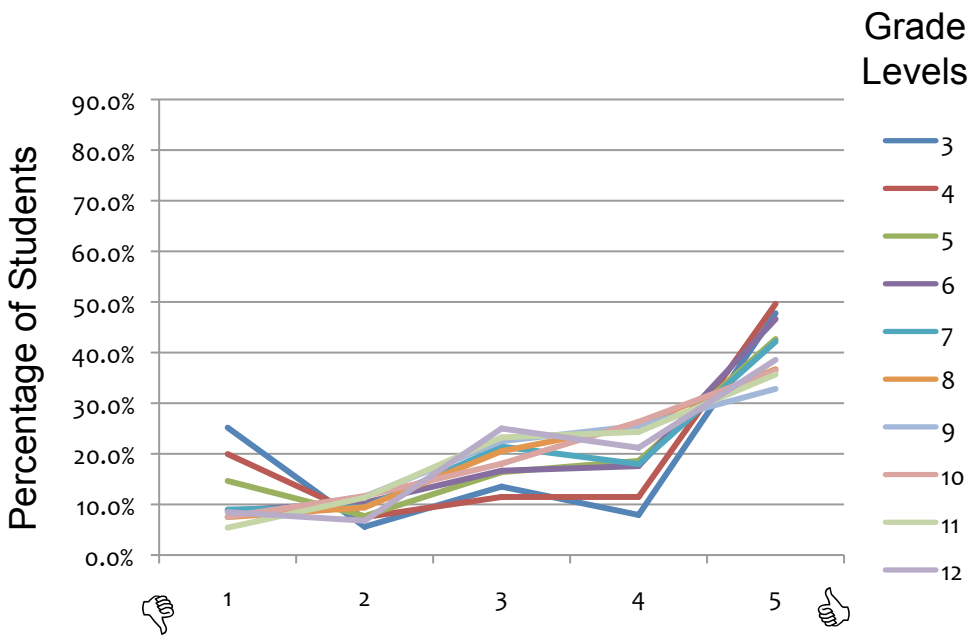


Collaborating

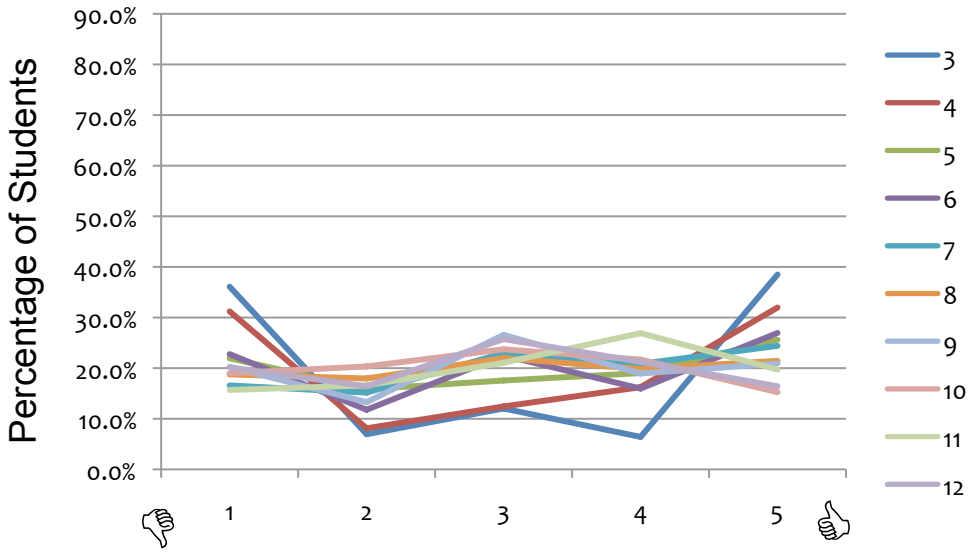
Females



Males

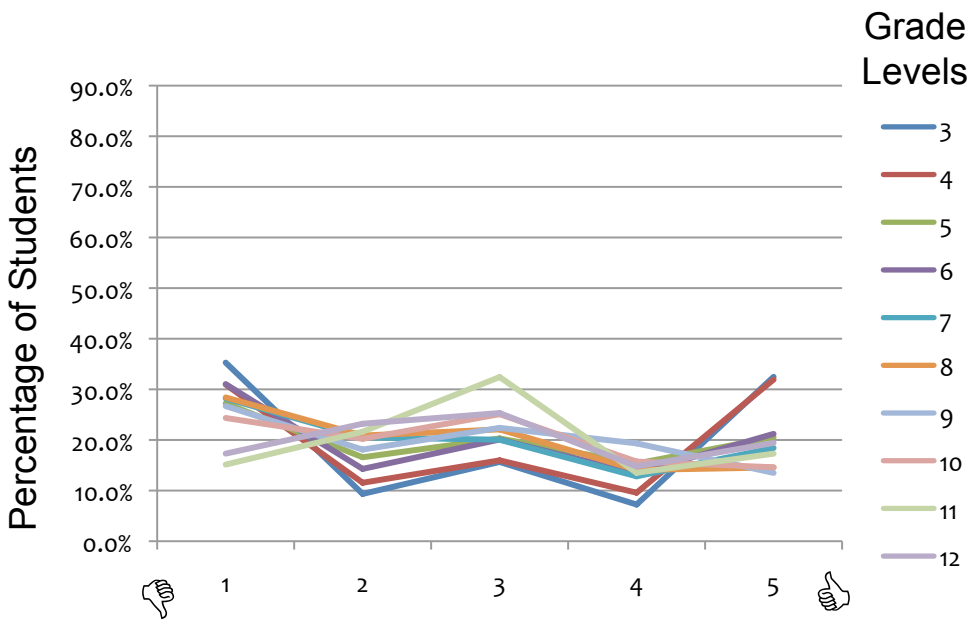


Females



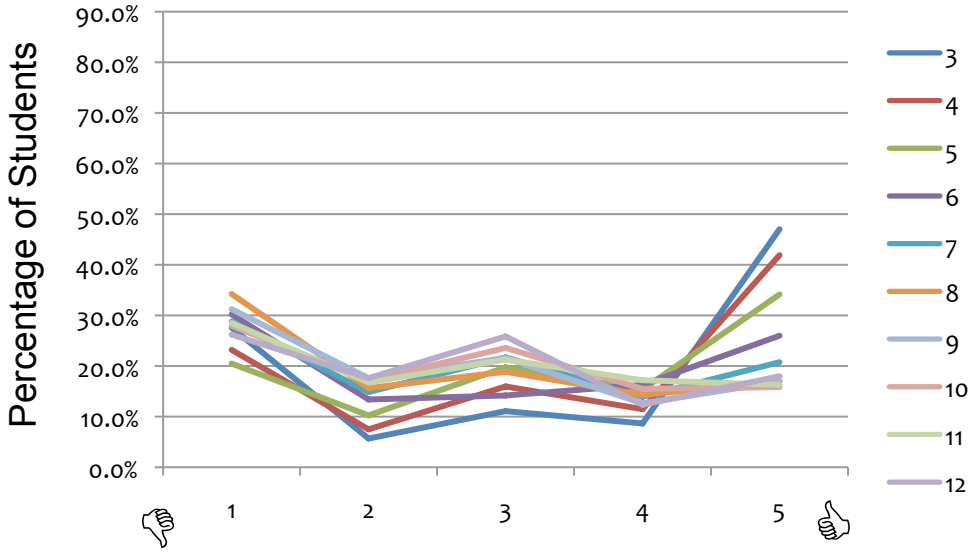
Competing

Males

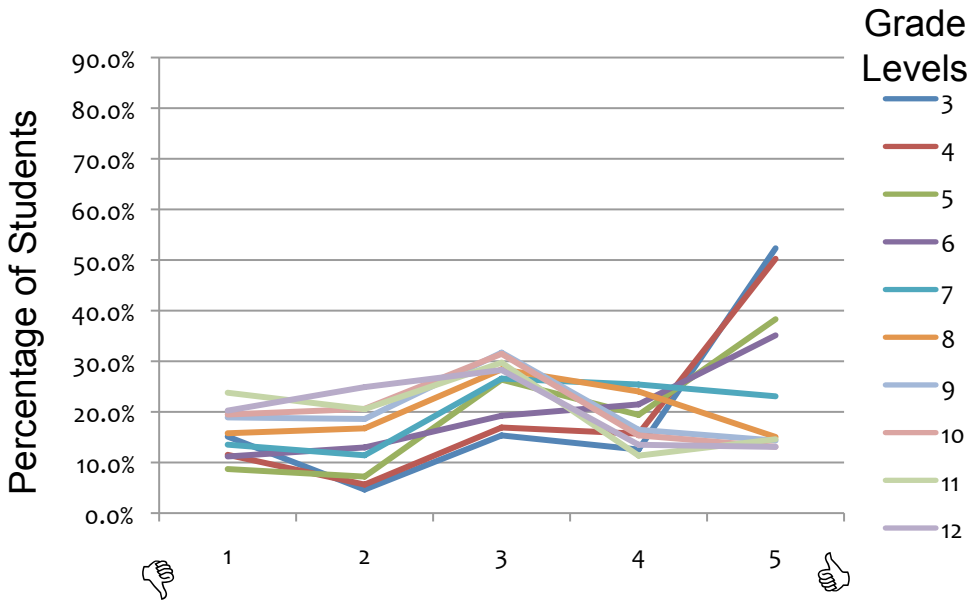


Performing

Females

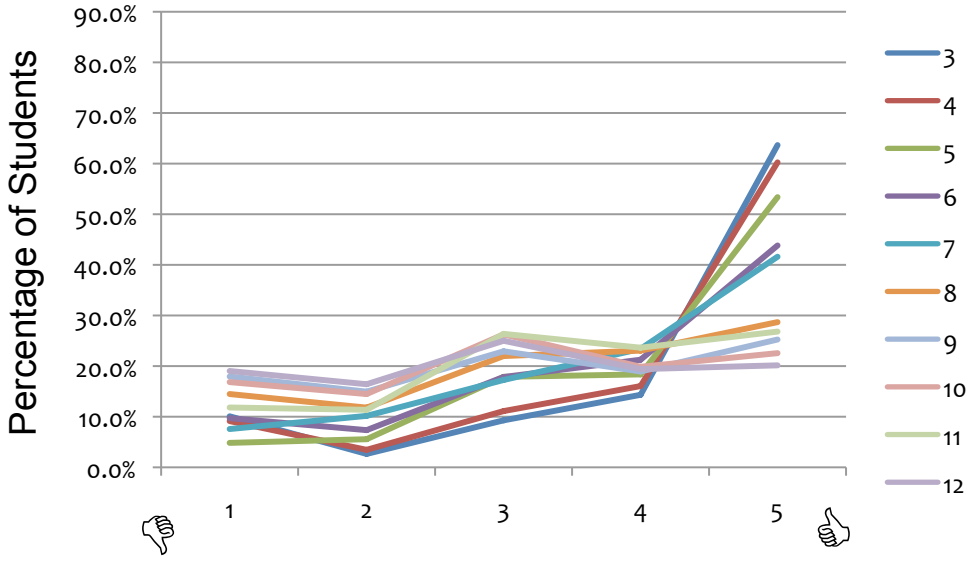


Males

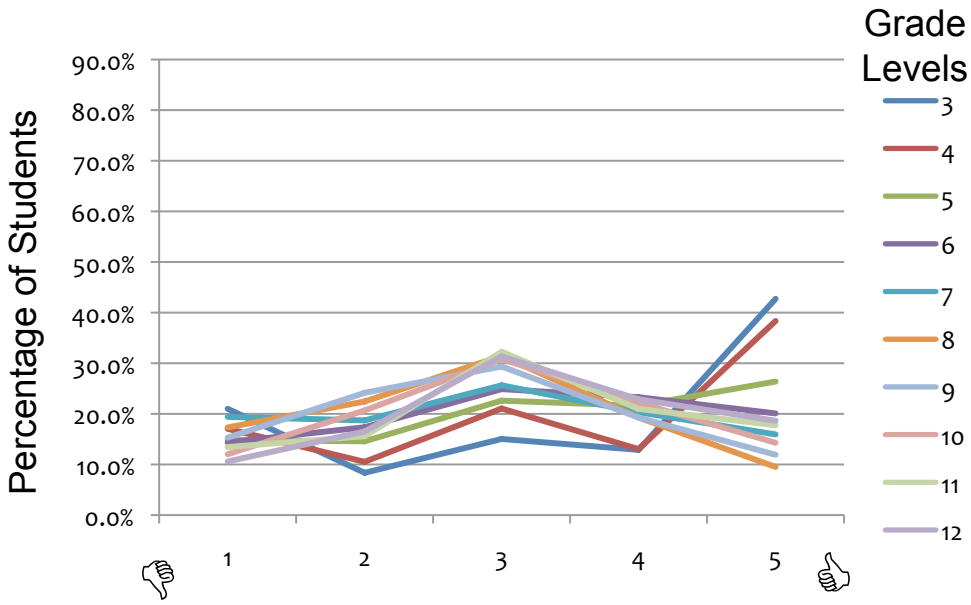


Caretaking

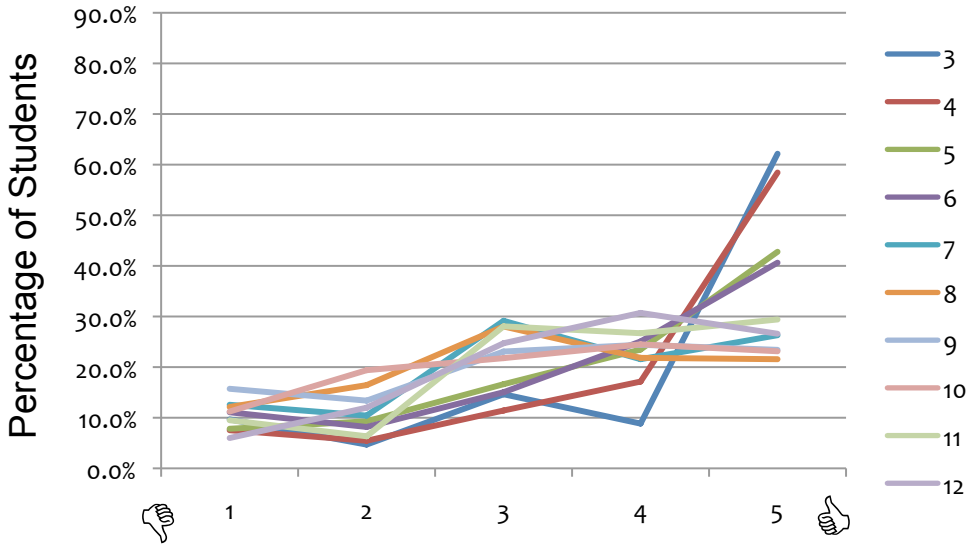
Females



Males



Females

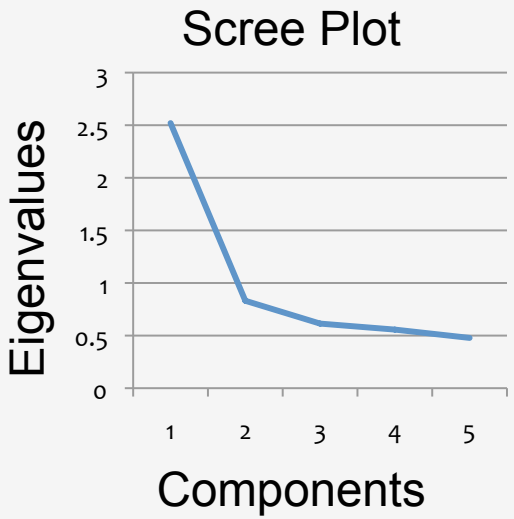


Teaching

Research Question

Are youth who have preferences for particular types of learning activities more likely to select STEM-related career choices than youth who have different preferences (accounting for demographic characteristics)?

Principal Component Analysis extracted a single component from the five "**Discovering**"-related questions.



Created a composite variable equal to the average value of the five original survey questions to create a composite variable named "**Discover**" which has a value that varies between [1 to 5] and is treated as continuous in this analysis.

The same process was carried out for the other six types of learning activities.

Logistic Regression Analysis
STEM-related Job = [0, 1] Dichotomous Outcome Variable
(All 21 LR Models include Demographic Background Controls for Gender and Race/Ethnicity)

Comparison of Odds Ratios from Seven Logistic Regression Models of Learning Activity Composite Variables (Each LR model included baseline demographic control variables, gender and race/ethnicity)

Learning Activity **Composite** Variable	Grade Level		
	Elementary	Middle	High
Discover [a]	1.38**	1.99***	1.74***
Make [a]	1.27*	1.60***	1.35***
Collaborate_**REVERSE** [ab]	1.31***	1.30***	1.28***
Compete [a]	0.92	1.04	0.93
Present [a]	1.10	1.16**	0.95
Caretake [a]	0.99	1.03	1.03
Teach [a]	0.93	1.00	1.06

[a] All odds ratios reported above are based on LR models which include demographic background variables for gender and race/ethnicity.

[b] Collaborate_REVERSE is the reverse coded composite variable for the composite variable Collaborate, where a 5 score has been recoded to a 1 score, and vice versa. This status implies that youth with lower scores have greater odds of choosing STEM Jobs, than youth with higher scores.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Comparison of Prototypical Students

Comparison of Prototypical Elementary School Students

Learning Activity	Neutral (3 / 5) vs Positive (4 / 5)	Neutral (3 / 5) vs Highly Positive (5 / 5)
Discover	38% greater odds	90% greater odds
Make	27% greater odds	61% greater odds

Comparison of Prototypical Middle School Students

Learning Activity	Neutral (3 / 5) vs Positive (4 / 5)	Neutral (3 / 5) vs Highly Positive (5 / 5)
Discover	99% greater odds	296% greater odds
Make	60% greater odds	156% greater odds

Comparison of Prototypical High School Students

Learning Activity	Neutral (3 / 5) vs Positive (4 / 5)	Neutral (3 / 5) vs Highly Positive (5 / 5)
Discover	74% greater odds	203% greater odds
Make	35% greater odds	82% greater odds

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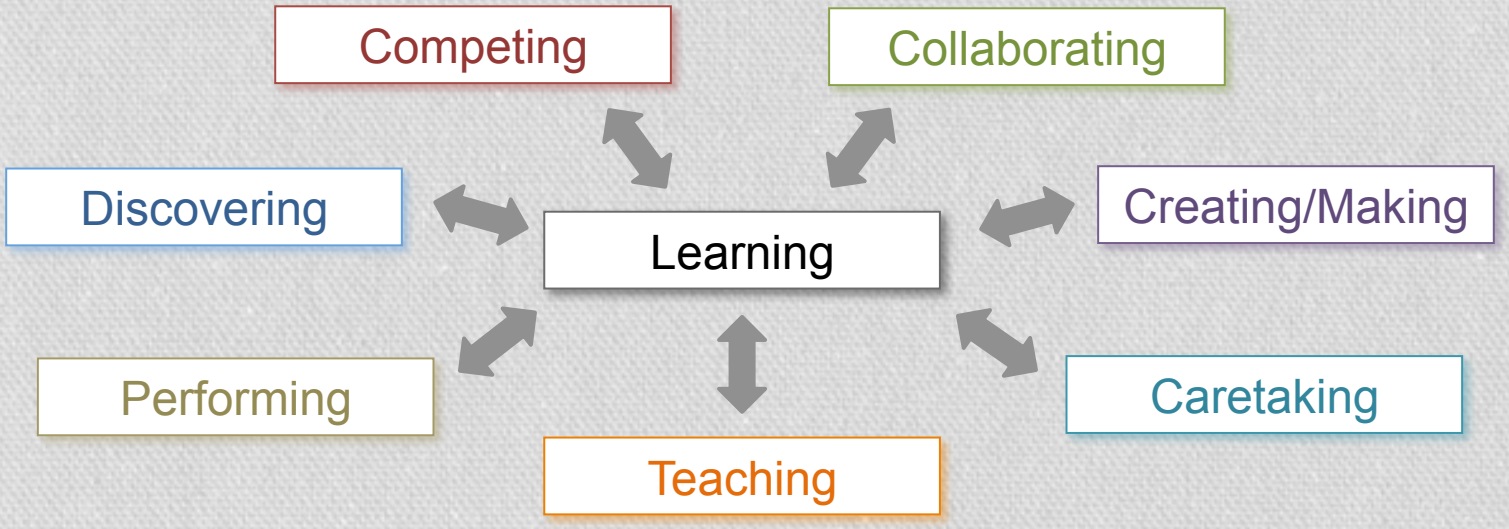
Competing
Collaborating
Discovering
Learning
Creating/Making
Performing
Caretaking
Teaching

We gratefully acknowledge the support of these organizations

All views expressed are those of the researchers and do not represent the views of the National Science Foundation, the Robert N. Noyce Foundation, or the S. D. Bechtel, Jr. Foundation

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I gratefully acknowledge their contributions

Thank you

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SUPPLEMENTARY SLIDES

Gender Differences?

With respect to aspirations for a STEM-related career, what **gender differences**, exist among youth across elementary, middle, and high school?

Investigating Gender Differences Across Grade Ranges

Frequency Distribution

Grade Level	Gender			
	Male		Female	
	n	Percent	n	Percent
Elementary	1265	51.0	1215	49.0
Middle	1306	52.4	1186	47.6
High	1043	48.4	1110	51.6

Logistic Regression Analysis
STEM-related Job = [0, 1] Dichotomous Outcome Variable
(All 3 LR Models include Demographic Background Controls for Race/Ethnicity)

Grade Level	Odds Ratio
Elementary	3.0***
Middle	4.3***
High	4.1***

These results suggest that among Elementary School children, **a prototypical MALE** has **3.0 times greater odds** of choosing a STEM-related career **than a prototypical FEMALE**.

Among Middle School children, **MALES have 4.3 times greater odds than FEMALES** of choosing a STEM-related career.

Among High School children, **MALES have 4.1 times greater odds than FEMALES** of choosing a STEM-related career.