The Effect of Informal STEM Experience: A Mediation Analysis

On Interest and Career Aspirations in Computer Programming Among Middle Schoolers

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Introduction

Background

- Goal: Programs aim to encourage pursuit of STEM+C careers among female & underserved students [1,2]
  - **Curated Pathway to Innovation** (CPI)
  - Web app for middle schoolers to learn about and foster interest in computer programming
- Difficulty: Interest usually decreases during middle school if no intervention takes place [3,4]
- Decline may be due to
  - Lack of informal STEM experience (iSTEM) [5]
  - Low Science Achievement Value (SAV) [6]

Literature

Constructs appeared to be influenced in the following ways:

- SAV → Resources and Parental Education [7,8]
- Resources and Parental Education →iSTEM [9]
- iSTEM → Interest [10]
- Interest → Aspirations [11]

Purpose: To explore the relationship between iSTEM, Resource Variables, and Interest and Aspiration in CP

Research Questions

1. Can "iSTEM" be modeled as a single latent factor model?
2. How do students' iSTEM scores vary based on their resources? (i.e., material, social, time, parental ed.)
3. (a) Is there an indirect effect of iSTEM on aspirations by way of interest? (b) Are the effects still significant after accounting for resources?

Method

Data: Survey responses pulled from the CPI project.

Participants: N = 636, Mean age = 13.5 years, 43.4% female, 45.4% URM, 15 sites in US

Data Preparation

- Compute average scale scores
- Defined and dichotomized resource variables

To Address...

RQ 1 - Confirmatory Factor Analysis (CFA)

RQ 2 - ANOVA

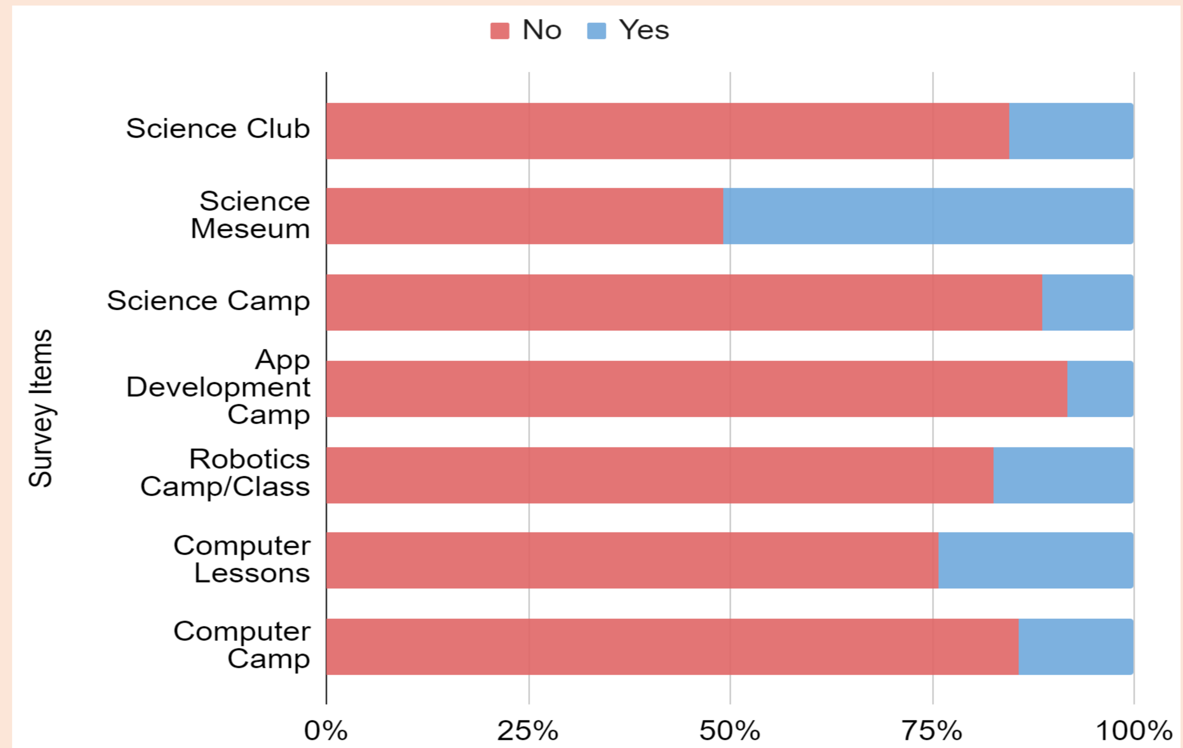
RQ 3 - Structural Equation Model, Mediation Analysis

Software: R Studio (LAVAAN package)

Result

Research Question 1

Figure 1. Students' Response to iSTEM Survey Items in Percentage

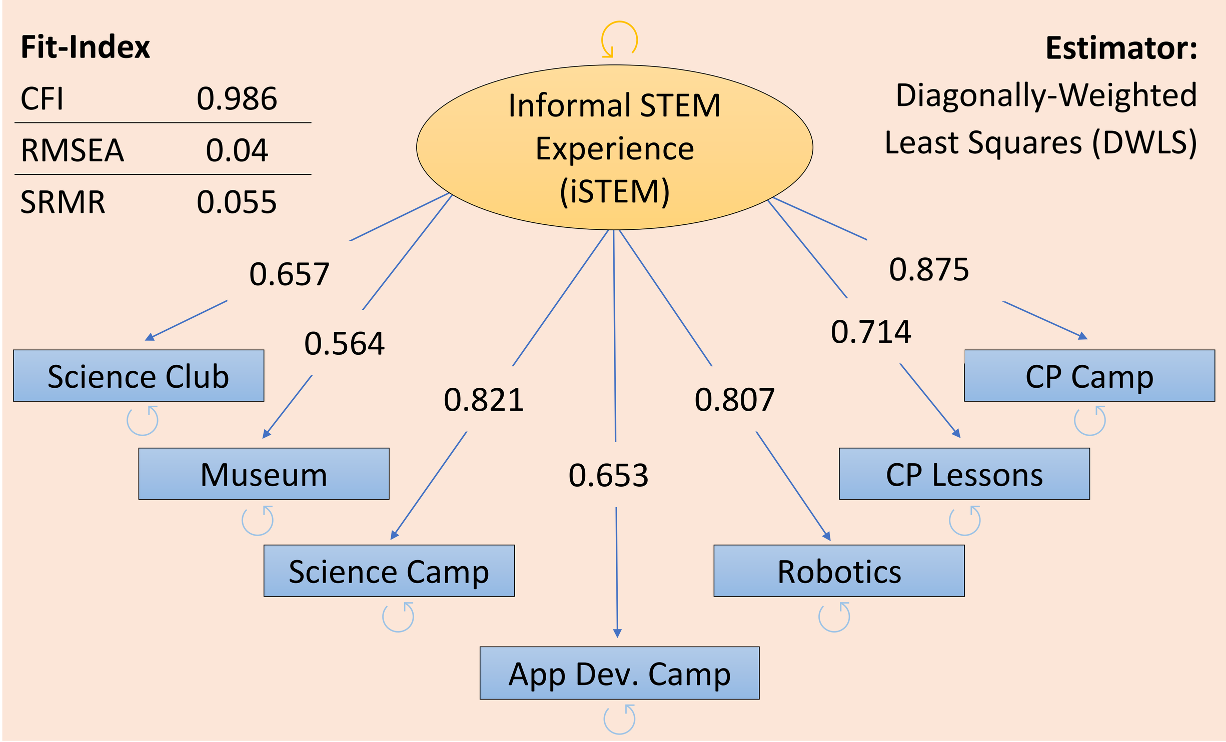


Example Survey Question: Outside of school, have you been to/participated in a science themed museum; science camp; robotics camp or class?

Confirmatory Factor Model Result

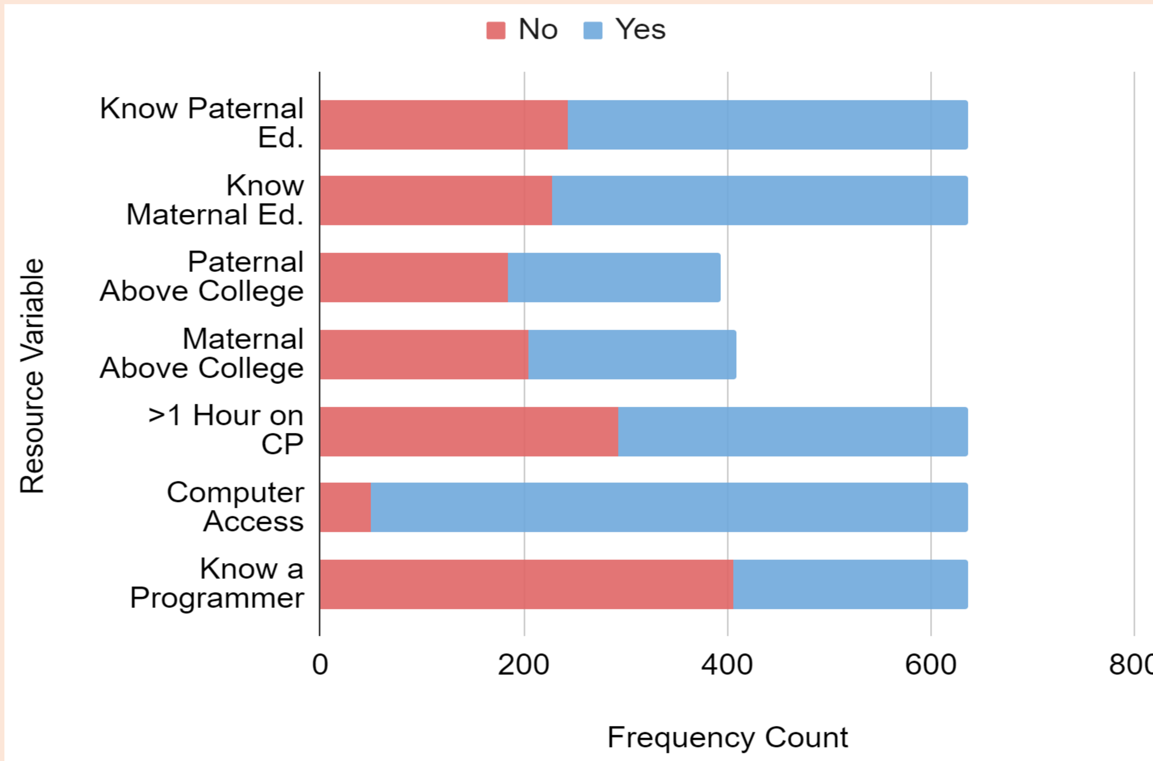
- Survey items loaded well; model fit is sufficient

Figure 2. Factor Loadings of the iSTEM Single Factor Model



Research Question 2

Figure 3. Frequency Count of Responses to Resource Survey Items



Parental Ed.: 37% answered "I don't know."

Time: During a normal weekday, how many hours do you spend working on computer programming activities?

Material: Do you have access to a computer at home?

Social: Do you know anyone who has a job working as a computer programmer?

ANOVA Result

- Students' iSTEM Scores vary significantly on most

Table 1. ANOVA on iSTEM and Resource Variables

Resource Variable	Estimated Marginal Mean		p	F	η_p^2
	Yes	No			
Paternal Ed. Known	0.267	0.199	<.001*	12.643	0.022
Maternal Ed. Known	0.261	0.205	0.03	4.728	0.014
Paternal Above College	0.332	0.267	<.001*	21.038	0.018
Maternal Above College	0.319	0.264	<.001*	12.526	0.014
Spends >1 Hour on CP	0.294	0.215	<.001*	27.526	0.032
Has Computer Access	0.254	0.185	<.001*	13.11	0.007
Knows a Programmer	0.317	0.207	<.001*	59.282	0.058
Gender (Being Male)	0.253	0.235	0.025	5.001	0.001

*significant after Bonferroni Correction (corrected critical value = 0.00625)

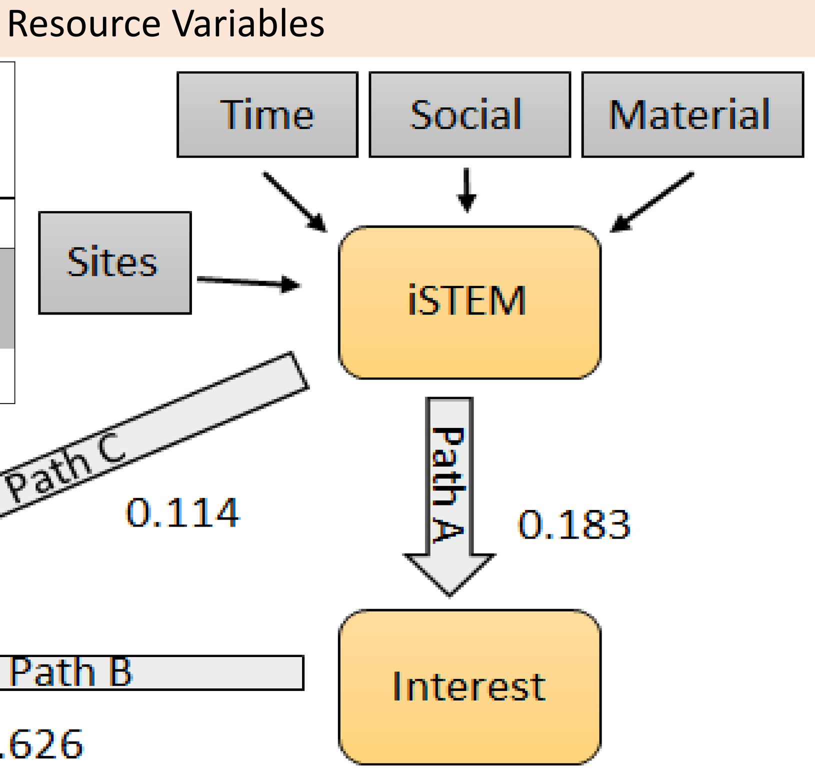
Research Question 3

Figure 4. Analysis of the Mediation Pathways Between iSTEM, Interest, and Aspiration, accounting for Resource Variables

Table 2. Correlation Between iSTEM, Interest, and Aspiration Scores

	iSTEM	Interest	Aspir.
iSTEM	1		
Interest	0.19*	1	
Aspir.	0.23*	0.65*	1

*p < .001



- iSTEM's direct effect AND indirect effect on Aspiration are significant, indicating a partial mediation model

Table 3. Regression Coefficient and Standard Errors For Mediation Pathways

Paths	Standardized Coefficient (SE)
Total Effects	0.229 (0.038)*
Indirect Effects	
iSTEM → Interest → Aspiration (A × B)	0.115 (0.024)*
Direct Effects	
iSTEM → Interest (A)	0.183 (0.038)*
Interest → Aspiration (B)	0.626 (0.024)*
iSTEM → Aspiration (C)	0.114 (0.030)*

*p < .001

- Total effect and indirect effect are significant
- Same after controlling for resources and schools

Discussion

- Results suggest positive answers to the research questions
- Informal STEM Experience is correlated with, and has direct and indirect effects on CP Interest and Aspirations

Implications

- Result is in accordance: Findings of significant differences in Interest pre and post "Out of School" interventions (Young, Ortiz, & Young, 2017) [12]
- Organizations: Providing more opportunities for informal STEM experience to combat declining interest

Limitations

- Many "I don't know" responses for Parental Education; cannot analyze socioeconomic status
- Analyses are purely correlational

Future Direction

- Further experimental or quasi-experimental work

To establish that information STEM experiences results in more positive attitudes towards STEM+C careers

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