STELAR Webinar:

Measuring Student Interest & Motivation in Informal Settings

October 29, 2015

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Webinar Overview

- **About STELAR and the NSF ITEST Program**
- **CSI: Classroom Student Investigators**
  (Karen Yanowitz)
- **Integrating Science Into Afterschool**
  (Tara Cox & Sukey Blanc)
- **Capturing Student Interest and Motivation Through the Experience Sampling Method**
  (Carolina Milesi & Kevin Brown)
- **Questions & Answers**

Who We Are

- STEM Learning & Research Center (STELAR)
- Education Development Center
- Supporting the ITEST program and its grantees since 2003
- http://stelar.edc.org

NSF's Innovative Technology Experiences for Students and Teachers (ITEST) Program

- To build understandings of best practice factors, contexts and processes contributing to K-12 students' motivation and participation in STEM
- Helps students to be aware of STEM careers, and to pursue formal school-based and informal out-of-school educational experiences to prepare for such careers
- **297** current and past projects across **46** states have served **304,900 students**, **10,500 educators**, **4,100 parents and caregivers**

What STELAR Does

- Facilitate projects' success through **technical support** with a focus on synthesis of findings
- Inform and influence the field of STEM stakeholders by **disseminating** project findings nationally
- Deepen the impact and reach of the ITEST program by **broadening participation** in the ITEST portfolio

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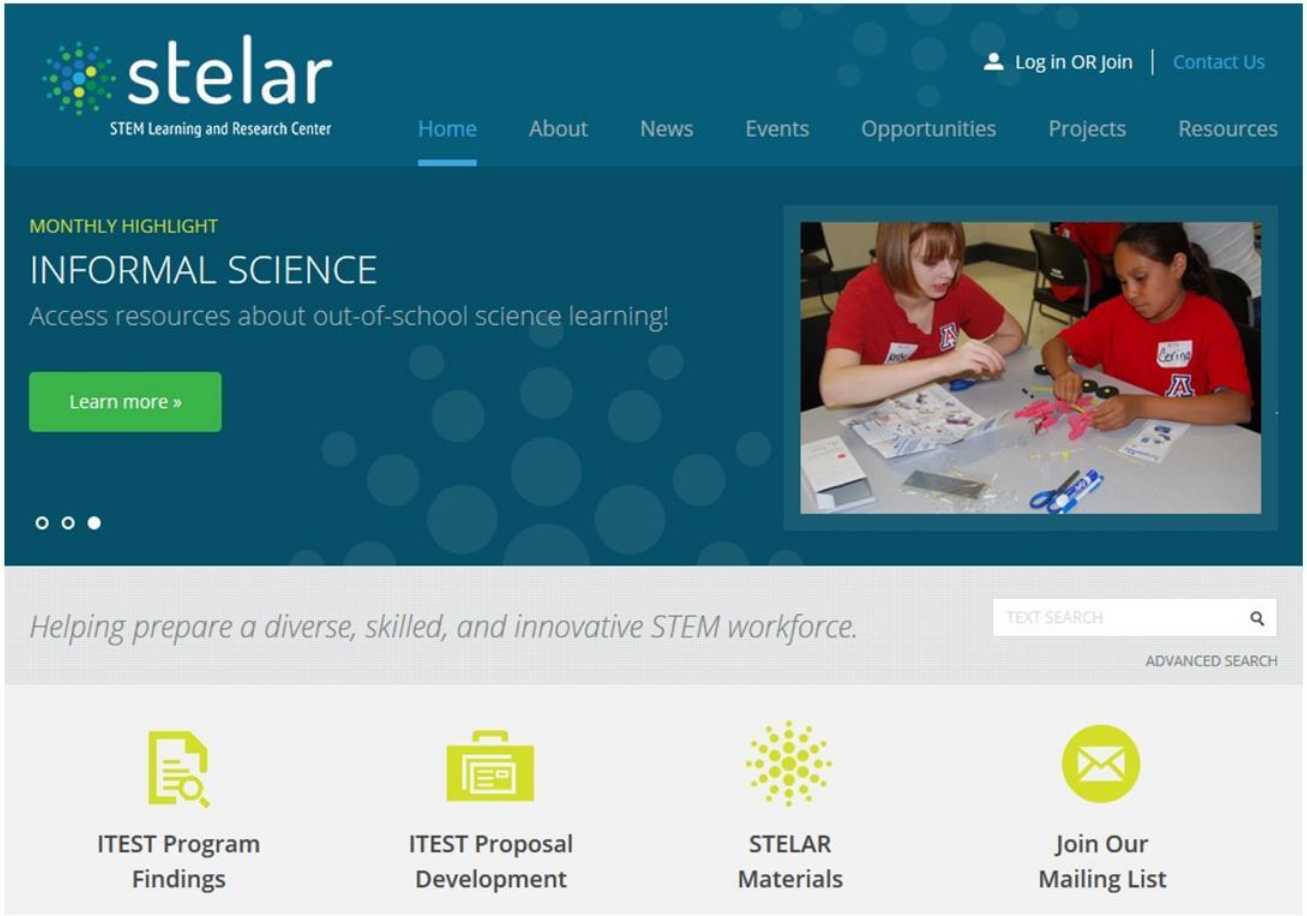
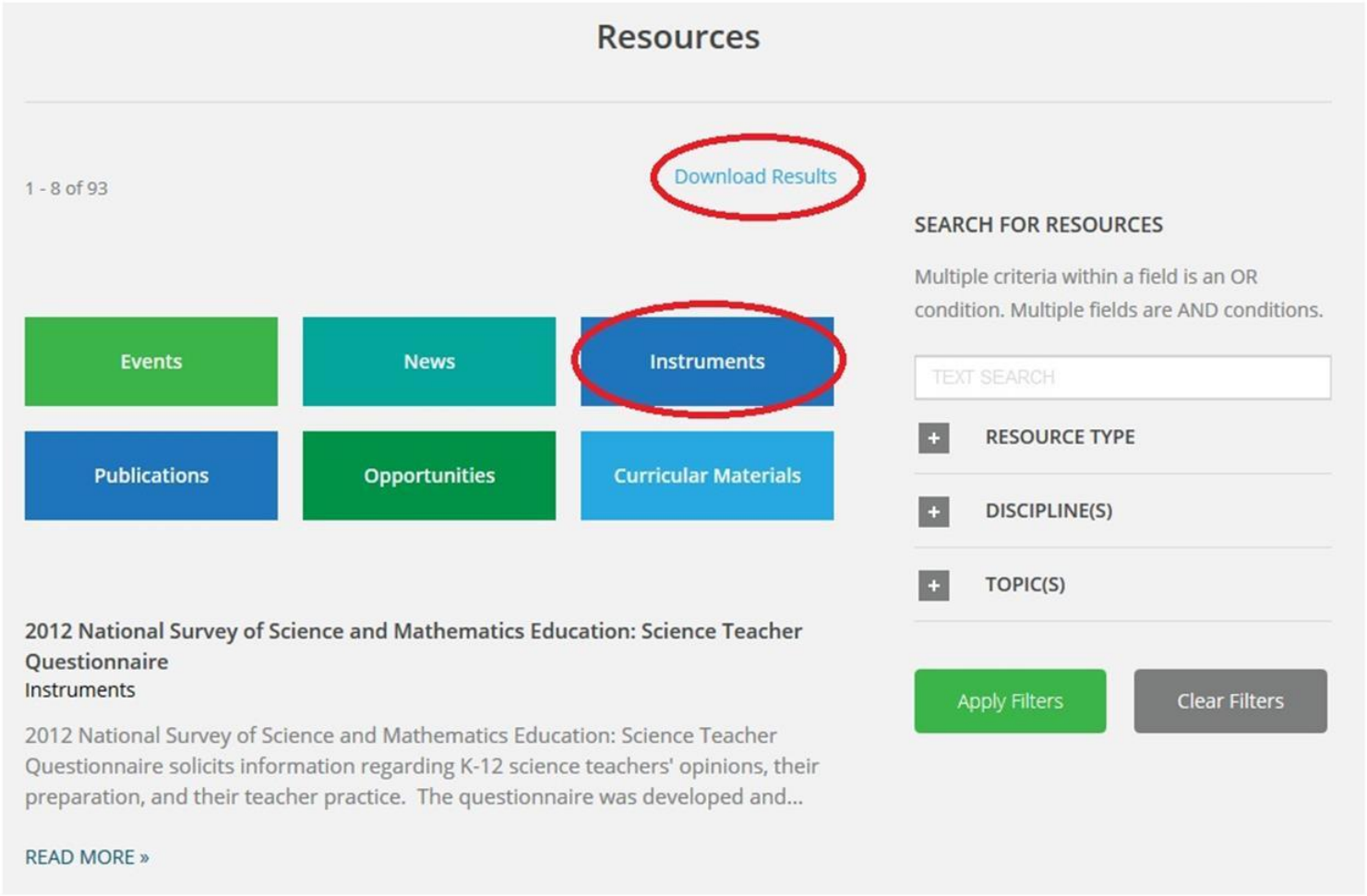
STELAR Website – http://stelar.edc.org



ITEST Instrument Database



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ITEST Instrument Database

Science Motivation Questionnaire II (SMQ-II)

Instruments

DESCRIPTION

The Science Motivation Questionnaire II (SMQ-II) contains 25 items regarding students' motivation to learn science in college courses. Students respond on a 5-point rating scale of temporal frequency ranging from (0) never to (4) always. The SMQ-II contains five montivation components: intrinsic motivation, self-determination, self-efficacy, career motivation, and grade motivation. Each component is measured with 5 separate items.

Access to the instrument as well as instrument documentation can be found under the relevant website(s) heading. Separate questionnaires to measure students' motivation to learn biology, chemistry, and physics specifically are also available.

Authors provide instrument validity and/or reliability information.

RELEVANT WEBSITE(S):

Instrument with documentation
Instrument
Instrument documentation (article 1)
Instrument documentation (article 2)

RELATED PROJECTS:

Collaborative Research: Creating a STEM Pipeline for Low Income and Immigrant Youth
Memphis Virtual STEM Academy at East High School
NanoExperiences: Pathways to Workforce Success
Promoting Our Worth as Entrepreneurs and Researchers in Innovative Technology (POWER-IT)

Feedback on this instrument from projects that have used it

Ginger Fitzhugh
July 24, 2015 - 8:28pm

Q: In what context did you use this instrument (setting, population, project name)?

Response: We included selected items from the SMQ-II in pre- and post-survey surveys for youth participating in Studio, an afterschool tinkering program serving low-income middle and high school students (grades 6- 12) living in Seattle Public Housing. The majority of the youth are from East African immigrant communities. We also administered the pre- and post-surveys to comparison youth who did not participate in the program.

Q: Did you run into any limitations with this instrument? (Y/N) If yes, please explain.

Response: We originally planned to use two of the subscales from the SMQ-II (intrinsic motivation and career motivation). Partly due to concerns about the length of our survey and the need to assess other program outcomes, we decided to use only a small number of the items (4) from the SMQ-II and instead use another scale to measure students' STEM career interests.

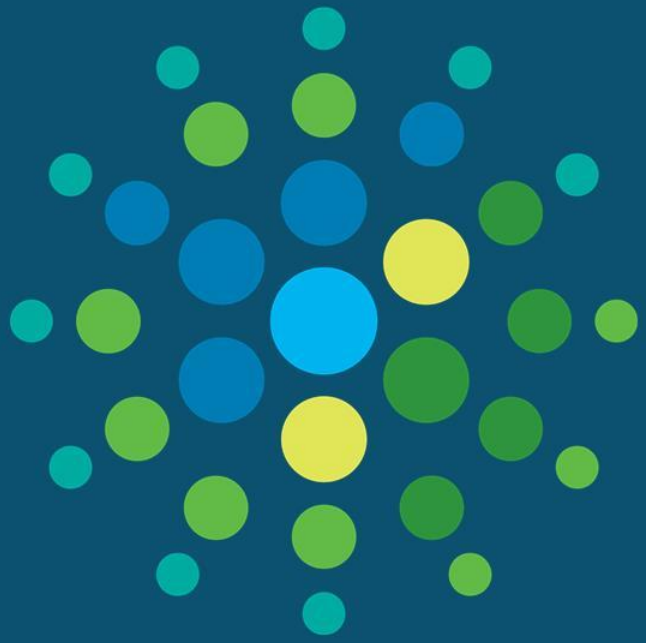
Q: Did this provide you with relevant information to address your research questions? (Y/N) If yes, what question did this answer?

Response: Yes, in part (together with other survey items and additional instruments), the items helped us to address one of our research questions: "Does participation in STEM programming enhancements of the Studio program produce measurable impacts on youths' interests and motivation in STEM?"

PROJECT NAME:

Collaborative Research: Creating a STEM Pipeline for Low Income and Immigrant Youth

Log in or register to post comments



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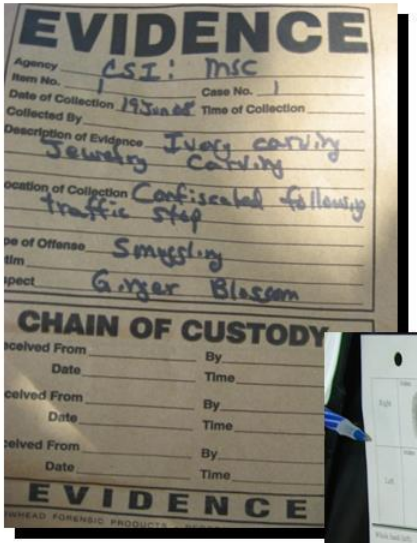
CSI: Classroom Student Investigators

Karen L. Yanowitz

Arkansas State University

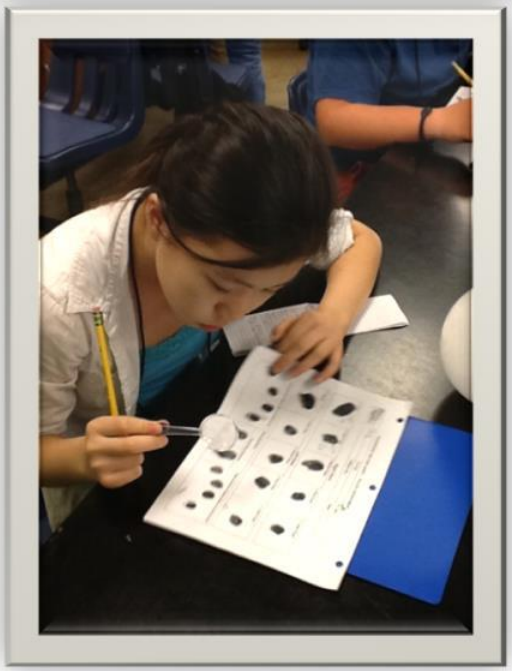
Why forensics?



- There is a high interest in the field.
- It incorporates a variety of scientific content areas and technology.
- Allows for inquiry-based learning using a variety of activities.

SUMMER PROGRAM

- Teachers receive training in science and pedagogy.
- Two-day summer camp with youth to "try out" best practices.
- Primarily rural population.



Long term impact

- Students often show high levels of enthusiasm and interest immediately after program participation.
- Ultimately, developers and funders hope to see long-term impacts on participants.
- However, longitudinal research on these informal summer camp enrichment programs is fairly limited.
- ***Goal***: Assess impact on students' interest and motivation in STEM one year after participation.

Self-efficacy

- ***Science self-efficacy***: The belief that one can succeed in science tasks, courses, or activities.

- Motivational researchers (e.g., Eccles, Bandura) have found self-efficacy predicts many outcomes, including career choice, academic persistence, academic performance.

- In other words, if you believe that you can be successful in science, you might be motivated to put in the time and energy to ***become*** successful.

- Used a self-efficacy sub-scale developed by:
  - Velayutham, S., Aldridge, J., & Fraser, B. (2011). Development and validation of an instrument to measure students' motivation and self-regulation. *International Journal of Science Education, 33,* 2159-2179.
- Items were rated on a Likert-type scale ranging from *5* (strongly agree) to *1* (strongly disagree).
- Students were asked to consider the items in terms of their performance in science:
  - *I can master the skills that are taught.*
  - *I can figure out how to do difficult work.*

ENGAGEMENT

- Would students be motivated to continue to engage in STEM related activities after the camp was completed?

- ***Behavioral engagement***: defined in many ways, including involvement in academic tasks, or participation in school-related activities.

- Use a survey to assess students' behavioral engagement in additional informal STEM activities.

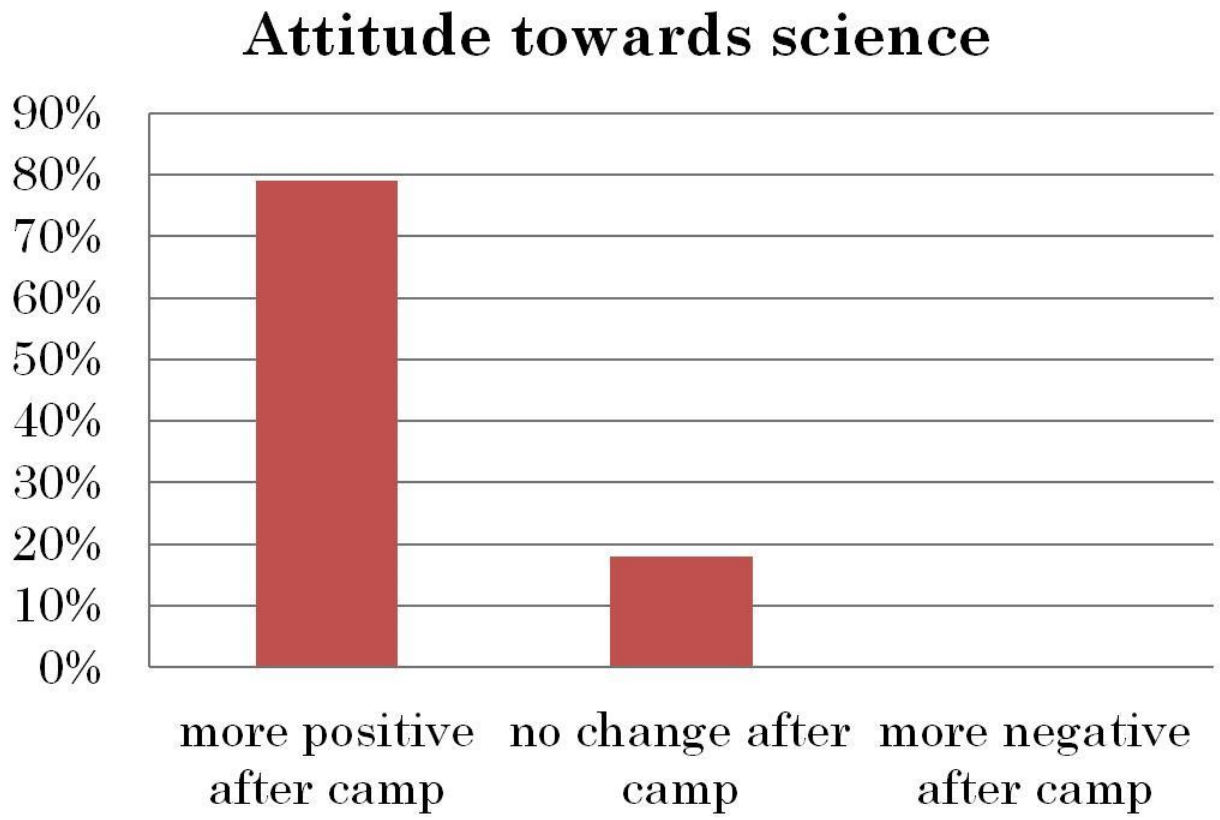
- Because of the CSI camp:
  - *I looked for other out of school science activities.*
  - *I went to more science museums.*
  - *I read more books/magazines about science.*
  - *I watched more TV shows about science.*
  - *I visited more internet sites about science.*

Methods and Results

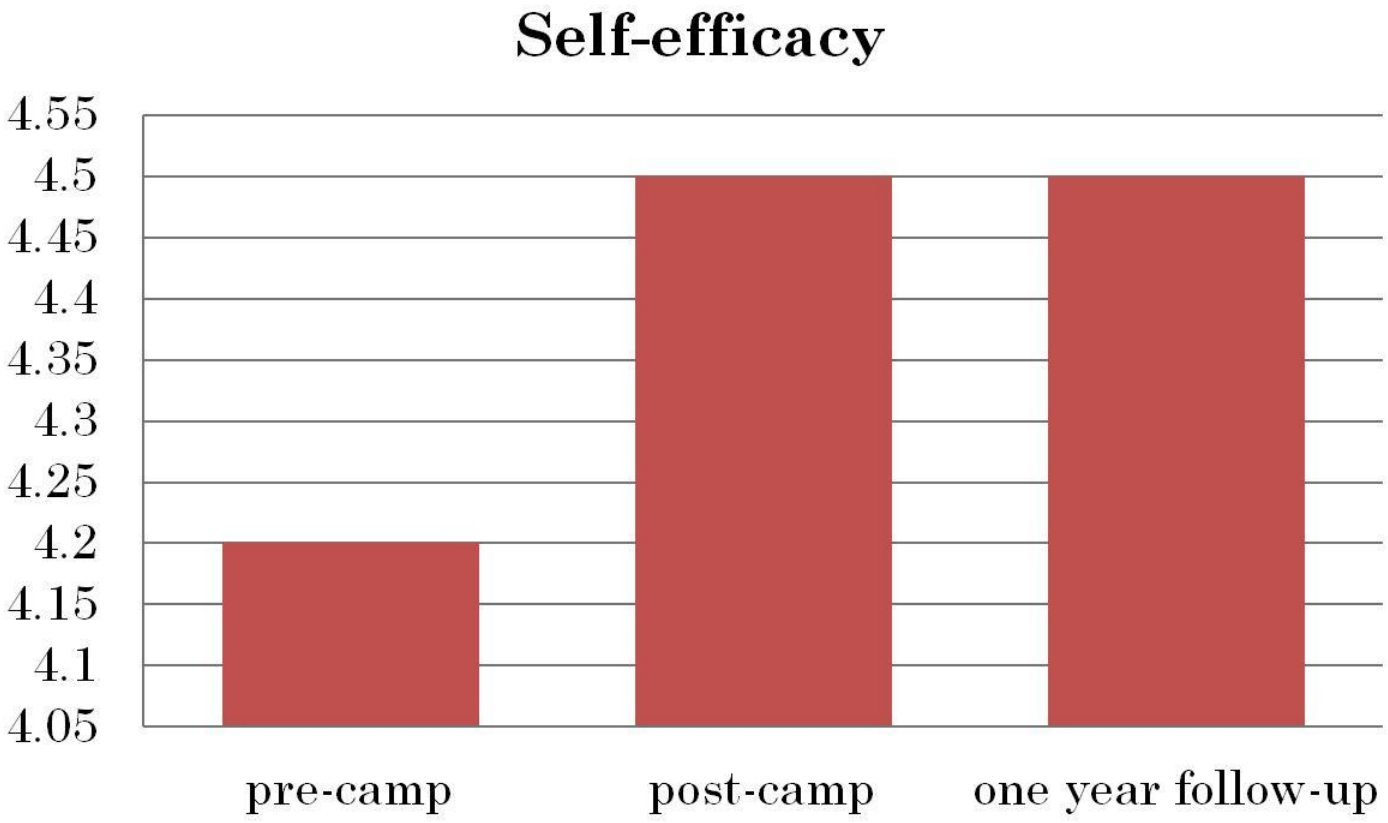
Participants and Procedure

- 124 students attended the camp (over two years).
- Students took pre-summer camp surveys, post-summer camp surveys and were mailed a follow-up survey at the end of the academic year.
- Data based on 66 students who completed all surveys (53% return rate).
  - *Gender*: 66% girls ($n = 43$, 66%)
  - *Grade*: 54% middle school, 46% high school
  - *Ethnicity*: 72% White, 19% African-American

1. Attitude and interest



2. Changes in self-efficacy



Significant increase comparing pre- to post-camp, maintained at one year follow-up

3. Qualitative results

"What impact did the camp have on you?

- 21% greater interest in STEM.
  - *"I do [believe the camp had a long term impact] because I become more interested in science."*
  - *"It helped me grow a love for science."*
- 16% focused on the impact that the camp had on their future plans.
  - *"The lessons and activities. They helped me see which field I may be interested in learning more about."*
  - *"CSI helped me to be prepared for future classes in high school and college. It made me even more sure of what I want to do with my life."*

4. Behavioral engagement: Increased activities in informal science after the camp

- Because of the CSI camp:
  - *I looked for other out of school science activities.*
  - *I went to more science museums.*
  - *I read more books/magazines about science.*
  - *I watched more TV shows about science.*
  - *I visited more internet sites about science.*
- Calculated variable, 1 = strongly agree or agree
- Mean = 2.1, Range = 0 – 5
- Significantly higher than zero, $p < .001$.

Conclusion

- Students had a highly positive perception of their summer camp experience, both immediately and one year later.
- Self-efficacy in the ability that one will be successful is a crucial element in career decisions and a variety of measures revealed increased confidence after attending the camp.
- Self-efficacy and engagement measures provide a more nuanced way to look at interest.
- Use of multiple measures provides converging evidence as to impact.
- Even simple informal science experiences can act as a way to increase interest in under-served populations.

Limits and further directions

- Self-report measures only.
- Selection bias; perhaps only students who had higher levels of self-efficacy in STEM were motivated to return survey after one year.
- Further refinement of the behavioral engagement scale is needed.
- Further examination of behavioral engagement in regards to other measures, particularly intrinsic motivation is planned.

Acknowledgements

- Co-PIs: Dr. Tanja McKay, Dr. Ann Ross
- External evaluator: Dr. Debbie Hahs-Vaughn
- Project Manager: Ms. Renee Carroll
- This project is funded by a grant given to Arkansas State University by the National Science Foundation (NSF 05-621 Innovative Technology Experiences for Students and Teachers – ITEST).
- Thanks to all the teachers and students who have participated in the project so far!

CREATIVE RESEARCH AND EVALUATION

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STEM 3D

Integrating Science into Afterschool, Home, and Community

Tara Cox
The Franklin Institute

Sukey Blanc, Ph.D.
Creative Research & Evaluation

Dale McCreedy, Ph.D.
STEM 3D P.I.
The Franklin Institute

NSF

Project Goals

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- Increase engagement with STEM across contexts
- Support family-based science learning in diverse, low income communities
- Build capacity of OST programs to increase access to STEM learning and careers

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Integrating Science into Afterschool, Home, and Community

Program Focus

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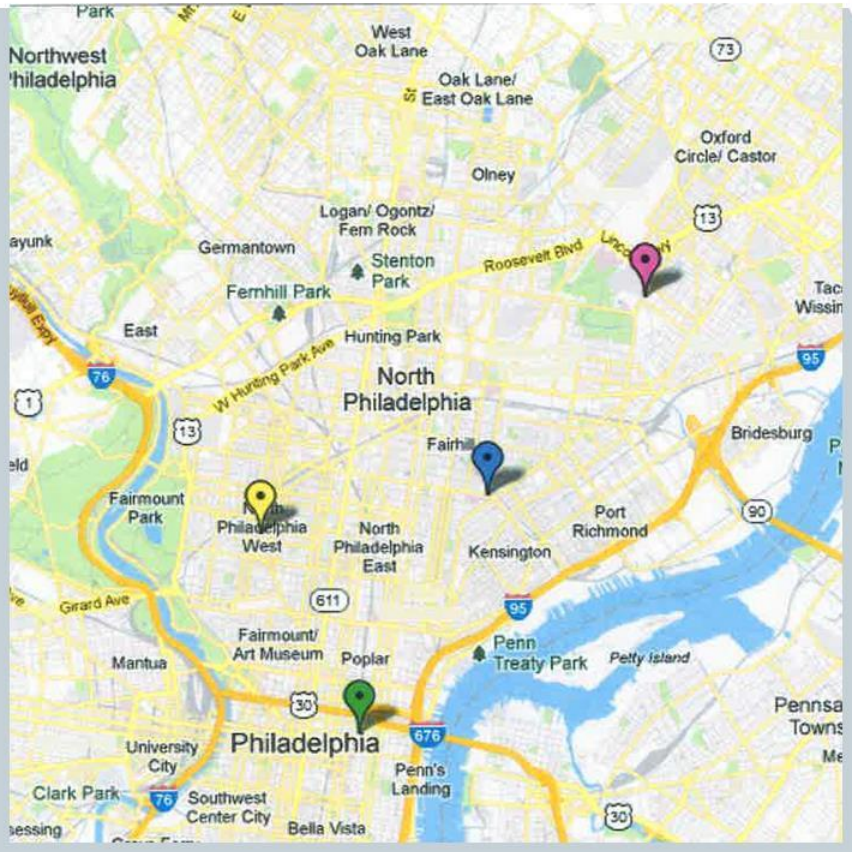
OST staff…

- Attend training at TFI
- Develop and implement STEM units
- Develop STEM family engagement events

STEM 3D

Integrating Science into Afterschool, Home, and Community

Participants



- CORA/ Northwood Academy
- Honickman Learning Center
- Visitation BVM
- Children's Village

Diverse models of afterschool/ OST programs that serves 3-5th grade

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How to measure interest and motivation within these complex environments?

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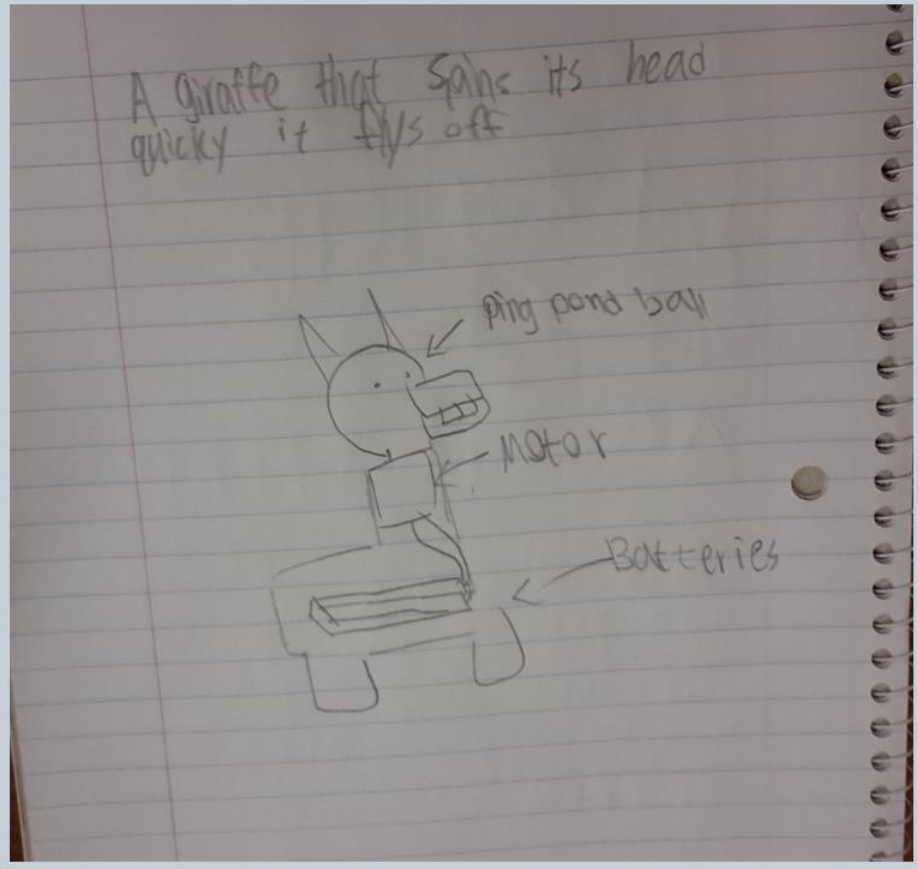

Understanding STEM 3D

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- How do we negotiate the complexity of these environments?
- How do we better understand engagement?
- How do we measure it?
  - Identify appropriate instruments
  - Align approach with program activities
  - Seek IRB approval

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Integrating Science into Afterschool, Home, and Community

Measuring Broad Impacts

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The PEAR Common Instrument

pear PROGRAM IN EDUCATION, AFTERSCHOOL & RESILIENCY

HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

McLean HOSPITAL HARVARD MEDICAL SCHOOL AFFILIATE

Today's Date: Month Day Year

Birthday: Month Day Year

First Name:

Last Name:

Program Name: _____

Please circle the number that best describes what you think about each statement. Mark only one answer per line please!

	Thinking about how you feel today compared to the beginning of this program…	Much Less Now			About the Same			Much More Now
1.	Science is something I get excited about.	1	2	3	4	5	6	7
2.	I like to participate in science projects.	1	2	3	4	5	6	7
3.	I like to see how things are made (for example, ice-cream, a TV, an iPhone, energy, etc).	1	2	3	4	5	6	7
4.	I am curious to learn more about science, computers or technology.	1	2	3	4	5	6	7
5.	I want to understand science (for example, to know how computers work, how rain forms, or how airplanes fly).	1	2	3	4	5	6	7
6.	I get excited about learning about new discoveries or inventions.	1	2	3	4	5	6	7
7.	I pay attention when people talk about recycling to protect our environment.	1	2	3	4	5	6	7
8.	I am curious to learn more about cars that run on electricity.	1	2	3	4	5	6	7
9.	I would like to have a science or computer job in the future.	1	2	3	4	5	6	7
10.	I like online games or computer programs that teach me about science.	1	2	3	4	5	6	7

Less is More

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The PEAR Common Instrument

- Age appropriate
- Validated survey
- Short (10 item)
- Designed to be administered by sites themselves
- Provides broad-brush picture of engagement and interest in STEM

http://www.pearweb.org/tools commoninstrument.html

Systematic Observation

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- Dimensions of Success Observation Tool

- More information at www.pearweb.org

Exploratory Research

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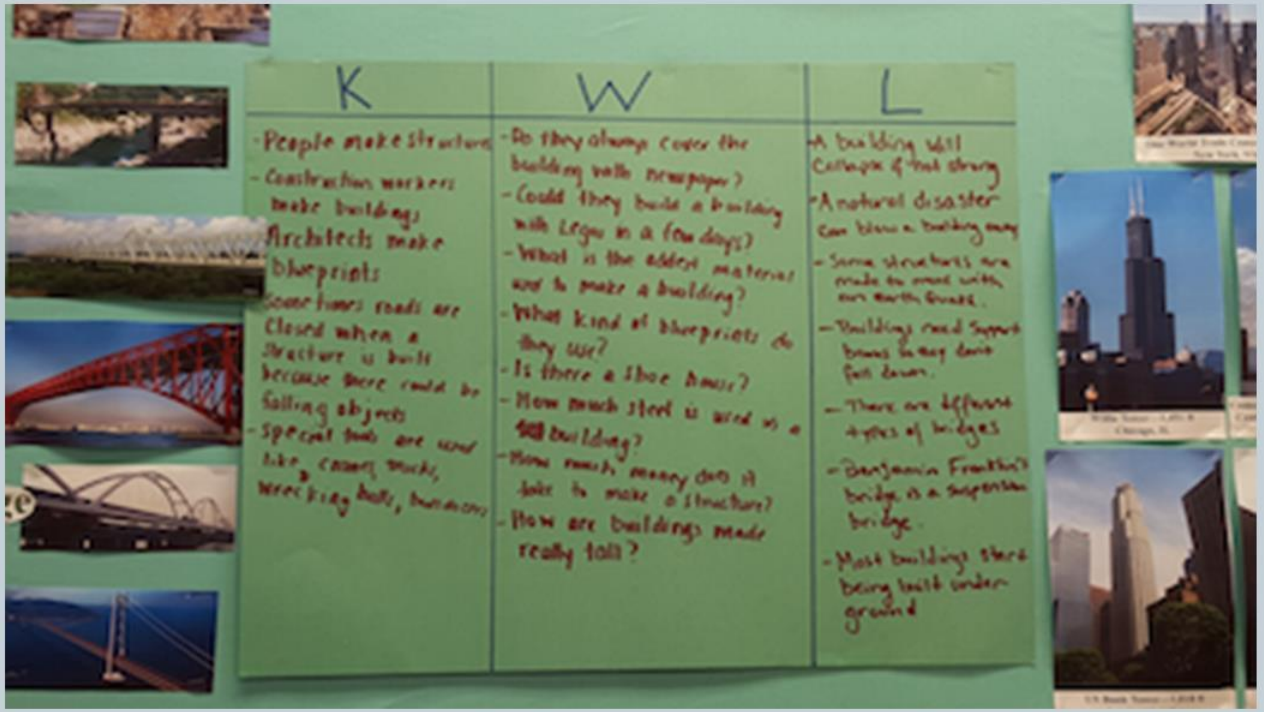
What does STEM career interest look like among 3rd - 5th graders?



What do children say?

What does their work show?

How do we document change?

Emerging Results

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- **Staff and researcher observations indicate classroom interest and engagement.**

- **Preliminary data suggest statistically significant change in STEM interest and engagement.**

Next Steps

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- **Finalize IRB**
- **Data collection and analysis**
  - **Audio tape student talk**
  - **Collect artifacts**
  - **Continue to use PEAR Common Instrument & DOS Observation Tool**

STEM 3D

Integrating Science into Afterschool, Home, and Community

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The Franklin Institute and *Creative Research and Evaluation* thank our site partners!

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CENTER FOR ADVANCING RESEARCH AND COMMUNICATION IN STEM

Capturing Student Interest and Motivation Through the Experience Sampling Method

Carolina Milesi and Kevin Brown

STELAR webinar

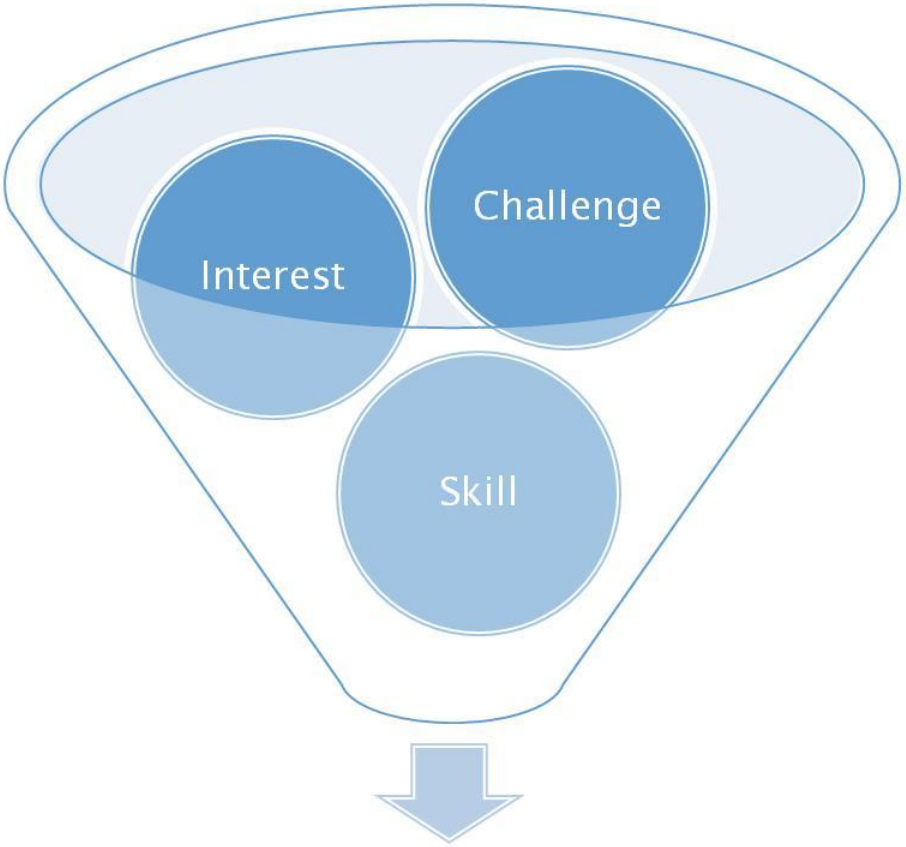
October 29, 2015

This material is based upon work supported by the National Science Foundation under Grant Numbers HRD-1232139 and DRL-0815295. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

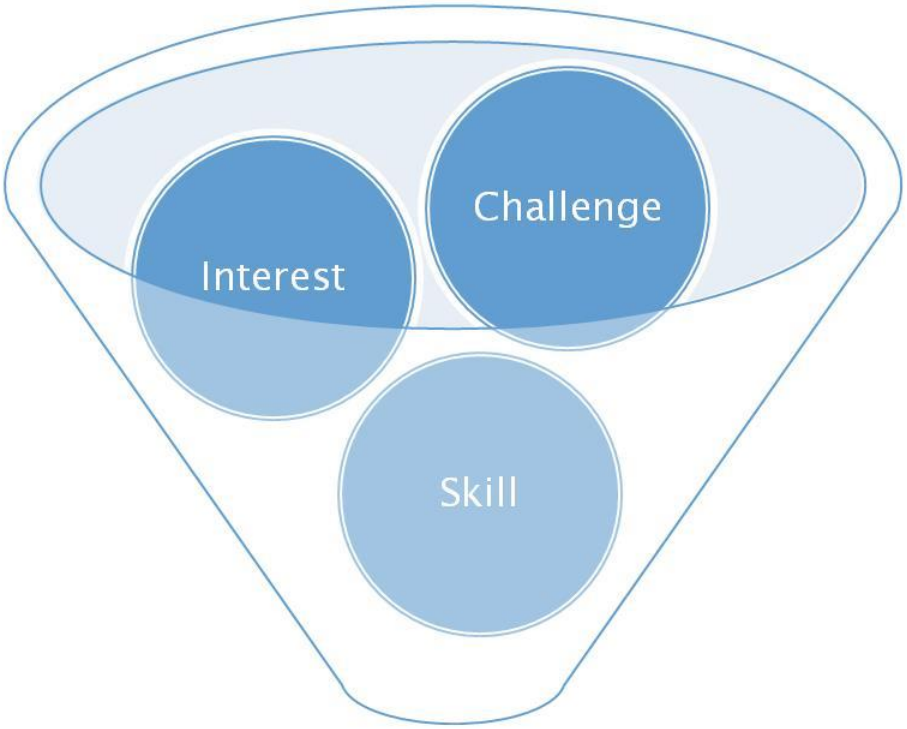
Our research project

- Funded by NSF's former Research on Gender in Science and Engineering (GSE) program
- PIs: Barbara Schneider (Michigan State University and NORC) and Lara Perez-Felkner (Florida State University, formerly NORC)
- Goal: Assess whether male and female college students' "engagement" in formal and informal Computer Science activities is associated with their persistence in a CS major

Theoretical framework: Optimal Learning Moments

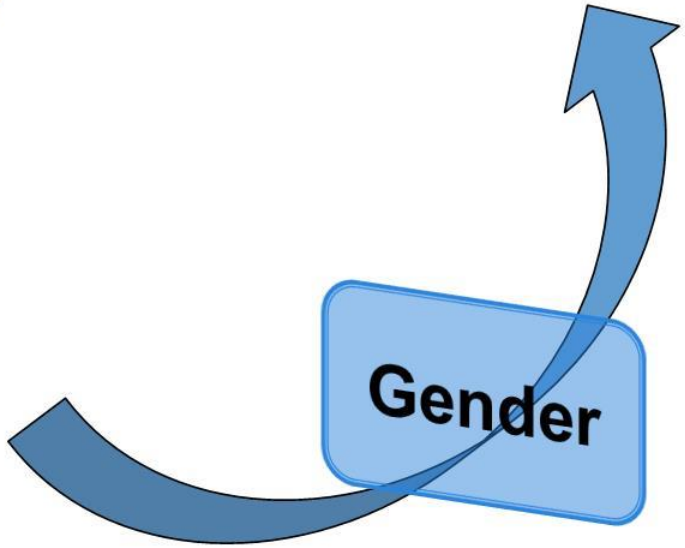


Research question



Context-Specific

Engagement



Multiple methods of data collection

Instrument	Type of data collected
Online survey	Background information; prior computer science related activities
Administrative records	Declared majors, courses, grades, and credits accumulated in computer science
Experience-Based Sampling (ESM)	Real-time data on student experiences across multiple contexts

Multiple methods of data collection

Instrument	Type of data collected
Online survey	Background information; prior computer science related activities
Administrative records	Declared majors, courses, grades, and credits accumulated in computer science
Experience-Based Sampling (ESM)	Real-time data on student experiences across multiple contexts

Focus of today's presentation

What is ESM?

- The Experience Sampling Method (ESM) is a method of data collection that…
  - captures individuals' thoughts, feelings, judgments, and behaviors
  - when and where the action takes place
  - repeatedly over a given period of time
- Purpose
  - Capture individual subjective experiences in real time
- Called the "gold standard for capturing experiential states" by the National Academy of Sciences

ESM is called different things

- Experience Sampling Method (ESM)
- Ecological Momentary Assessment (EMA)
- Diary Method
- Daily Diary Method
- Day Reconstruction Method (DRM)
- In-the-moment (micro) survey
- Event sampling methodology

They all refer to much the same research methodology!

Typical features of ESM data collection

- Respondents stop at certain times and record their experience
- Respondents answer questions such as:
  - Where are you?
  - Who are you with?
  - What are you doing?
  - How are you feeling?
- Respondents are assessed:
  - a few times per day (i.e. 3–10)
  - for several days (i.e. 2–14)
- Questionnaires are concise
  - 1–2 minutes to complete

Type and frequency of signals depend on research question

- Responses may be initiated by:
  - Researcher
    - Participants are signaled specific times or random intervals
  - Participant
    - Specific times
    - Specific events
    - Specific contexts

Methods of ESM data collection have evolved

Paper & pencil

- ESM was originally implemented as a hardcopy diary method
- Respondents were asked to fill out a diary or questionnaire at specific times

Electronic prompting

- Pagers or watches were used to send preprogrammed signals to participants
- When prompted, respondents would record responses in a paper & pencil or web questionnaire

Mobile phones

- Smartphones serve at the same time as a signaling device and survey platform
- Answers are input directly on the phone and responses have an automatic timestamp

Key advantages of using mobile phones to carry out ESM studies

- Mobile phone technology provides a new way to measure affective states in real time
  - ✓Less cost
  - ✓Less burden
  - ✓More flexibility
  - ✓More coverage of schedules and contexts

Advantages of using ESM

- Detailed measurement of individual affective states
- Assessment of change in mood and behavior over time and across contexts:
  - Formal educational contexts
  - Informal settings
- No recall bias
- No context effects caused by artificial environments (e.g., a laboratory)
- Statistical power

Challenges of using ESM

Traditional challenge	How challenge is being mitigated
Cost	• Cost is rapidly decreasing as technology advances • Most current studies rely on participants' own devices
Sample bias	• Selectivity of study participants is declining due to pervasiveness of smartphones
Respondent burden	• ESM is mostly used in small and mid-size studies (up to ~1,200 participants)
Short questionnaire	• ESM data is usually integrated with other sources of data such as initial survey or administrative data • ESM module within a large scale survey

ESM can be used in innovative ways

- Supplement ESM with "objective" measures of contexts not captured from participants' phones:
  - random sound recordings or video recording of the same environment in which ESM respondents are reporting about
- ESM data collection accompanied by real-time interventions
- Use of ESM as a detailed study for a subset of a large scale study

Additional resources

- Csikszentmihalyi, M. & Schneider, B. (2000). *Becoming Adult*. Basic Books.
- Hektner, J.M., Schmidt, J.A., Csikszentmihalyi, M. (2007). *Experience Sampling Method: Measuring the Quality of Everyday Life*. Sage Publications, Inc.
- Zirkel, S., Garcia, J.A., & Murphy, M.C. (2015) Experience-Sampling Research Methods and Their Potential for Education Research. *Educational Researcher*, 44(1), 7-16.

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