# TEXAS STEAM NETWORK TO EMPOWER MIDDLE SCHOOL STUDENTS

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Texas A&M students serve as near peer mentors, working with middle school students to create imaginary worlds using game engines.

## Project CHISPA

**Calculation, Hitech, Imagination, Systems, Procedural, Art**
**Pilot year project, 2020 - 2021**

Texas STEAM network aims to provide 5th-8th grade students an opportunity to imagine how math, science, and coding are bridges to creating the fantastic environments they enjoy in video games and films. The project combines studio culture, STEAM education, digital world-building, and creative collaboration.
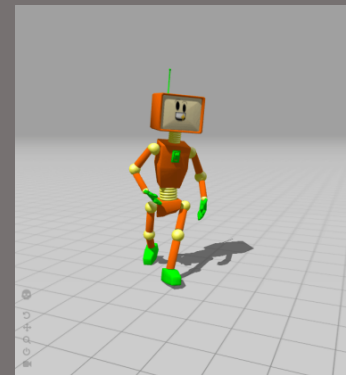
The CHISPA research team conducted a literature review to inform best practices for near peer mentoring.

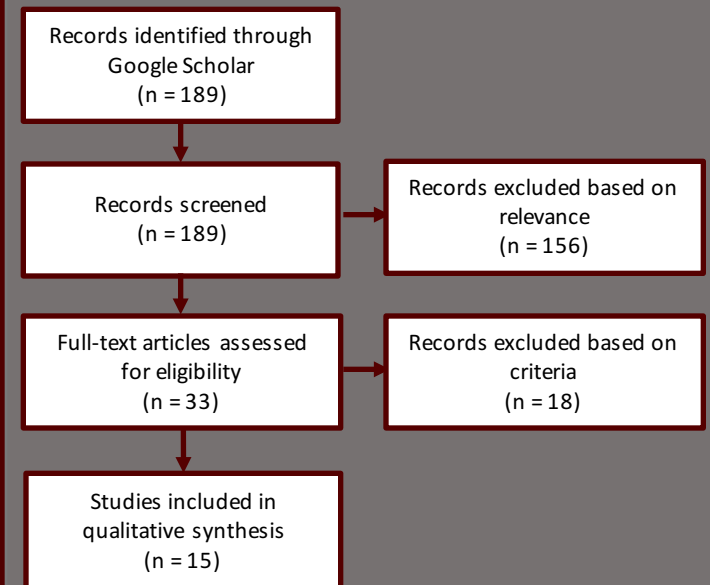# TEXAS STEAM NETWORK TO EMPOWER MIDDLE SCHOOL STUDENTS

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## The Effects of Informal STEM on 6th Grade Students: A Systematic Literature Review

Nicole Svetlov

By sixth grade, students are beginning to form early professional identities that will help them make career choices. At this stage, academic interventions to prepare students for rigorous higher- and post-secondary learning paths have shown to help middle schoolers to enter high school better prepared to graduate on time and with good grades. In this work in progress paper, we present preliminary results of a systematic literature review on the effects of out-of-school STEM activities on sixth-grade students. We used the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method to record our literature search results. Our initial search resulted in 189 articles.

Through our inclusion /exclusion criteria we restricted the results to articles published in the English language during or after the year 2000. Also, we were only interested in articles that were published in peer-reviewed journals, appeared in conference proceedings, or were committee approved master's or Doctoral theses. After the initial screening, we identified 19 quantitative articles, 3 qualitative articles, and 12 mixed-methods articles. Full-text analysis of the 33 articles resulted in the exclusion of 13 quantitative articles, 1 qualitative article, and 4 mixed-methods articles. After inter-rater discussion, we identified 15 articles to be included in the final analyses. The preliminary results from this work in progress, systematic literature review indicate that out-of-school learning environments create more possibilities for applied, hands-on learning that is more impactful and motivating than traditional in-class teaching methods.
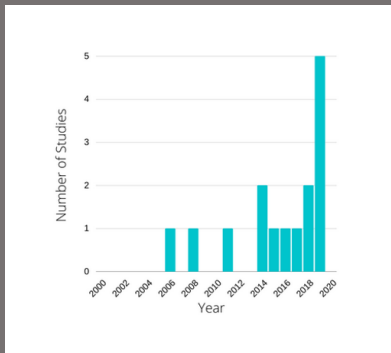
## PRISMA Diagram
**(Preferred Reporting Items for Systematic Reviews and Meta-Analyses)**

Records identified through Google Scholar (n = 189)

↓

Records screened (n = 189) → Records excluded based on relevance (n = 156)

↓

Full-text articles assessed for eligibility (n = 33) → Records excluded based on criteria (n = 18)

↓

Studies included in qualitative synthesis (n = 15)

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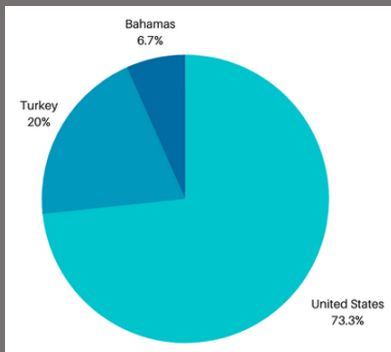Powered by: Texas A&M School of Innovation

## Publication Year

In recent years, more research has been conducted on Middle School STEM education. An indication that the importance of middle school education is becoming more globally recognized.

## Country of Publication

Many of the studies, included in our systematic review of literature, were conducted in the United States. This may prove to be a limitation as educational practices differ between countries.

Bahamas 6.7%
Turkey 20%
United States 73.3%

## Sample Size
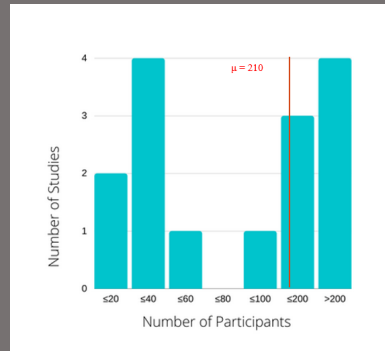
Our studies had a wide range of participants, with a mean of 210. Comparatively Project CHISPA has 38 participants.

$\mu = 210$
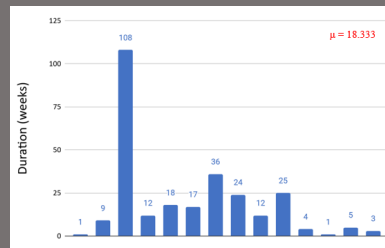
## Duration

The mean duration of the studies is approximately 18 weeks. However, when the outlier (108 weeks) is excluded, the mean duration is 11.928 weeks. Comparatively, the duration of Project CHISPA is 15 weeks.

$\mu = 18.333$

## Perceptions

"The STEM career program POSITIVELY affected the participants' STEM awareness and perceptions of STEM"
Altan et al., 2019 (Journal; pre-post; Turkey) n=24 / duration 1 week / After-School.

"IOS programs, such as the one conducted in their study, can shift students' negative views of STEM and help them to BUILD HEALTHY PERCEPTIONS of the STEM fields."
Rolle, 2018 (Journal, Pre-Post, The Bahamas) n=36/duration 25 weeks/After-School.

## Attitudes

"The findings of this study indicate that as a result of the IOS program, girls had STRONGER ATTITUDES towards gender equity."
Mouza et al., 2015 (Journal; Pre-Post; United States) n=52/ duration 9 weeks/After-School.

"Student participation ENHANCED THE PARTICIPANTS' ATTITUDES towards the activities and skills incorporated in the IOS program"
Reynods, 2008 (Dissertation; Quasi Experimental; United States n = 17/duration 17 weeks/After-School.

## Interests

"Increased exposure to IOS programs have the POTENTIAL TO FOSTER STUDENT INTEREST in STEM fields"
Wortel, 2019 (Dissertation, Quasi-Experimental, Afterschool) n = 80/duration 24 weeks/After-School.

"The findings provide indication that IOS programs have the POTENTIAL TO FOSTER STUDENT INTEREST in STEM fields"
Sabin et al., 2014 (Journal; Case Study; United States) n=146/duration 12 weeks/After-School

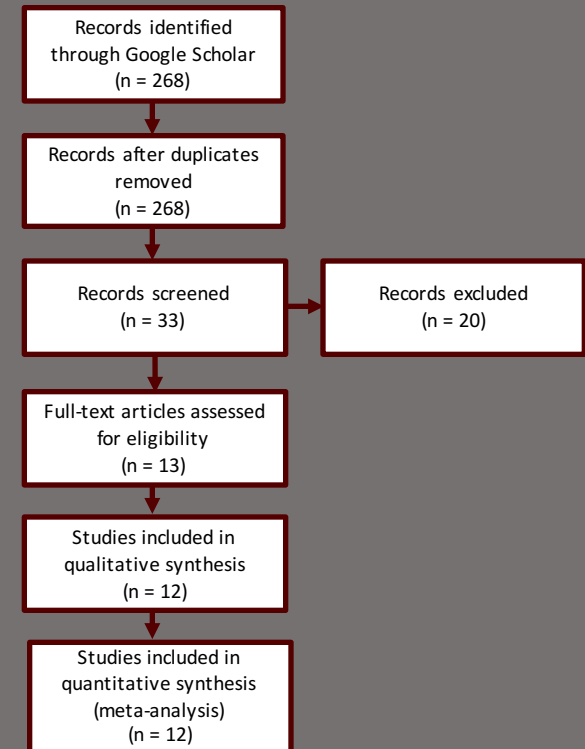# TEXAS STEAM NETWORK TO EMPOWER MIDDLE SCHOOL STUDENTS

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## Effects of STEM/STEAM Activities on Middle School Student Attitudes, Beliefs, and Perceptions of Learning and Career Paths: A Systematic Literature Review

Vinisha Vasan and Ria Sharma

Hispanic, Native American, and Black students are underrepresented in STEM/STEAM coursework and are more likely to drop out of STEM/STEAM degree programs in comparison to their Asian and White peers. Our findings suggest this has little to do with intellectual capabilities and everything to do with the students' attitudes, beliefs, and perceptions of STEM/STEAM careers. Research suggests the two main reasons for students' apathy towards STEM/STEAM learning and career pathways are a lack of qualified instructors and innovative learning opportunities.

We introduce the preliminary results of a systematic literature review on the effects of innovative STEM/STEAM activities on career perceptions of underrepresented middle school students. We utilized the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method to conduct this systematic review. Using our inclusion/exclusion criteria we restricted the results to articles published in the English language during or after the year 2000. Only the articles that were published in peer-reviewed journals, appeared in conference proceedings, or were committee approved Masters or Doctoral theses were considered for further review. The inter-rater discussion resulted in the identification of 12 articles for inclusion in the final analysis. Our initial findings indicate that STEM/STEAM Activities foster a deeper interest and improved attitudes towards STEM/STEAM careers in middle school students.
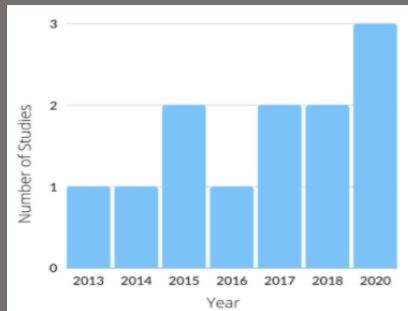
## PRISMA Diagram
(Preferred Reporting Items for Systematic Reviews and Meta-Analyses)

Records identified through Google Scholar (n = 268)

↓

Records after duplicates removed (n = 268)

↓

Records screened (n = 33) → Records excluded (n = 20)

↓

Full-text articles assessed for eligibility (n = 13)

↓

Studies included in qualitative synthesis (n = 12)

↓

Studies included in quantitative synthesis (meta-analysis) (n = 12)

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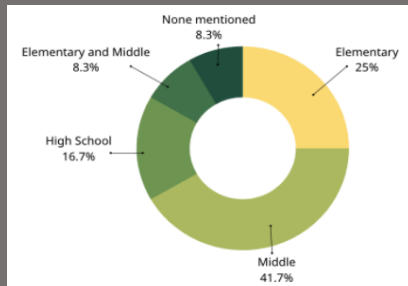# TEXAS STEAM NETWORK TO EMPOWER MIDDLE SCHOOL STUDENTS

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## Publication Year



In recent years, the frequency of research conducted surrounding STEM education has increased. This may indicate the importance of middle school education in becoming more globally recognized.
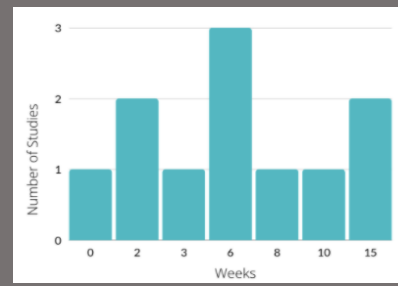
## Grade Level



Most of the literature reviewed conducted the research in a middle school setting. Similarly, Project CHISPA works with Middle School students (5th-8th grade)

## Factors Assessed
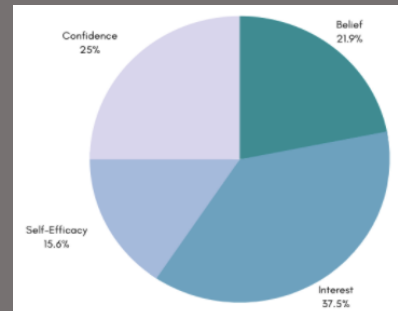


This graphic shows what percentage of literature reviewed used the above factors (confidence, belief, self-efficacy, and interest) to assess results in students.

## Duration



Many of the studies conducted spanned a duration of 6 weeks. In comparison. Project CHISPA conducted workshops with students for 15 weeks.

## Main Findings

"A web-based interactive program IMPROVED MOTIVATION in low-motivated and low-academically achieving Hispanic middle school students"
Whorrall, 2018 (Dissertation; Quasi-Experimental) duration 8 weeks / Middle School.

"The education program with active learning had a more POSITIVE IMPACT on beliefs of all students and skills of students that are underrepresented by race or ethnicity."
Stubbs, 2016 (Dissertation; Quasi-Experimental) duration 6 weeks.

"There is a POSITIVE CORRELATION between students who could consider a science career throughout duration of an after-school science program."
Hill, 2013 (Dissertation; Pre-post) duration 30 weeks/High School.

"Participation in a robotics program led to high-achieving students to exhibit a STRONG DESIRE to enroll in advanced math and science courses."
Burt, 2014 (Dissertation, Quasi-Experimental) duration 6 weeks/Middle School

"The use of art and animation while teaching programming INCREASED MOTIVATION in students to write and share more code."
Jawad, 2018 (Dissertation; Experimental) duration 10 weeks/ High School.

"The use of art and animation while teaching programming INCREASED THE STUDENTS' MOTIVATION to write and share more code"
Ventresca, 2020 (Dissertation, Pre-post) 2 weeks/ Elementary school/

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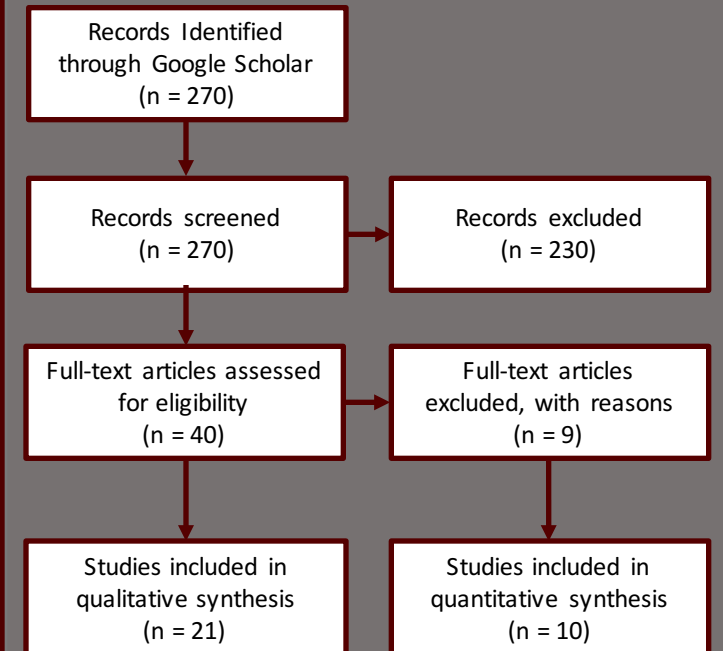## Near-Peer Mentoring in STEM/STEAM Education: A Systematic Literature Review

Alexander Ling

The professional and post-secondary STEM and digital arts landscape lacks diversity. Students who identify as Hispanic, Black/African American, Native American and those students who belong to low-SES families are less likely to choose and survive in the STEM pipeline. Research suggests many reasons for these disparities including a lack of innovative new teaching and learning techniques to improve students' perceptions and attitudes towards careers in STEM and digital arts. Near-peer tutoring has shown promise in improving students' academic outcomes and attitudes towards targeted outcomes. This innovative new social learning approach has shown potential to improve K-12 students' academic outcomes.
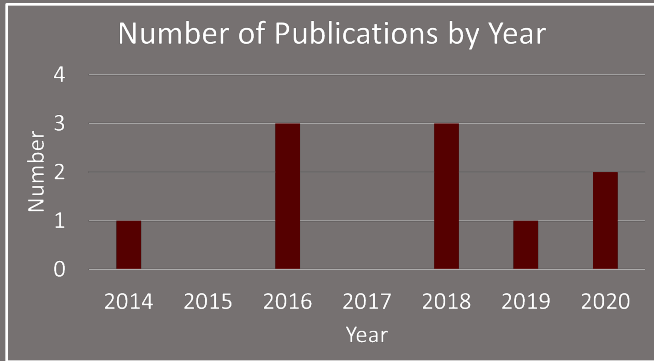
In this poster we present the initial findings from a PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guided systematic literature review. Our initial search resulted in 270 articles that were published during or after 2000. We further restricted our search to articles that were published in English language and were either peer-reviewed journal articles, conference proceedings; or were committee approved master's or doctoral thesis. Initial screening of the articles resulted in exclusion of 230 articles. We screened the remaining 40 relevant articles and found 10 quantitative articles to be included in the final meta-analysis. We also found 21 qualitative papers to be included in the systematic literature review. Initial analyses indicate that near-peer mentoring has a positive effect on students' attitudes, perceptions and beliefs along with an improvement in their STEM academic achievements.

## PRISMA Diagram
(Preferred Reporting Items for Systematic Reviews and Meta-Analyses)

Records Identified through Google Scholar (n = 270)

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Records screened (n = 270) → Records excluded (n = 230)

↓

Full-text articles assessed for eligibility (n = 40) → Full-text articles excluded, with reasons (n = 9)

↓

Studies included in qualitative synthesis (n = 21)    Studies included in quantitative synthesis (n = 10)

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**Number of Publications by Year**

Of all articles included in the studies, the oldest study was published in 2014, suggesting that the topic is relevant.



**Histogram of Sample Sizes**
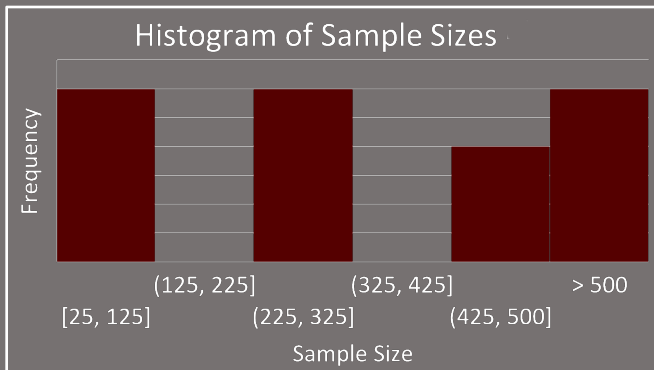
The studies looked at had varying sample sizes, with no defined "best" or most common sample size.



**Histogram of Study Durations**
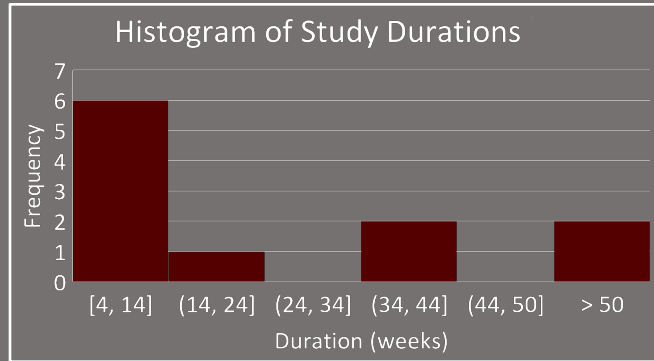
Most studies had short durations, with over half of them in the 4-14 week range. This is due to conducting the study during a school semester.



**Percent of Studies Containing Elementary, Middle, High or Post-High School Mentees**
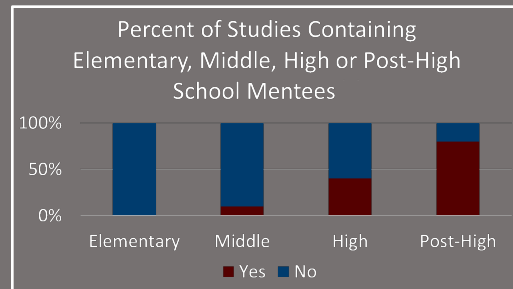
The majority of the studies involved post-high school students, yet few involved middle school students. While this is a good place for us to contribute, it would be nice to see more research conducted on non-post-high school students.

## Key Positive Findings

"Across all grade levels, there was an increase in the mean level POSITIVITY towards STEM. 11th grade, in particular, had the greatest difference."
Dotson et al., 2020

"Students who participated in Project PATH had a GREATER MEAN OF PROFESSIONS they were interested in compared to the control school and before they were involved in the project."
Seng, 2014

"Students who participated in the intervention course performed better than those who did not. It was also noted that students in the intervention course did have a GREATER SENSE OF BELONGING."
Wilton et al., 2019

"The better the quality of the student-mentor relationship, the more students' attitudes toward MOTIVATION AND SELF-EFFICACY around college increased."
Woods & Preciado, 2016

## Key Negative/Neutral Findings

"There was NO SIGNIFICANT INCREASE in students' perceptions and attitudes towards I-STEM fields from pre to post test."
Rosenzweig et al., 2016

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## CHISPA Leadership Team

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College of Engineering

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Harold L. Adams '61 Interdisciplinary Professor in Visualization

**Tim McLaughlin,** Associate Professor
College of Architecture, Department of Visualization

**Kim Wright**, Assistant Research Scientist
College of Education and Human Development, Education Research Center

**Sinjini Sengupta**, Instructional Assistant Professor
College of Science, Department of Mathematics

**Shinjiro Sueda**, Assistant Professor
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College of Architecture, Department of Visualization

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