



The road to research

By Victor M Garcia, PhD, EIT
US Army Engineer Research and Development Center

Who is Victor?



Appointment

- Research Civil Engineer at ERDC Airfield and Pavements Branch (2021)
- Post-doc Researcher at UTEP CREATE (2021)

Education:

- BS (2014), Civil Engineering, UTEP
- MS (2016), Civil Engineering, UTEP
- PhD (2020), Civil Engineering, UTEP

Research Interests:

- Engineering properties of paving materials
- Recycling techniques for asphalt pavements
- Airfield pavement evaluations
- Nondestructive testing methods
- STEM education



Agenda for This Presentation

01

Intro to Research

Why is undergraduate research important?

02

Identify Research Gaps

What topic(s) should I focus my research on?

03

Design Research Plan

What type of research do I need to accomplish my goals?

04

Interpret Research

How can I highlight the importance of my research?

05

Disseminate Research

No proof, no existence?



Intro to Research

What is research?

“a systematic process of investigating a topic or subject”

“the process of discovering solutions”

“critical inquiry to learn new aspects of a topic or subject”

“innovative work to increase the body of knowledge”



Undergraduate Research

Academic Benefits:

- Deeper understanding of subjects
- Critical thinking development
- Problem-solving skills
- Writing and communication skills

Career Advantages:

- Professional marketability
- Graduate school opportunities
- Industry relevance
- Relationships with faculty mentors



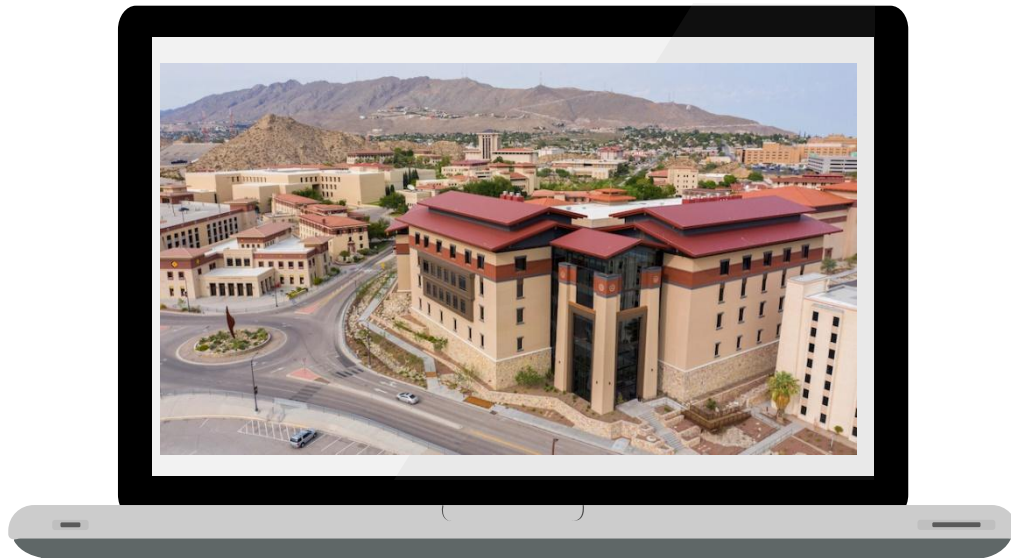
Personal Growth:

- Intellectual curiosity
- Confidence building
- Perseverance and sense of accomplishment/success



CREATE

Center for Research in Engineering and Technology Education



WE inspire

But,

Our com

Education...

ucceed



How are we going to prepare you?

THROUGH RESEARCH!!

You will embark on a research experience that will help you exercise your mind and body.

We will support you along the experience, but we will let you lead the road to accomplish your goals.

You and only YOU will know more about your research.

✓ Identify a research gap

✓ Select a research topic

✓ Design your research

✓ Execute research plan



Identify Research Gap



Select a topic or question that motivates you



Find keywords and related terms to your selected topic



Look for topics or issues that are missing or not addressed within (or related to) your main topic



Read systematic reviews

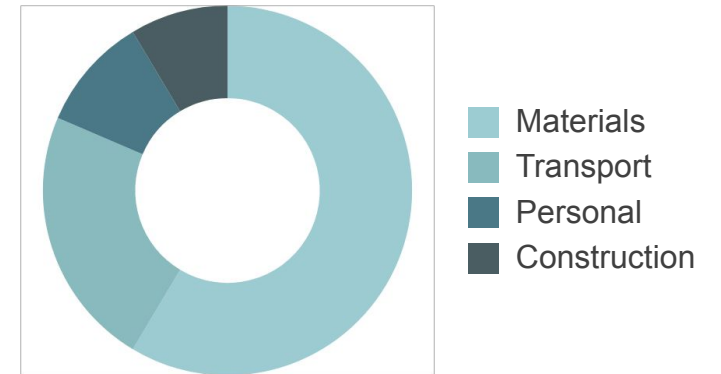
Challenges:

2020 ~ 2021 Need access to pavements in remote locations

2021 ~ 2022 Lack of guidelines for the reconstruction of pavements

2022 ~ 2023 Only access to small-footprint construction equipment

DOD Pavement Reconstruction Cost Allocation



Proposal for the US Air Force on *Developing Guidelines and Construction Practices to Restore Structural Capacity of Airfield Pavements in Strategic Theaters*

Full Depth Reclamation

Motivation



Lack of Training



Limited Access



Remote Locations



Poor Condition



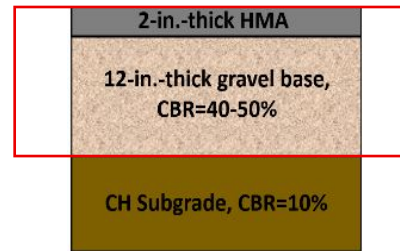
Expensive Aircrafts

Need for Research



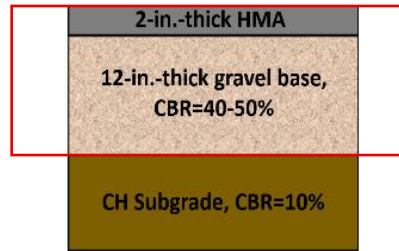
Full Depth Reclamation

Approach



Full Depth Reclamation

Approach



Full Depth Reclamation

Approach



	2-in.-thick HMA	
	12-in.-thick gravel base, CBR=40-50%	
	CH Subgrade, CBR=10%	



(a) Initial compaction with pneumatic tire roller



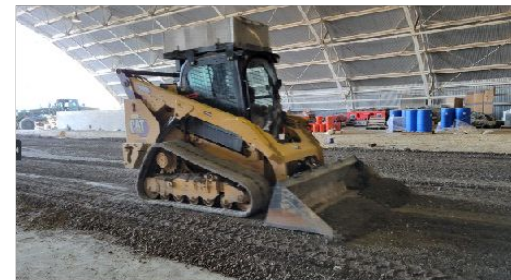
(b) Test section during initial compaction



(c) Field density testing during compaction



(d) Grading with a motor grader



(e) Surface correction with skid steer



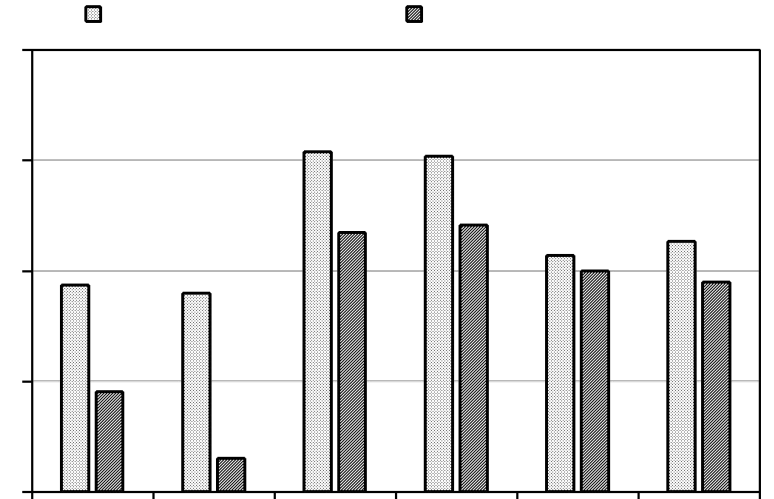
(f) Final compaction with steel drum roller

Full Depth Reclamation

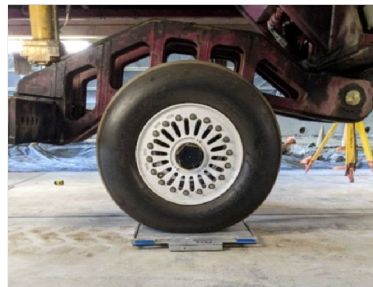
Results



ERDC's Heavy Vehicle Simulator for
P-8 Aircraft Testing Research Program

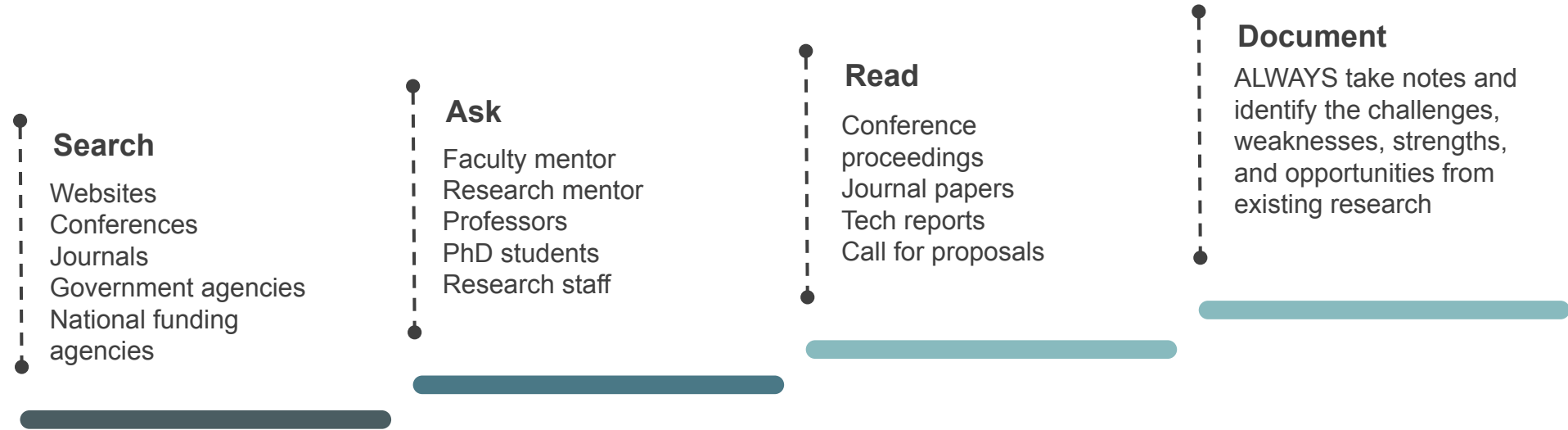


(a) Front view



(b) Side view

Conventional Approach



You are ready to select a topic!!

- It is important to consider your interests too. What topics, subjects, disciplines, or fields motivate you?

Invest quality time doing a literature search/review

Literature Review

What should I be doing...



Topic/Title: Exploring Integrated Peer and Reverse Mentoring in Engineering Education

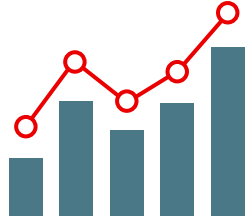
Keywords: Mentoring, Peer Mentors, Engineering Education, Hispanics, First-year Students

Subsections:

- First Year Engineering Students
- Impact of Peer Mentoring
- Impact of Reverse Mentoring
- Benefits of Dual-Form Mentoring
- Research Gaps or Relevance of Your Research

VICTOR MANUEL!!

**Do not forget to
show an example...**



Lit Search and Review

My first choice to
collect papers is...

Google Scholar

Google Scholar

☒ Articles ☐ Case law

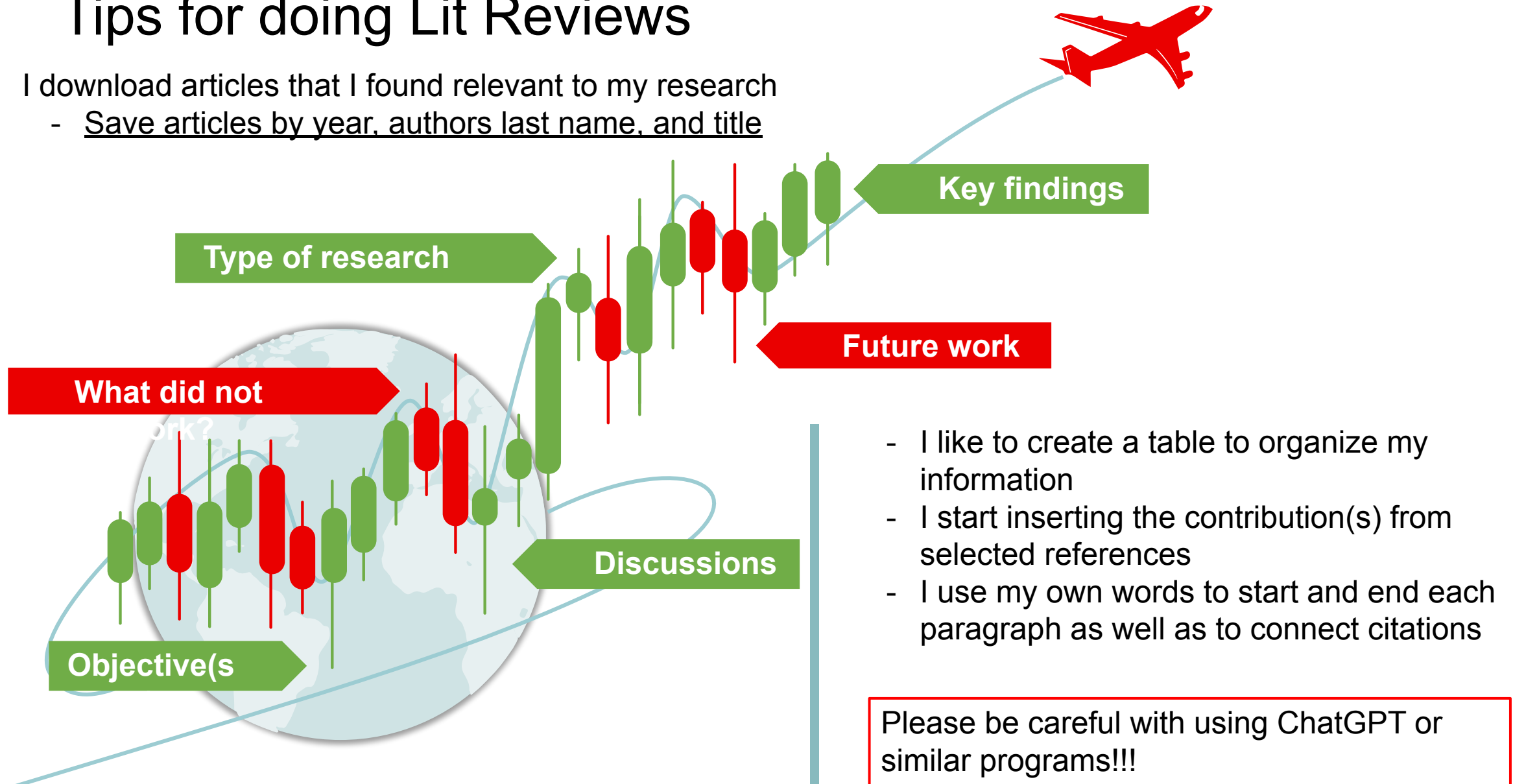
Recommended articles



- ☆ Graph neural network-based 3D asphalt concrete pavement response modelling
F Liu, IL Al-Qadi
International Journal of Pavement Engineering - 5 days ago PDF
- [More articles from 5 days ago](#)
- ☆ Effect of Warm Mix Additives on the Properties of Unmodified and Polymer Modified Asphalt Binders
M Sukhija, N Saboo, A Pani
Transportation in Developing Economies - 6 days ago
- [More articles from 6 days ago](#)
- ☆ Fatigue and age-related cracking performance of asphalt mixes containing RAP, RAS and recycling agents (RA)
MA Rahman, A Mateos, JT Harvey, J Buscheck, J Brotschi, DJ Jon...
Construction and Building Materials - 12 days ago HTML
- ☆ Stepwise filling method for predicting the dynamic modulus and creep behavior of asphalt mixtures
T Liu, H Wang, Y He, L Lyu, J Zhang, J Pei
Construction and Building Materials - 12 days ago HTML
- ☆ Component-based damage characterization of asphalt mixtures considering binder rheological indexes and aggregate morphology
AJ Enríquez-León, ML Rocha, PH Osmari, LFM Leite, LM de Barro...
Construction and Building Materials - 12 days ago HTML

Tips for doing Lit Reviews

- I download articles that I found relevant to my research
 - Save articles by year, authors last name, and title



- I like to create a table to organize my information
- I start inserting the contribution(s) from selected references
- I use my own words to start and end each paragraph as well as to connect citations

Design your Research

What type of research do I need to do?
Basic? Applied? Experimental? Field or Lab? Mixed?



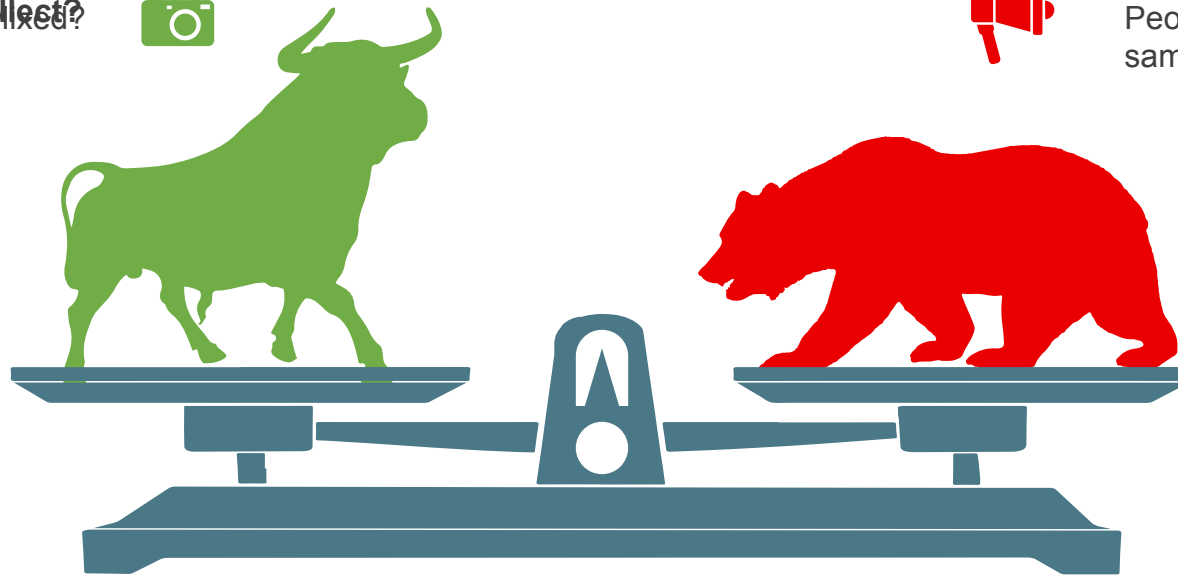
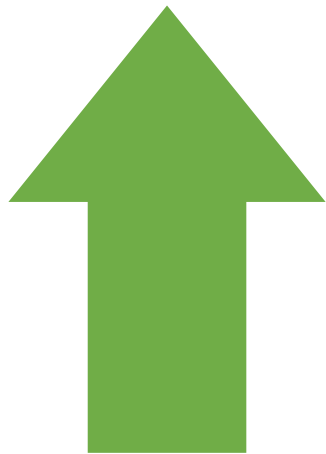
What type of data do I need to collect?
Qualitative? Quantitative? Mixed?



What data collection do I need?
Surveys? Interviews? Observations? Focus groups? Experiments? Social media monitoring?



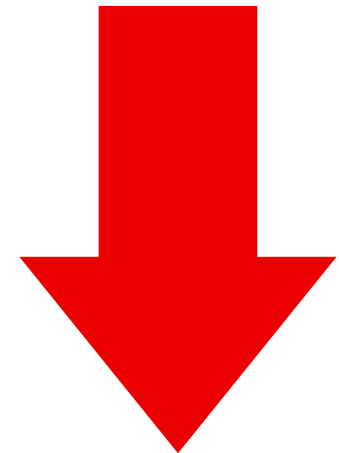
What are my sources of data?
People? Animals? Lab specimens? Field samples?



Qualitative

Quantitative

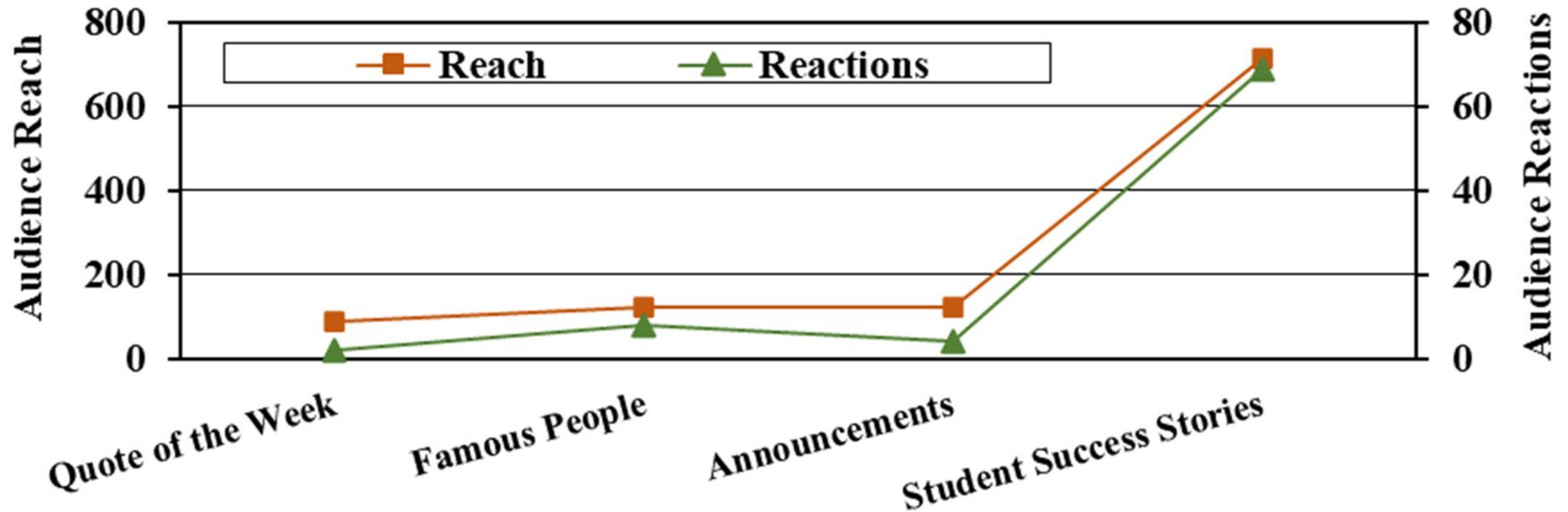
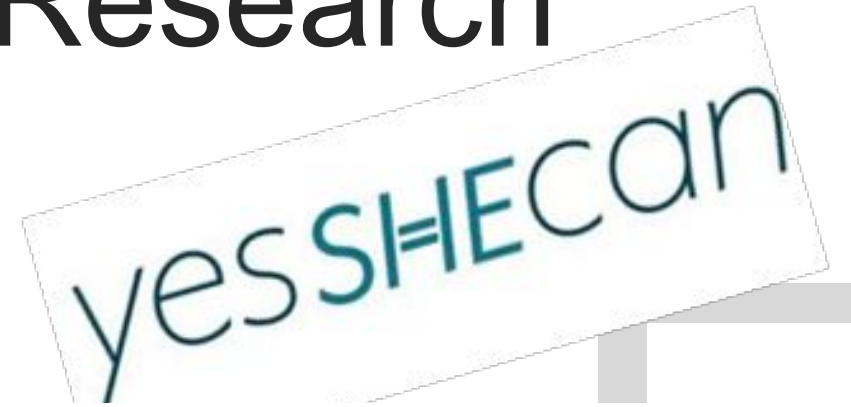
Mixed



Example of CREATE Research

Topic/Title: Inspiring Academic Engagement and Motivation of Minority College Students through Transformative Success Stories in Social Media

We wanted to explore the impact of social media



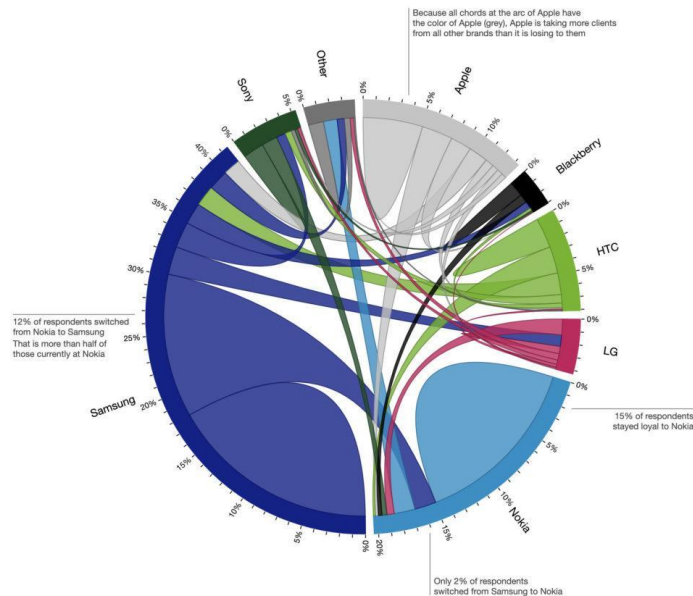
Data Interpretation

How can you visualize/interpret your data to achieve your research goals?



Visualization versus Interpretation

Data visualization is the presentation of data graphically for better and faster analytics and communication of business insights



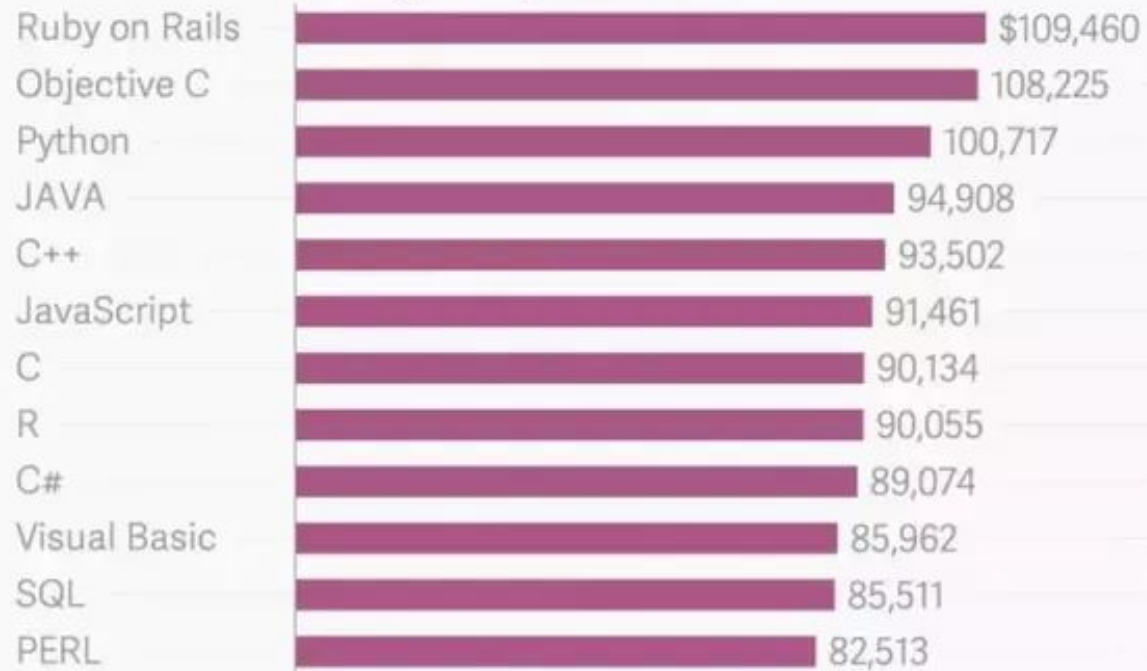
A process of reviewing data and arriving at relevant conclusions using various analytical research methods



Example of Data Visualization

The most valuable programming skills to have on a resume

Average salary value of skill



Quartz | qz.com

Data: Brookings/Burning Glass

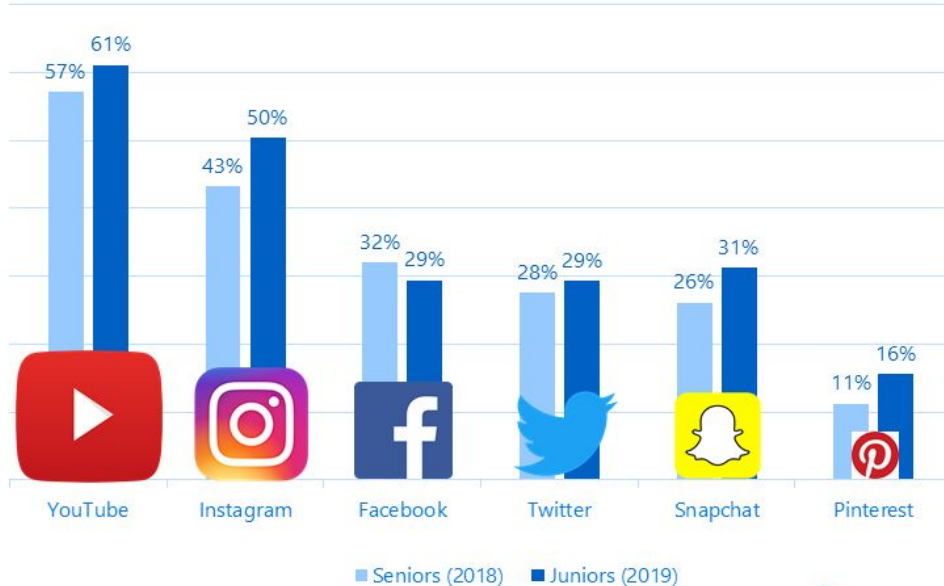
Statement: Ruby on Rails is a programming skill that can be used for any software development

Example of Data Visualization

encoura™

Eduventures® Research

Channels **ever** used for researching colleges by prospective students: YouTube, Instagram, Facebook & Twitter



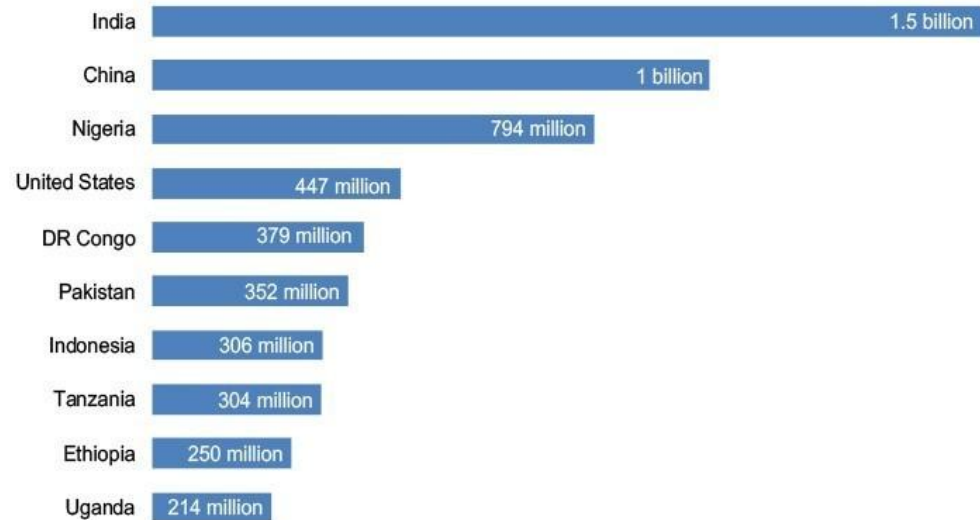
2018 Eduventures Student Sentiment Survey® (n=4,741) – data visualization by [higherexperts.com](https://www.higheredexperts.com)

Statement: YouTube is the easiest channel to use by college students

Example of Data Visualization

These will be the world's biggest countries by population in 2100

Figures are rounded to the nearest million based on UN data



Source: UN

Statement: India will be the best country to live in 2100

Disseminate your Research

No proof, no existence!



Presentations at conferences or symposiums, for sponsors, for the university, for research group or research mentor



Research Paper



What information do you need to develop a research paper?

- 1) Title
- 2) Introduction
- 3) Lit Review
- 4) Objective
- 5) Methodology
- 6) Results
- 7) Conclusions
- 8) Recommendations

You should already have information relevant that can be used for these parts of the paper if you conducted your research project...

Do not forget to show examples

Reflecting on my first research experience



- ✓ Started my experience when I was a senior student (CE department)
- ✓ Did research for the Center for Transportation Infrastructure Systems under Dr. Nazarian
- ✓ Developed a research paper for the Transportation Research Board Minority Fellowship Program
- ✓ Was motivated to complete a Master's degree
- ✓ Won a national fellowship from the Federal Highway Administration to pay for my PhD program
- ✓ Met Dr. Diane Golding during my last year as a PhD student and engaged in STEM education research.
- ✓ Offered opportunity by Dr. Peter Golding to be part of CREATEs



My undergraduate research experience was

The opportunity to start my career as a civil engineer and researcher



Thank you
for your
attention!