

# Let Us Start Research Experience at Freshman Level

Christian Servin<sup>1</sup>, Olga Kosheleva<sup>2</sup>,  
Vladik Kreinovich<sup>3</sup>  
*(with audience suggestions)*

<sup>1</sup>El Paso Community College  
El Paso, Texas 79915, USA  
cservin@gmail.com

<sup>2</sup>Departments of Teacher Education

<sup>3</sup>Department of Computer Science  
University of Texas at El Paso  
El Paso, Texas 79968, USA  
olgak@utep.edu, vladik@utep.edu

## 1. Plan

- First, we share our experience of actively encouraging freshman Computer Science students from EPCC to engage in research.
- In our experience, active participation in developing new ideas:
  - enhances their academic efforts,
  - boosts their self-esteem, and
  - widens the graduate school pipeline.
- Of course, a lot of what we do is specific for Computer Science.
- So, after our introduction, we invite all the participants:
  - to share their experiences of engaging freshmen in research, and
  - to brainstorm on the best practices of such engagement.

## 2. Undergraduate Research Is Helpful

- Universities (including UTEP) and funding agencies strongly encourage involving undergraduates in research.
- This helps students understand the need for studying breadth courses that many students perceive as unrelated (e.g., math for CS folks).
- It boosts students' self-esteem when they contribute to new discoveries: every paper is a world record.
- It motivates them to join graduate programs.

### 3. Undergraduate Research: Limitations of the Usual Approach and What We Encourage

- There are a few top schools that encourage student research engagement from the moment they start their studies.
- However, usually, students' involvement with research starts at junior or senior level.
- We believe that all schools should encourage research experience at freshman level.

## 4. How We Do It

- Many UTEP students take their freshman classes at EPCC.
- So, starting in 2015, EPCC CS educators have started – in collaboration with UTEP – teaching research elements at the freshman level.
- In the very first lectures, students are:
  - exposed to exciting advanced research topics and
  - encouraged to attend the meetings of the corresponding Affinity Research Groups.
- Yes, this takes time.
- But this nurtures good future graduate students – and it saves time in the long run.
- This is similar to money: to make money, you need to spend money.

## 5. Successes: Bragging Part

- This practice succeeded way beyond our expectation.
- More than 20 students went through this program.
- Most of them continued to do research after joining UTEP.
- 16 of them became undergraduate co-authors of serious research publications.
- Let us all join this effort!

## 6. Floor Is Open for Discussions

- Our plan is to ask participants:
  - what discipline they represent and
  - how, in their opinion, students from their discipline can be engaged in freshman-level research.
- Our preliminary experience is that quite a few instructors are doing this already.
- So we expect that we – and others present at this session – will learn from these experiences.
- At the end of this session, we plan to leave time:
  - to summarize what we all learned and
  - to form a working group.

## 7. Why Involve Undergraduate Students in Research: Suggestions from the Audience

- Growing your own students is a perfect way to get good graduate students.
- This is much more effective than letting your undergraduate students leave and try to recruit graduate students elsewhere.
- Most research students perform better academically, since they better understand the need for all required classes.
- Creativity – important part of research – is a valuable asset even if a student does not go into the academia.



## 8. How to Encourage Undergraduate Students to Participate in Research: Suggestions from the Audience

- Send individual emails to top students in undergraduate classes encouraging them to do research.
- Emphasize research opportunities during advising.
- Mention research and teach elements of research techniques in as many regular classes as possible.
- Explicitly mention remaining open problems in regular classes.
- Periodically organize research tutorials.
- Have special research-methods classes for undergraduate students.
- Get students excited about research – e.g., at seminars.
- Come up with flashy names for research areas and research topics.
- Provide detailed, convincing, easy-to-understand motivations for research topics.

## 9. How to Successfully Mentor Undergraduate Research Students: Suggestions from the Audience

- Select a project that is doable.
- Relate the research topic to classes that students are taking.
- Teach students that failing is part of research.
- Teach students to be independent researchers.
- Help students to be patient when entering a ten-year Bachelor's-Master's-PhD research training.

## 10. What We Expect from a Working Group

- This working group will try to develop general guidelines for applying this idea.
- These guidelines should be as general as possible – beyond CS to general STEM and even beyond STEM.

## 11. Acknowledgments

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- **Oscar Galindo**, Olga Kosheleva, and Vladik Kreinovich, “How to Efficiently Store Intermediate Results in Quantum Computing: Theoretical Explanation of the Current Algorithm”, In: Songsak Sriboonchitta, Vladik Kreinovich, Woraphon Yamaka (eds.), *Credible Asset Allocation, Optimal Transport Methods, and Related Topics*, Springer, Cham, Switzerland, 2022, pp. 51–64.

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- **Javier Tellez**, Weibo Xie, and Vladik Kreinovich, “Commonsense ‘And’-Operations”, In: Martine Ceberio and Vladik Kreinovich (eds.), *Decision Making under Uncertainty and Constraints: A Why-Book*, Springer, Cham, Switzerland, 2022, to appear. [pdf file](#)

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### 43. Where Are They Now?

- Kevin Alvarez – completed BSc, working on MSc
- Pedro Barragan Olague – working for USAA, financial services company
- Daniel Cervantes – working in Houston
- Chris Cuellar – working at Sandia National Lab
- Oscar Galindo – Creative Director at Apple Inc.
- Sebastian Gonzalez – Software Applications Developer at Texas A&M AgriLife
- Reynaldo Martinez – working at Microsoft in Charlotte
- Gerardo Muela – working at CISCO, Chicago
- Salamah Salamah – Professor and Department Chair, University of Texas at El Paso

#### 44. Where Are They Now (cont-d)

- Abraham Saldana – working for United States Air Force
- Nick Sims – MS in Computer Science Student at UTEP
- Jesus Tovar – IT specialist at Socorro Independent School District