Techniques for Engaging Your Interdisciplinary STEM Graduate Students

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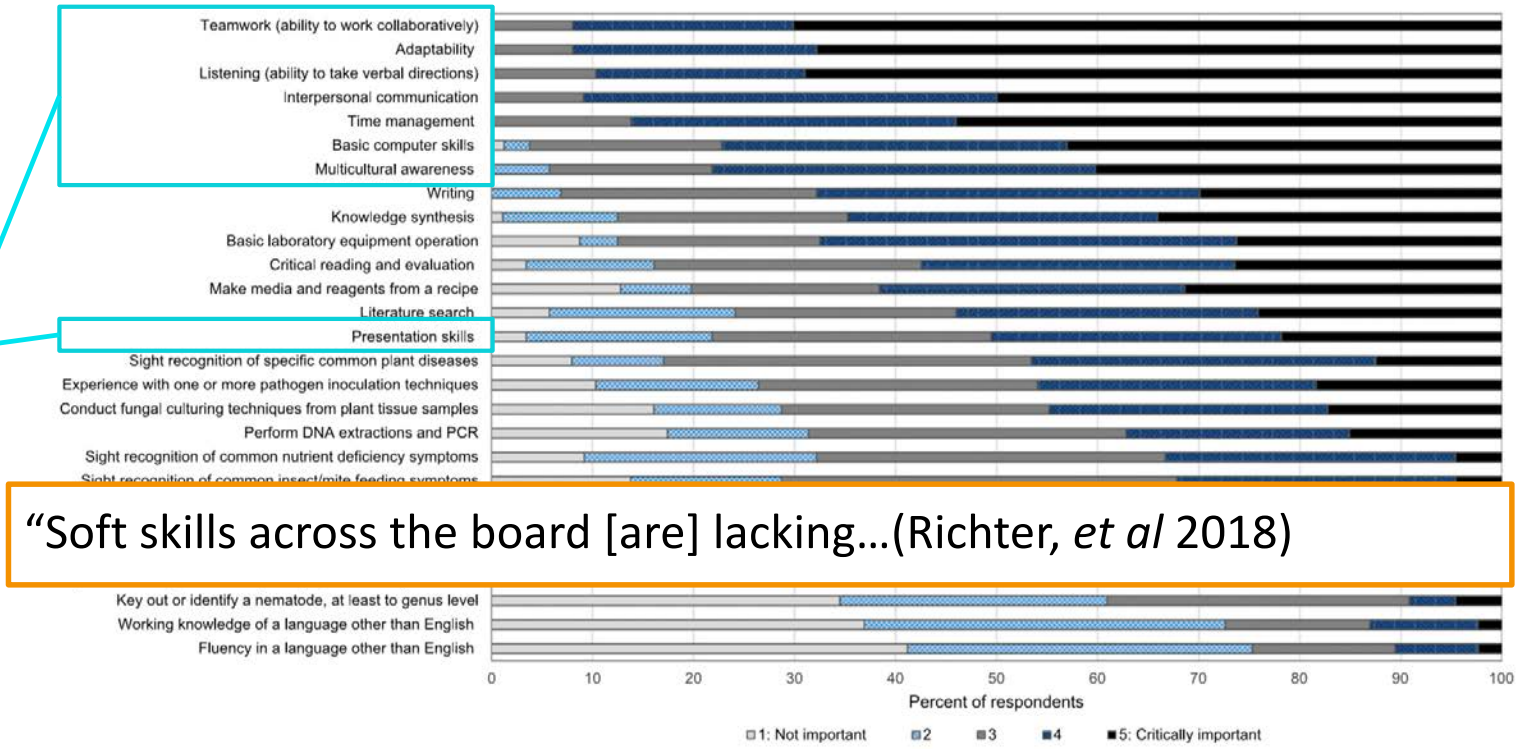
Adequate Professional Development is Essential

- Teamwork
- Adaptability
- Listening
- Interpersonal Communication
- Time Management
- Basic Computer Skills
- Multicultural Awareness
- Presentation Skills



"Soft skills across the board [are] lacking…(Richter, *et al* 2018)

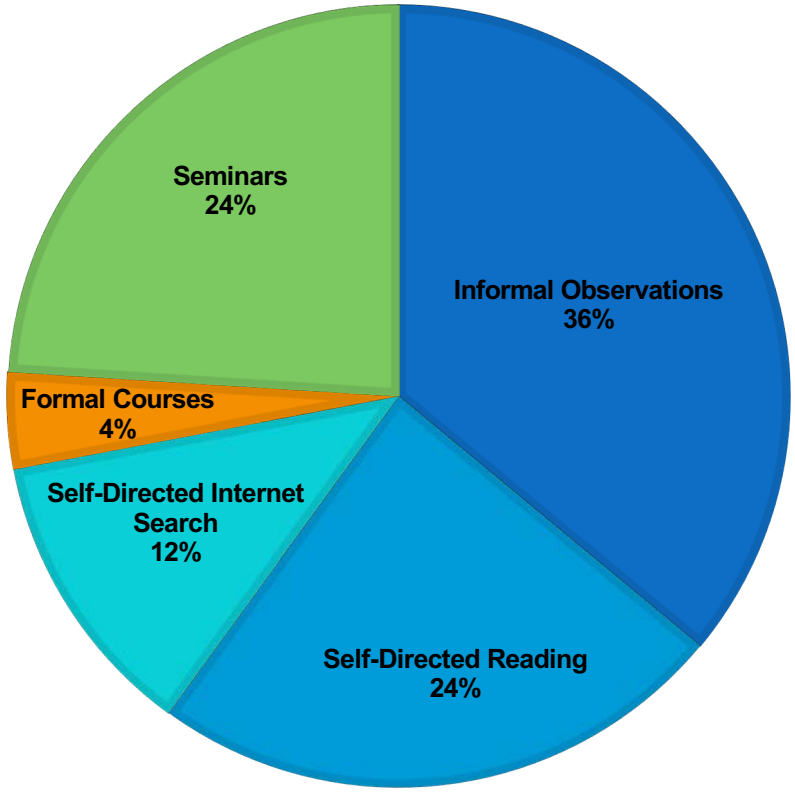
Fig. 7. Skills employers would like to see at the time of hire in entry-level employees entering with a BS degree, whether or not the employee has completed one or more plant pathology courses. Content areas are listed in descending order by mean expectation.

Richter, B.S., Poleatewich, A., Hayslett, M. and Stofer, K., 2018. Finding the Gaps: An Assessment of Concepts, Skills, and Employer Expectations for Plant Pathology Foundational Courses. *Plant disease*, *102*(10), pp.1883-1898.

Current Professional Development Falls Short

4% of Soft Skills are from **Formal Courses**

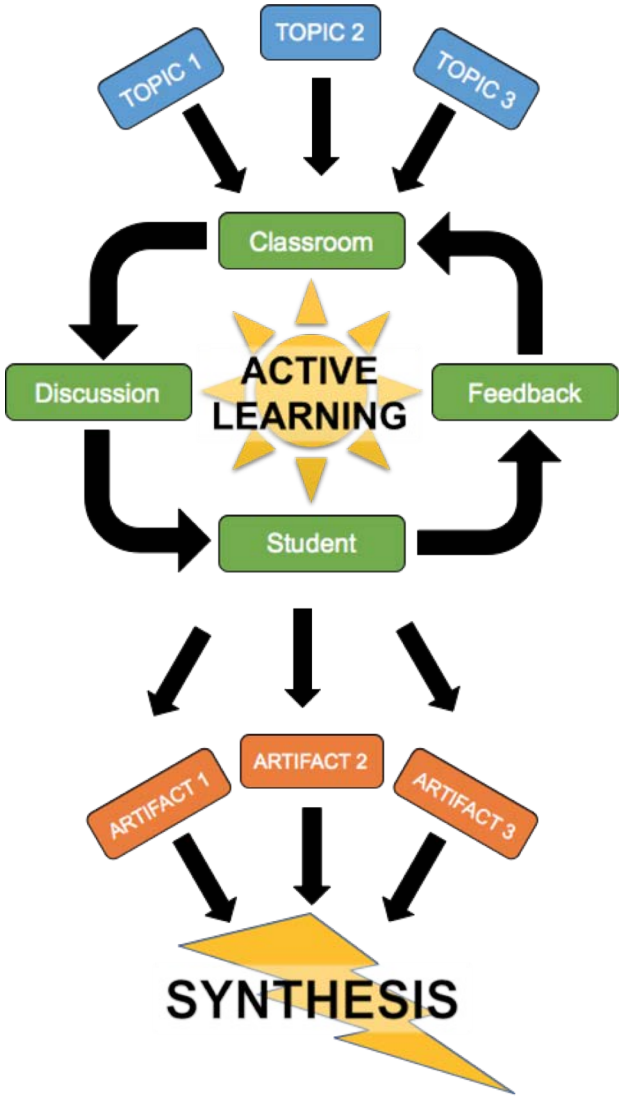
72% of Soft Skills are **Self-Taught**



Data from Beckerman, J. and Schneider, W., 2016. Mining the Gap: Assessing Leadership Needs to Improve 21st Century Plant Pathology. *Plant disease*, *100*(12), pp. 2349 - 2356.

Filling the Gap

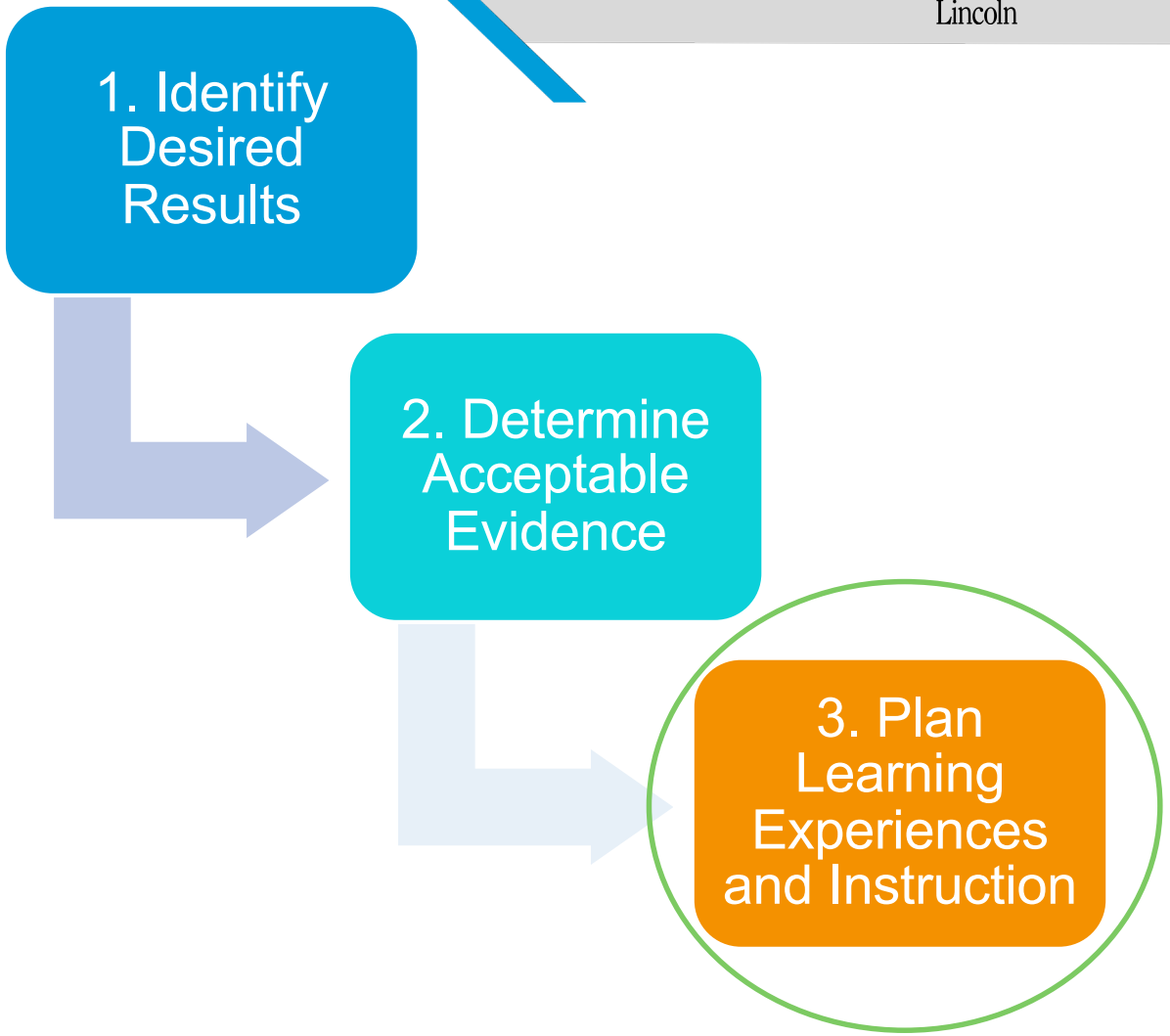
- **Course Developed:** Success in the Sciences
- **Design Team:** Assistant Professor and 2 Graduate Students
  - Synergistic collaboration, with multiple weekly and *ad hoc* meetings
- <u>Active learning</u> used to address employer-identified skill deficiencies



Course Design

This approach emphasizes:

- Long-term goals of the course
- Student-centered outcomes
- Learning over Teaching



Techniques

- Course Design: Sticky Wall & Dot Prioritization
- Engagement:
  - Peer-Instruction
  - Jigsaw
  - Gallery Walk
  - Rubric Development
  - Sequence Chains
  - "Field" Trips
- Reflection: Reflective Writing, Minute Papers, Summative Project

Application of rubric development:

"What makes a "good" scientific story?

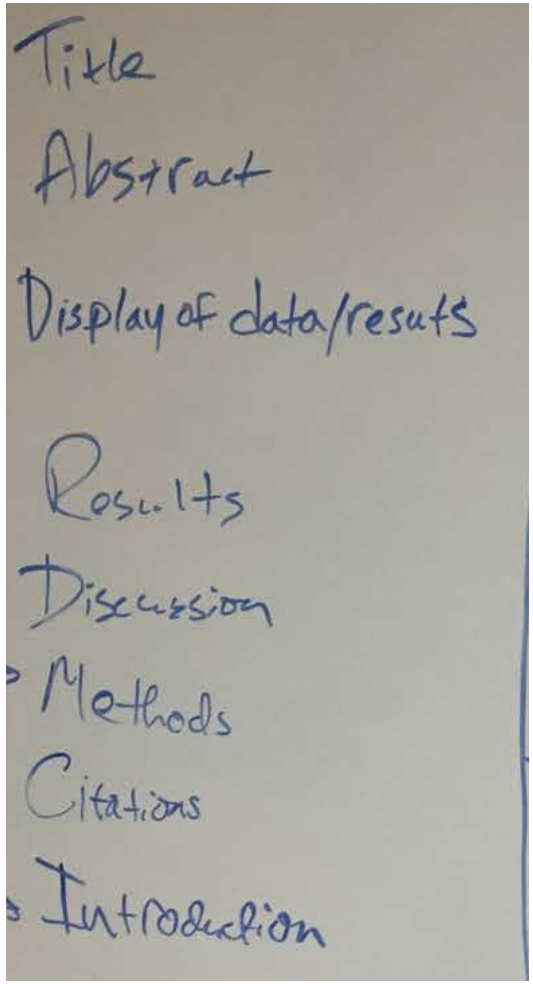
The Importance of a "Good" Story

- Writing scientific stories is crucial to achieving success
- What makes a good scientific story?
  - There are several measurements:

- A "good" scientific story means different things to different fields and different applications.

Student Thoughts on Scientific Stories

- We asked students which parts of a scientific story could be evaluated for quality
- Expected: Students to identify high level things like novelty, flow, experimental design
- Reality: Students identified traditional sub-sections in scientific literature

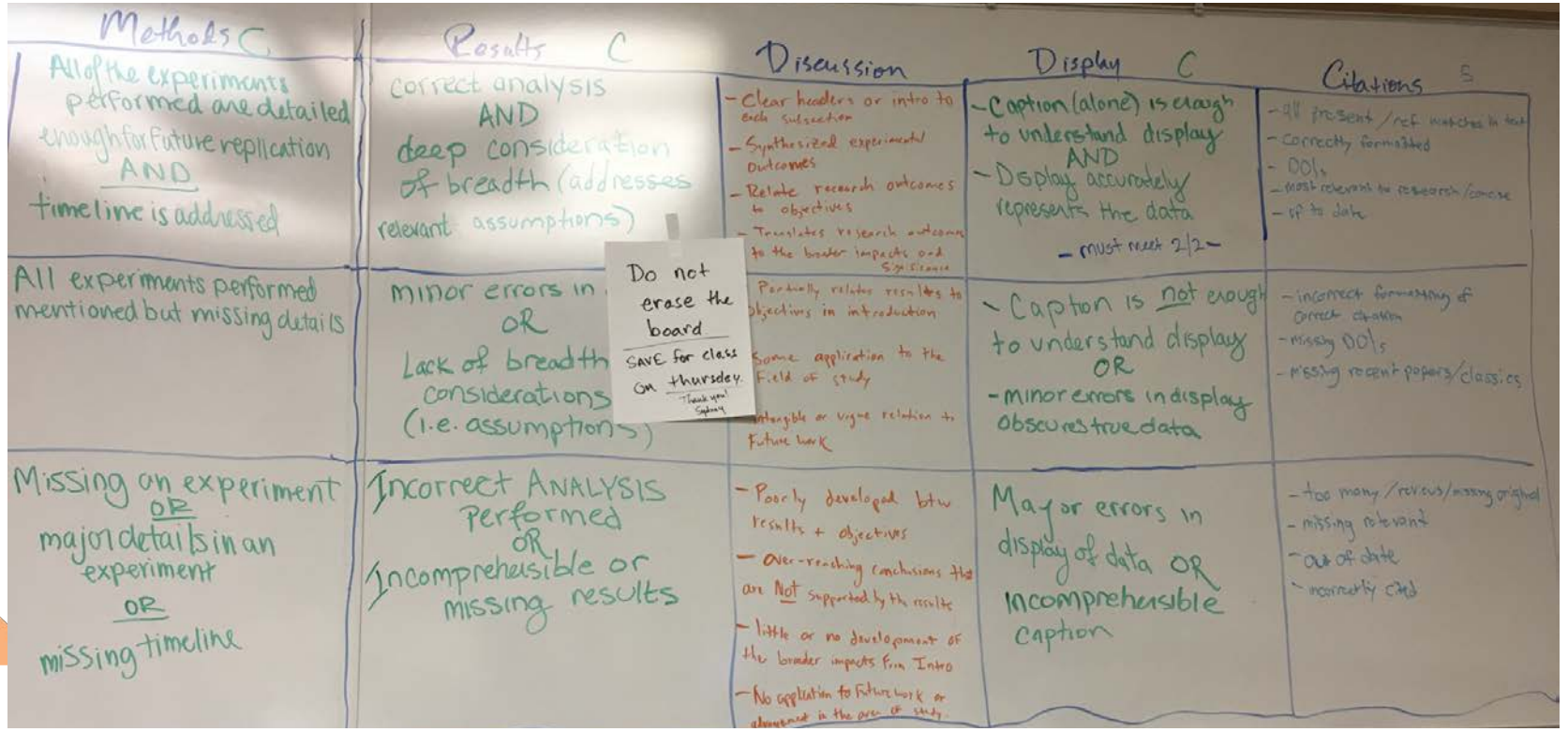


Modified Gallery Walk

- Three groups, collaboratively developed descriptions of quality

Modified Gallery Walk

- Groups rotated through all sections, provided comments



Summary of Rubric 1.0

- Students developed an analytic-trait based rubric with separate categories for traditional paper sections
- Each section could earn a score of 3, 2, or 1

Class Developed Rubric - PLPT892 - Fall 2018

	Title	Abstract	Introduction	Methods	Results	Discussion	Display	Citations
Weight	7	8	20	10	15	20	15	5
3	Gives premise without giving away ending	Summarizes important points	Well developed background	All experiments performed are detailed enough for future replication	Report statistically relevant values	Clear headers or intro to each subsection	Caption (alone) is enough to understand the display	All present and references match inforamation in paper
	Comes up in a search	Captures attention	Clearly stated objectives, questions, and/or hypothesis	Timeline is addressed	References all figures and tables	Synthesized experimental outcomes	Display accurately represents the data	Correctly formatted
	Clear and concise	Not overly technical	Concise and focused description that is appropraite for the audience		No discussion or methods overlap	Related research outcomes to objectives		DOIs are present
	Accurately represents research	Includes hypothesis and conclusions	States the important or the significance of the work (overview)		Origanization is logical and fits the theme of the paper	Translates research outcomes to the broader impacts and significance		Most relevant to research/concise
		Highlights most relevant results			Concise, yet comprehensively descriptive			Up to Date
2	Gives away the ending	Too long, but contains all important information (i.e. also contains irrelevant information)	Importance is present, but not well defined	All experiments performed are mentioned but lack the details for reproducibility	Reports additional values which are not statistically relevant	Partially relates results to objectives	Caption alone is not enough to understand the display	Incorrect formating of correct citations
	Not as clear or consise	Main point (hypothesis) is not clear	Objectives are not clearly tied to the background		Minor overlap with methods or discussion	Mentions some application to field of study	Minor errors in the display obscures the data	Missing DOIs
	Not focused or misrepresents the paper	Overly technical	Background is present, but not clearly adapted to audience		Comprehesively descriptive, but with extra informatino	Intangiable or vague relation to future work		Missing recent or classic papers
1	Too broad	Does not summarize/synthesize	Missing information important to understanding the story	Missing an experiment	Addresses old results	Poorly developed relationship between results and objectives	Major errors in display of data	Too many reviews (i.e. missing originals)
	Click bait	Lacks broad importance/overview	Objectives do not meet/support the scope of the paper as outlined	Missing major experimental details	Illogical order	Over-reaching conclusions that are NOT supported by the results	Incomprehensible caption	Missing relevant work
	Does not represent research	Information is missing		Missing timeline	Relevant statisitics nore reported	Little or no development of the broader impacts from introduction		Out of date
	Too long or overly technical				Focus is on irrelevant statistics/tests	No application to future work or advancement to the area of study		Incorrectly cited
	Overly technical							

Outcomes of Rubric Development 1.0

Reflective Writing Assignment – Evaluate a given paper and provide your thoughts on the efficacy of this rubric:

- "The rubric is particularly good at judging the content, but not how it is written."
- "The rubric is helpful for addressing the main goals of each section, however, it does not allow for an evaluation of the story nor does it account for stylistic differences by journal or discipline."
- "I conclude that the rubric is a nice way of analyzing different parts of a paper, but I do think there needs to be some additions in scores as well as an additional category for the overall storytelling."

Rubric 2.0: Active Discussion

- Provided students a criterion-based rubric:

Criterion	YES	NO	Max pts Worth	Points Earned
Does the title accurately describe the research or area of study?	☐	☐		
Is the framework of the research interesting, novel, or captivating to the reader?	☐	☐		
Is the writing concise and easy to understand?	☐	☐		
Do the authors build on prior knowledge to make their story more accessible to the audience?	☐	☐		

Engaged in full class active discussion on the differences between the 2 rubric types and appropriate applications.

Field Trip: Application

- Goal: Encouraging participation and sparking discussion among students
- Think-Pair-Share
  - Led students around the halls to designated posters and asked them to apply a rubric to the posters (individually).
  - Form small groups and discuss the major points of the poster
  - Regrouped as full class and allowed students to actively discuss

Student Feedback

1) **What are the (2-5) most significant (central, useful, meaningful, surprising, disturbing) things you have learned in this session?**
2) **What question(s) remain on your mind on this topic?**

On Rubrics:

"Loved the variety of perspectives on evaluating a rubric; meaningful discussion on limitations of quantitative rubrics."

"Enjoyed practicing rubric."

"Poster walk was fun. [It was] cool to see differing opinions on among the crowd."

- 100% of students **self-identified** rubric development as meaningful, two class periods in a row.

Course Highlights

Student Buy-In

- No grades = Self ownership
- No rigid career goals
- Minimal “Sage-on-a-Stage”
- Few slides
- Active engagement
  - Uncomfortable silence

THANK YOU

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