AER PATHWAYS: RECENT RESEARCH AND FUTURE DIRECTIONS

Janelle M. Bailey, Ph.D.
Temple University
janelle.bailey@temple.edu
ACKNOWLEDGEMENTS

Paulo Bretones, Urban Eriksson, & Pedro Russo
Julia Plummer, Charles Henderson, & Debbie Brodbar
Doug Lombardi
ACKNOWLEDGING A LIMITATION

I have a (practical) limitation of being focused on English-language work...

But there is clearly more being done around the world!

Some here...
LARGE-SCALE REVIEWS OF AER

Wall 1973

Bailey & Slater 2003; Bailey et al. 2004; Bailey & Slater 2005; Bailey 2011

Lelliot & Rollnick 2010
## REVIEW CATEGORIES

<table>
<thead>
<tr>
<th>Wall 1973</th>
<th>Bailey &amp; Slater 2003</th>
<th>Lelliot &amp; Rollnick 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary School</td>
<td>Student Understanding</td>
<td>K-12 Schooling, Informal Education, Teacher Education</td>
</tr>
<tr>
<td>Secondary School</td>
<td>Lunar phases</td>
<td>Earth conceptions</td>
</tr>
<tr>
<td>College-Level</td>
<td>Earth’s shape</td>
<td>Gravity</td>
</tr>
<tr>
<td>Achievement studies</td>
<td>Diurnal motion</td>
<td>Day/night</td>
</tr>
<tr>
<td>Curriculum development</td>
<td>Other</td>
<td>Seasons</td>
</tr>
<tr>
<td>Status studies</td>
<td>Cosmology, astrobiology</td>
<td>Earth-Moon-Sun system</td>
</tr>
<tr>
<td></td>
<td>Teachers’ understanding</td>
<td>Solar System</td>
</tr>
<tr>
<td></td>
<td>Instructional Methods</td>
<td>Stars and Sun</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Size and scale</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
</tr>
</tbody>
</table>

16 Sept 2019
Focused Reviews in AER

Agan & Sneider 2004 (Earth’s shape and gravity)
Albanese et al. 1997 (Earth’s place in the universe)
Brazell 2009 (planetarium instructional efficacy)
Brock et al. 2018 (cosmological time)
Cole et al. 2018 (spatial thinking)
Gomez & Fitzgerald 2017 (remote telescopes)
Kavanaugh & Sneider 2007a, 2007b (gravity)
WHO IS WAS DOING AER? (BAILEY & LOMBARDI 2015)
PUBLISHING AER

Wall 1973
- 3 peer-reviewed journals + mostly dissertations/theses

Bailey & Slater 2005
- Additional 26 peer-reviewed journals + books, conference proceedings, dissertations/theses

Lelliot & Rollnick 2010
- Additional 22 peer-reviewed journals not in the above, etc.
PUBLISHING AER

Astronomy Education Review (deceased)
• 2001-2013, 1-2 issues/year, open-access, archived in Portico

Revista Latino-Americana de Educação em Astronomia (Latin-American Journal of Astronomy Education)
• Since 2004, 2 issues/year, open-access

Physical Review Physics Education Research
• Since 2005, 2 issues/year, open-access, article publishing charge (APC)

Journal of Astronomy & Earth Sciences Education
• Since 2014, 2 issues/year, open-access, submission fee and APC
FOCUSED COLLECTION ON AER (IN PHYSICAL REVIEW PER)

June 2016: Approval

12 August 2016: Call for Proposals

31 October 2016: Proposals Due

15 May 2017: Full Papers Due

3 new AER articles in PRPER since FC

15 June 2018: Issue Published

13-Month Review Process

16 Sept 2019
PRPER FOCUSED COLLECTION

- Initial Proposals
- Encourage Submission / Submission with Reservation
- Full Manuscripts Received
- Published Articles
TYPES OF PAPERS IN THE FOCUSED COLLECTION

Review (2), Empirical (12)
Quantitative (5)
Qualitative (4)
Mixed Methods (3)
TOPICAL CATEGORIES (PUBLISHED)

Spatio-temporal issues
Astronomer-educator partnerships
Content understanding
Instructional strategies
Science literacy / Nature of science
Gender issues
TOPICAL CATEGORIES (PROPOSALS)

Spatio-temporal issues
Astronomer-educator partnerships
Content understanding
Instructional strategies
Science literacy/nature of science
Gender issues
Teacher professional development/training
Authentic inquiry/disciplinary thinking
Goals and student learning outcomes
Assessment and instrumentation
Citizen science
European curriculum in astronomy
Outreach program efficacy and outcomes
Scale and distance
Software, online resources
Learning assistants’ influence
Project-based learning in
...and more
UPCOMING WORKS OF INTEREST 1

Chris Impey, Sanlyn Buxner, & Matthew Wenger—two edited volumes

- *Astronomy education volume 2: Best practices for online learning environments* (2020)
- Workshop at AAS in January
1. Learner-Centered Teaching in Astronomy
2. Effective Course Design
3. Lecture-Tutorials in Introductory Astronomy
4. Technology and Engagement in the University Classroom
5. Using Simulations Interactively in the Introductory Astronomy Classroom
6. Practical Considerations for Using a Planetarium for Astronomy Instruction
VOLUME 1, CONT.

7. Authentic Research Experiences in Astronomy to Teach the Process of Science
8. Citizen Science in Astronomy Education
9. World Wide Telescope in Education
10. Measuring Students’ Understanding in Astronomy with Research-Based Assessment Tools
11. Everyone’s Universe: Teaching Astronomy in Community Colleges
12. Making Your Astronomy Class More Inclusive
Editors: Chris Impey, Sanlyn Buxner

UPCOMING WORKS OF INTEREST 2

The Curious Case of Active Learning

- Review paper by Doug Lombardi, Tim Shipley, and teams of discipline-based education researchers
- Psychological Science in the Public Interest
- Astronomy team: me, Ed Prather, Paulo Bretones

Working definition of active learning…
ACTIVE LEARNING IS...

...a classroom situation where instructors and instructional activities explicitly afford students increased agency for their learning. In undergraduate STEM instruction, students should have higher levels of engagement in (a) people’s direct observations of phenomena, (b) scientific data providing evidence about phenomena, (c) scientific models that serve as representations of phenomena, and (d) domain-specific practices that guide scientific interpretation of direct observations, analysis of data, and construction and application of models.

(Lombardi et al., 2019-in preparation)
ACTIVE LEARNING IN ASTRONOMY

Active learning is typically considered anything that gets students working independently or in small collaborative groups (2-6) to learn or reinforce content.
ACTIVE LEARNING IN ASTRONOMY 2

Think-Pair-Share and Peer Instruction
Lecture-Tutorials and Ranking Tasks
Simulations
Remote Telescopes and Authentic Research
Cooperative Learning Activities, Laboratories, and Flipped Classrooms
Mixing Approaches
American Astronomical Society’s Education Committee

- 2nd year of Education and Professional Development grants

- Early discussions of research on astronomy majors, with Forum at January 2020 conference:
  - The AAS education committee invites all of those interested in the astronomy curriculum for undergraduate majors to a forum discussion. This includes a discussion of courses taught as part of an astronomy or astrophysics major/minor/concentration as well as curricula, ideas, and needs for individual courses.
FUTURE DIRECTIONS 1

Increased use of qualitative and mixed methods

Robust quantitative analyses, e.g.
  ▪ Item Response Theory
  ▪ Multi-level Modeling

Longitudinal studies
FUTURE DIRECTIONS 2

International collaborations

New topics, e.g.
- spatial thinking in astronomy
- motivation and related constructs
- use of visualizations and simulations
EXCITING DEVELOPMENTS

Increasing robustness of research

This conference!
- Capacity registrations

New cohesion and emerging leaders within the community
SOME (BUT NOT ALL) RELATED UPCOMING TALKS

M 15:45 Astronomy education in France: survey and analysis, Frédéric Pitout, Observatoire Midi-Pyrénées

T 14:15 An Analysis of Peer-Reviewed Papers on Astronomy Education Published From 2007 to 2018 in Japan, Akihiko Tomita, Wakayama University

T 14:45 Female participation in thesis on astronomy education in Brazil, Paula Cristina da Silva Gonçalves Simon, Universidade Estadual de Campinas – UNICAMP

W 11:45 An overview of the current status of Astronomy Education Research, Paulo S. Bretones, Universidade Federal de São Carlos
OUTSTANDING QUESTIONS

How can we build upon existing work in other disciplines (e.g., education, cognitive science, physics education) to expand our impact?

How can we best support the community of astronomy education researchers, particularly our junior members?

How can we recruit a greater diversity into the community doing AER and into the communities of the learners it impacts?