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Mentoring Partnerships in Undergraduate Physics and Astronomy Education

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Overview

Relationships are the root of being able to teach well, regardless of the context. In this project, the researchers draw parallels between two studies into collegiate STEM learning where mentoring of students proved beneficial to the participants. The first study used an action research approach to partner a researcher with the community of a collegiate studio physics electricity and magnetism course. The second study took a quantitative approach to determine participant learning after a three-phase astronomy dataset activity. Connections are made across these two studies, and possible causes and future strategies to create stronger partnerships with students are discussed.

AR: Studio Physics

Theme	Successes	Barriers
I: Establishing a rapport with a mentor	In response to how the TA could motivate students to talk about their personal issues, 'Express her personal issues.' 'Offer points back on assignments if we come discuss it in office hours.'	'I think it is just a personal problem that I would need to focus more and do more work outside of class.' 'Not really one to talk about personal problems with people I don't know very well.' 'Teachers/professors shouldn't be too involved in personal life.'
II: Empowering students and reducing inequity	'Not grade as harshly on assignments, labs, and tests when we clearly have the concepts and only messed up the work. Easier to want to do better when we're not afraid of being thrown on the chopping block for small mistakes.' 'Maybe encourage students to set up study groups.' 'Post a % grade! It bothers me not knowing, and if I had a lower grade I would work much harder.'	'Not interrupting the teacher while he is teaching to interject her opinion on how to do a problem.' Many responses were about clarifying or expanding the existing power structure (e.g. 'Clearer guidelines for lab reports/homework,' 'Hold study sessions every week.')
III: Hearing student voices	'I think that more application examples could be used in class like where these principles in class are applied.' 'This study seems bias[ed] due to only yes/no answers on opinion, but could definitely be applicable.' 'I don't believe this study had anything to do with motivation. It only helped you be more open to questions.'	Four of the six free response questions had more blank and non-substantive responses (e.g., 'Fine as is,' 'nothing') than substantive responses. A total of 61.0% of free-response questions were either left blank or had non-substantive responses.

Astronomy Datasets

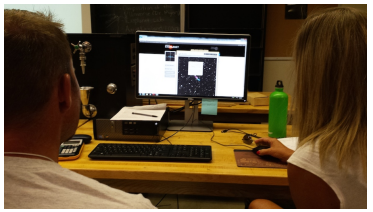
	Pre/Post-Test ± Stdev			Gains / Effect Size		
	Male	Female	Total	Male	Female	Total
I. Undergrads	57±19 / 78±19	**58±16 / 70±22**	58±18 / 75±20	0.467 / 1.12	**0.084 / 0.62**	0.285 / 0.86
II. Science Educators	73±20 / 91±10	57±27 / 85±13	65±25 / 88±11	0.438 / 1.18	0.475 / 1.37	0.457 / 1.22
Total	62±21 / 82±18	58±22 / 78±20	61±21 / 80±18	0.458 / 1.06	0.274 / 0.96	0.350 / 0.96

	Pre/Post-Test ± Stdev			Gains / Effect Size		
Synthesis	Male	Female	Total	Male	Female	Total
I. Undergrads	13±7 / 17±8	**12±8 / 16±9**	13±7 / 17±8	0.324 / 0.64	**0.250 / 0.49**	0.287 / 0.56
II. Science Educators	17±9 / 23±4	13±11 / 22±7	15±10 / 23±6	0.438 / 0.92	0.471 / 1.08	0.455 / 0.98
Total	14±8 / 19±8	12±9 / 19±9	13±8 / 19±8	0.360 / 0.68	0.357 / 0.76	0.351 / 0.70

	Pre/Post-Test ± Stdev			Gains / Effect Size		
Skills	Male	Female	Total	Male	Female	Total
I. Undergrads	63±20 / 81±25	**68±22 / 69±25**	66±21 / 76±26	0.515 / 0.79	**0.088 / 0.06**	0.326 / 0.44
II. Science Educators	73±21 / 84±15	59±22 / 79±20	66±22 / 82±18	0.344 / 0.61	0.426 / 1.02	0.386 / 0.80
Total	67±21 / 82±23	64±22 / 74±23	66±21 / 78±12	0.460 / 0.72	0.252 / 0.48	0.349 / 0.73

Conclusion

- Undergraduates are lacking in mentors in physics and astronomy.
- Mentoring can provide intervention for struggling students.
- Students from underrepresented groups (e.g., females) especially need mentors to model success for them.



Future Work

Qualitative data from the astronomy datasets study also collected includes free response questions on the pre/post-test, responses to questions on the activity worksheet, transcripts of audio/video recordings while participants were working, and transcripts of audio recordings of one-on-one interviews with participants. This data is expected to shed light on participant thought processes as well as the social interactions as they worked.

Schwortz, A. C., Burrows, A. C., & Guffey, S. K. (2016). Mentoring Partnerships in Science Education. *Educational Action Research*, 1-20.

Schwortz, A. C., & Burrows, A. C. (In prep). What Can I Do with All of These Numbers?: Exploring STEM Dataset Use. *In prep.*

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