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Fostering Physics Content and Pedagogy Learning by Future Physics Teachers via Student Authored YouTube Video Projects

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Fostering Physics Content and Pedagogy Learning by Future Physics Teachers via Student Authored YouTube Video Projects

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Abstract
We describe a curricular innovation for STEM teacher preparation -- the use of video projects in undergraduate and graduate physics courses for future physics teachers at *SUNY Buffalo State.* US courses were adapted under the guidance of our colleagues' similar work at *Universität zu Köln* [1]. Our students prepared end of course short "proof of concept" rough video vignettes of 5-10min addressing both physics content and physics pedagogical topics. YouTube [2] example videos are provided, and insights are shared.

1 Background

The use of video making by k-18 science students and STEM teaching students to learn science content has been reported since video cameras became available, but has become widespread with the advent of *YouTube* and the proliferation of video recording smartphones [1, 3-9]. Since 2015, *SUNY Buffalo State College* preservice and in-service STEM teachers taking physics (and some general science) undergraduate and graduate courses have been completing video projects. These video projects [2] were inspired and guided from efforts teaching STEM teachers in media classes at the *Institut für Physik und ihre Didaktik* of *Universität zu Köln.*

2 Goals

Our video making goals for teachers include: 1) developing teaching technical skills using video and media as representation tools – e.g. animation, dialogue and video presentations, 2) learning physics content through reflectively planning and preparing visual representations of physics content to their classmates, 3) practicing physics instructional development using student learning outcomes literature and known learning difficulties to prepare videos for their own students, and 4) learning the pedagogy of physics by developing presentations for their teaching colleagues on instructional techniques, touchstone learning activities, and research driven interventions.

3 Procedures

Student "rough cut" or "proof of concept" group video projects comprise 10% of their course overall grade. A short email proposal (10% of project credit) is required about midsemester, identifying a topic (often selected from a teacher-provided list), listing group members and roles, addressing safety, identifying and requesting materials and other required resources, and stating a working title. About 75% through the course, a storyboard and annotated bibliography are due for another 10% of project credit. The video (which must contain mathematics, other multiple representations, and references in the final credits) is presented (40% of credit) in the last weeks of class, and classmates and instructors provide brief feedback. The short final reflective report

(40%) is due at the final exam – the report includes an abstract and references, final transcript and storyboard, and discussion of strengths, weaknesses and suggestions for reshooting a second edition. A vanishing few of these videos are placed on YouTube with permission of all students.

4 Products

Example content videos from our students include learning about elementary energy transformations [10], electron-hole mechanisms in solar cells and LEDs [11] and completing a half-life measurement experiment [12]. Pedagogical videos include using formative assessment [13], developing kinematic equations via graphs [14], and guiding student video making [15,16].

5 Conclusions and Lessons Learned

Students are enthusiastic and have fun doing video projects. We focus on physics content and learning process, not product – foster clear thinking and communication, not preparing Hollywood directors. Students must be continuously refocused on the content and the learner, else they can get distracted by technical and stylistic issues (in-group humor, music, special effects). Students must manage time carefully with review by the instructor.

References

[1] D. Abbott, A. Roberts, D. MacIsaac, K. Falconer, F. Genz, S. Hoffmann, A. Bresges, & J. Weber, Adding Student Video Projects to Physics Courses, *Phys. Teacher* **57** (April 2019) 224-228.

[2] D. MacIsaac. (2020 Oct 1). Retrieved from https://www.youtube.com/user/danmacvids/ .

[3] M. Kearney. Towards a learning design for student-generated digital storytelling, *The Future of Learning Design Conference,* (2009), University of Wollongong Research Online.

[4] R. P. Hechter and M. D. Guy. Promoting creative thinking and expression of science concepts among elementary teacher candidates through science content movie creation and showcasing, *Contemp. Issues Technol. Teach. Educ.* 10(4), (2010) 411–431.

[5] G. Hoban, J. Loughran, and W. Nielsen. "Slowmation: Pre-service elementary teachers representing science knowledge through creating multimodal digital animations," *J. Res. Sci. Teach.* 48(9), (2011) 985–1009.

[6] M. V. Pereira, S. de Souza Barros, L. A. de Rezende Filho, and L. H. de A. Fauth, "Audiovisual physics reports: Students' video production as a strategy for the didactic laboratory," *Phys. Educ.* 47 (1), 44–51 (2012).

[7] A. Prud'homme-Genereux, "Student-produced videos for the flipped classroom," *J. Coll. Sci. Teach.* 45 (3), 58 (2016).

[8] D. A. Muller, "Designing Effective Multimedia for Physics Education," PhD dissertation (School of Physics, University of Sydney Australia, (2008).

[9] R. L. Coates, A. Kuhai, L. Z. J. Turlej, T. Rivlin, and L. K. McKemmish, "Phys FilmMakers: Teaching science students how to make YouTube-style videos," *Eur. J. Phys.* 39, 015706 (2018).

[10] D. MacIsaac. (2017, May 20). Electric Water [Video file]. Retrieved from https://youtu.be/FpC_cxF1QNg .

[11] D. MacIsaac. (2020, May 22). PHY522 Flashlight Overview: PN Junctions, PV Cells and LED function [Video file]. Retrieved from https://youtu.be/RZdUF2bq54w .

[12] D. MacIsaac. (2016, July 28). Half Life Beta Version [Video file]. Retrieved from https://youtu.be/rEu1JePXXwI .

[13] D. MacIsaac. (2016, Nov 11). Using Formative Assessments in the Physics Classroom V2 [Video file]. Retrieved from https://youtu.be/PHOZRy__Yms .

[14] D. MacIsaac. (2016, Oct 6). Linearization and the Kinematics Equations V2 [Video file]. Retrieved from https://youtu.be/ODvLr_zkfwE .

[15] D. MacIsaac. (2017, March 27). Law of Reflection sample video project [Video file]. Retrieved from https://youtu.be/9ozpJUBV3R0 .

[16] D. MacIsaac. (2017, April 27). Breaking the 4th Wall: Making a Physics Video [Video file]. Retrieved from https://www.youtube.com/watch?v=iecXeKgdnuU .