

Implementing Full Access Video Lectures to Improve Understanding and Performance of All Students in a Large Science Classroom

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1 Background

There is a need to increase the accessibility of science (STEM) materials in the general education classroom. This project aims to improve the accessibility of a general education freshmen-level biology course to all students, particularly those for whom English is not a first language, including Deaf and Hard-of-Hearing students, through the production of short content videos that are captioned, interpreted, and annotated. These videos have been used as the primary resource for both a "flipped" classroom (videos as homework, active learning in the classroom) and a fully online class, and the same content is delivered in a traditional lecture classroom. Overall learning gains are assessed through homework, quiz, and exam scores in each of the class types.

The General Biology course is targeted to non-biology majors offered in the Gosnell School of Life Sciences. The course presented here was taught Spring 2015 (20145) by a single instructor with four sections taught in four distinct modes of delivery: traditional lecture, flipped, small immersion, and completely online. No deaf and/or hard-of-hearing students were enrolled in the online class, so that data will not be included here.

2 Methods

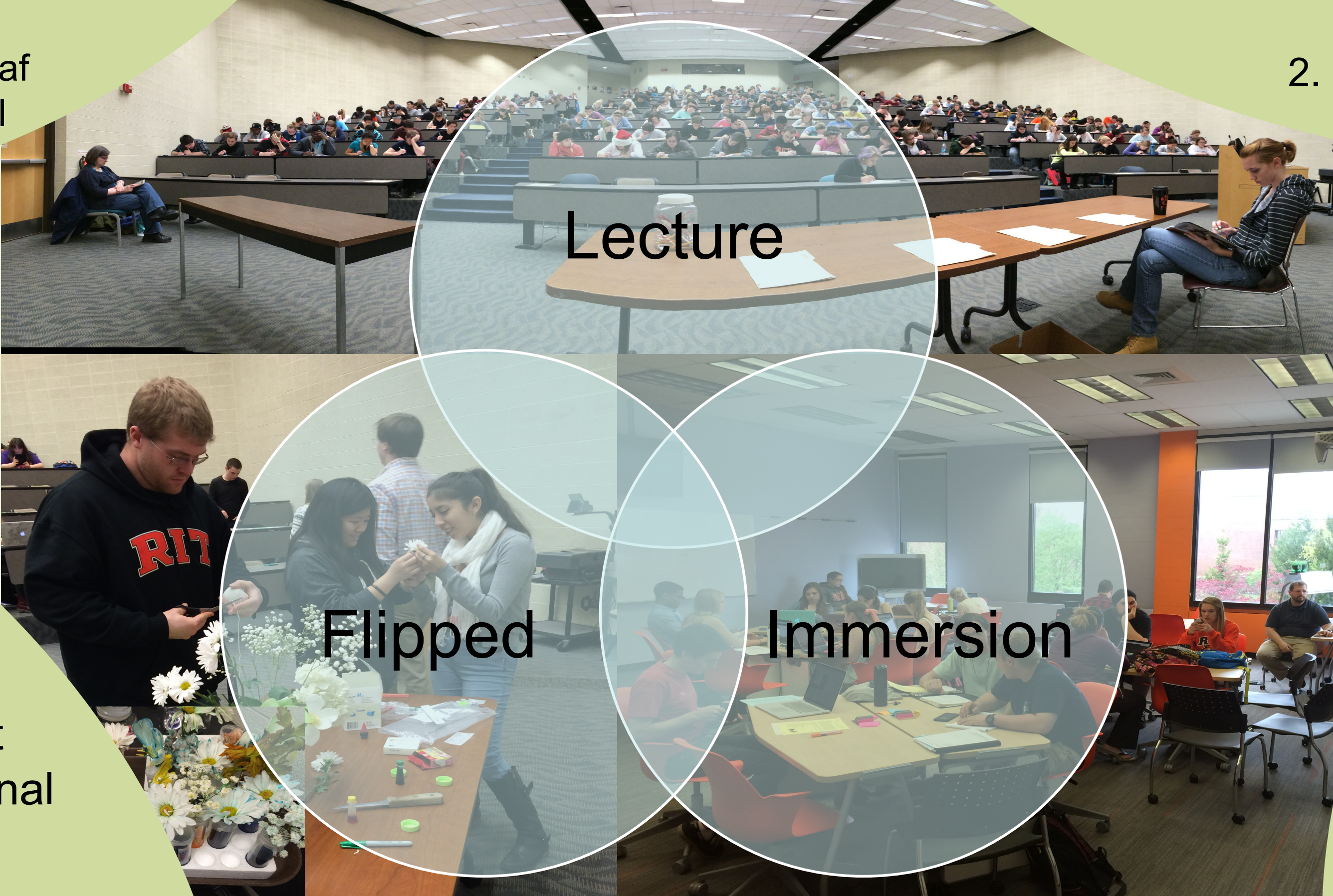
Research Question: test the understanding and retention of plant transpiration (the movement of water from roots to leaves) by students exposed to different modes of content delivery.

Presentation of materials in the different sections:

1. Traditional lecture: Lecture (n= 217; 13 supported)
2. Flipped class: Watch lectures on YouTube; Conduct an experiment on transpiration^{1,2} (n=63; 2 supported)
3. Immersion class: Watch lectures on YouTube; Use a virtual transpiration simulator³ (n=26; 2 supported)

The results presented here focus on:

1. Assessment of plant transpiration topic
2. Final class assessments (exam and course grade)



3 Topic Assessment

Two questions were targeted on both a homework and a quiz to compare the understanding of transpiration between the sections. Further, the plant anatomy and physiology test scores were compared between sections.

Targeted Questions:

HW Q #1: The loss of water from plants through transpiration _____.

HW Q #2: Which of the following describes the correct order in which water moves through a plant and into the atmosphere?

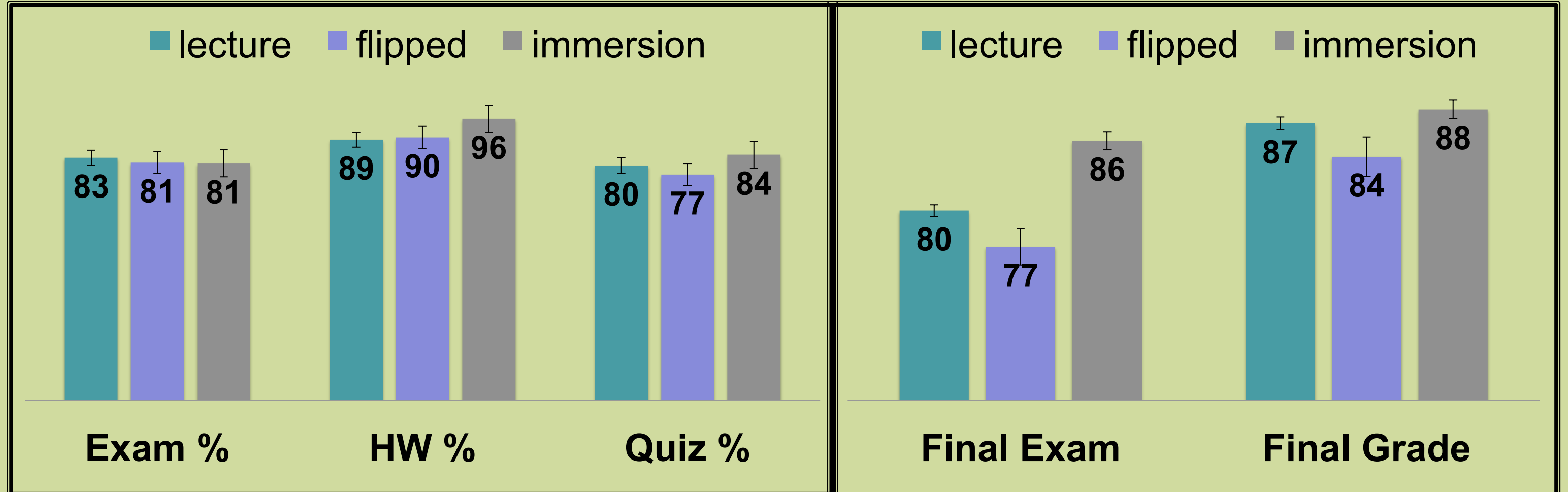
Quiz Q #1: Guard cells actively open and close the stomata of the leaves. What delicate internal balance do these guard cells control with their actions?

Quiz Q #2: The rate of transpiration is expected to be greatest on a _____ day.

6 Conclusions

- No significant difference observed in course delivery method of plant transpiration topic when analyzed through typical methods.
- Final exam scores are significantly different between modes of content delivery (p<0.01), The flipped classroom had the lowest final exam and final average (p<0.05).
- Due to the size of the course, sections may need to be analyzed by student major and then compared between content delivery methods.

5 Quantitative Data



Quantitative comparison of transpiration assessment by topical exam, topical homework, topical quiz score, final exam, and final course grade in the three sections. Bars = St Err

4 Qualitative Data

Correct answers:

HW Q #1: "... is an important part of the mechanism that pulls water from a plant's roots to its leaves."

HW Q #2: "Root, xylem, leaf cells, air space inside leaves, outside air"

Quiz Q #1: "... the balance between water uptake and gas exchange"

Quiz Q #2: "... warm and dry"

Most common wrong answers: (% answered)

HW Q #1: "... is called tension" (42%)

HW Q #2: "Root, xylem, air space inside leaves, leaf cells, outside air" (77%)

Quiz Q #1: "... water balance in the plant" (61%)

Quiz Q #2: "... warm and moist" (96%)

References

1. Connelly, SJ & C Spencer, YouTube Playlist "RITgenbio Plants", 2014.
2. Connelly, SJ. "Plant Transpiration." In class activity Spring 2015.
3. Virtual Plant Transpiration Lab. McGraw-Hill Biology. Last accessed Jan 2017. http://www.mhhe.com/biosci/genbio/virtual_labs/BL_10/BL_10.html

Acknowledgements

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