The Effect of Applying Flipping Method of Instruction in a Biotechnology Module to Increase Content Understanding of Viruses

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Abstract:

The purpose of this research is to measure content knowledge of students using a flipping strategy called "Team Based Learning" in an agriculture biotechnology course utilizing a unit lesson on plant viruses. This flipping method of instruction will be used to increase content knowledge of viruses. The methods that will be used are a virtual lab, reading or video based on a lab activity with reflection questions completed as a homework assignment the night before class. The content knowledge of each method will be measured with summative assessments of consisting of 5 questions at the beginning of the lesson and 5 questions at the end of the lesson. There will also be a pre and post- test administered at the beginning and end of the unit to measuring content knowledge. The scores will be evaluated using a combination of Anova and Regression.

Rationale:

The importance of getting students to have content knowledge on the real-world applications of biotechnology is important for our students to pursue careers in all fields of biotechnology and agriculture. Traditionally, students in agriculture biotechnology courses focus more on skill and less on application or theory. I have taught agriculture biotechnology for three years and getting students prepared with content knowledge and skills attainment to pass biotechnology industry certifications has been challenging. There is a tremendous amount of content knowledge and skill attainment for students to pass the industry exams.

The infusion of academics and career technology is part of the reform to increase student performance in academics. (Bottoms, 2008) Bottoms mentions that one of the challenges in state reform is to get students to increase academic skills through career and technical education courses. Training educators to infuse real-world, problem solving examples into academic content with the help of career and technical careers is important for educators to engage students to delve deeper into academic and skill attainment. The overall goal of my research is to measure learning gains in content knowledge using a method of flipping instruction called "Team Based Learning". The unit lesson will contain this "flipping" strategy to create curriculum modules to improve student performance on end of course exams and industry exams. This will lead students to continue and prepare for college or careers.

The purpose for my action proposal is to increase content knowledge of science concepts in biotechnology and to have students apply their biotechnology skills to real world applications in biomedicine, agriculture and industrial biotechnology. I want to evaluate the effectiveness of using "Team Based Learning" to increase content knowledge of viruses. According to (Kim, et.al 2012), using action-learning exercises like team based learning and problem-based learning will

help students engage in the content. The research study by (Jamuldin et. al 2014) on using flipped classrooms students found that students were more cognitively and emotionally engaged with the content. This will be an opportunity to provide some statistical analysis for learning gains in science.

Action Research Intervention

The intervention strategy that I will be using is "flipping" or action learning. I want to investigate if there is any content knowledge gains by using flipping techniques, such as team -based learning. The goals is to create a unit on plant viruses that contains both biotechnology lab exercises, team based learning and reflective prompts to increase content knowledge of Agriculture Biotechnology 3 students.

The unit that I will be doing my action proposal is named "Virulent Plants". Prior knowledge will be created using flipping exercises and assessed with Team Based Learning. The flipping method will be infused to build back -ground knowledge and have students prepare for the pretest for the team based learning exercise. The TBL strategy will be measured quantitatively.

A. Flipping Exercises: Team Based Learning: 2 Lessons

1. Viruses (General Biology)
2. Plant Viruses: Tobacco Mosaic Virus

The students will start with Lesson #1: Viruses, Pathogens and vectors of disease. In this exercise they will be exploring the physical structure of viruses, their reproduction, and virulence and how the virus is spread. They will be reviewing two small video clips on viruses as a homework assignment before the lesson. The students will be organized into groups and be instructed through team based learning. The team based learning strategy will be followed using the iRat and tRat format as demonstrated in the bench to bedside workshop by Dr. Wayne McCormack. Technology and project creation by the students will be encouraged and assessed with rubrics to monitor student understanding of the content.

Hands on Biotechnology Labs. This will be a unit spanning 4-6 weeks.

1. Inoculation of TMV: Students will grow host plants and inoculate.
2. Immunoassay Strips or ELISA.
3. DNA extraction
4. Gel Electrophoresis
5. PCR or microarray
6. Heat sterilization of virulent plants
7. Problem –Based Learning: Agriscience Research Report on an emerging plant virus that can be used in bioengineering. (Students can utilize this as an SAE or Agriscience Fair Project).

Item	Vendor	Total Cost
Inoculation Activity of Tobacco Mosaic Virus	Lowes for Seed, Tobacco Potting Soil, Pots	$20.00
Immunoassay Strips	Agdia http://www.agdia.com/ Agdia ImmunoStrip™	$105.00 for 25
PCR Kit: Quick plant genetics (You may want to buy separate primers, ladder and taq polymerase	Edvotek	$179.00
DNA Extraction: Ziploc bags, 70% alcohol, dish soap, mortar and pestle	Walmart Class laboratory	10.00
Team Based Learning Scratch off cards for IFAT	Teambased learning.org	$85.00
DNA electrophoresis: Electrophoresis Chamber Buffer, 1.5 ml micro-tubes Pippeter, micropipettes tips 2-20ul, gel dyes, fast blast stain	Classroom laboratory supplies Biorad	$50.00 for Chemicals
Total Cost for Activities		$364.00

Data Collection and Analysis:

Data Collection will be measured using a combination of Anova and Regression statistical analysis of the Team Based Learning Activities. There will also be a pre and post- test on the unit of viruses with data collected and compared to a covariant on their district EOC Biology score.

1. Treatment Group: Students will be divided using either their G.P.A or their Biology EOC score.
2. Control Group: Students in this group will be divided into groups by using their GPA or Biology EOC score but they will not receive the team based activity for that lesson.
3. The pre and post tests will be administered and data collected
4. The scores will be collected and can be used using SPSS statistical software. I will use a combination of Anova and regression to determine if there is any significant difference between the control and treatment group. They will then be analyzed to see if this had any impact on final EOC scores.

5. I will also be using a Likert -based survey to monitor the attitudes and perceptions of students using team -based learning to understanding of plant viruses.
6. Assessments: Teacher learning journals, student learning journals and lab reports will be graded and evaluated qualitatively to assess attitudes and perceptions. Project creation and peer assessment will be measured with rubrics.

UF Bench to Bedside Connections: I am connecting two pieces of the workshop in my proposal. The team based learning strategy and the lecture on virology. The students will learn about viruses and their use in research, bioengineering and vaccinations.
Presentation Link: https://animoto.com/play/y8FtM0DmZuWzBwd6Z3q0Sg

Literature Cited:

Works Cited

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Bottoms, G. (2008). *A Vision for High Schools: Joining Academic and Technical Studies to Promote More Powerful Learning* (Vol. 1). (A. o. Education, Ed.) Alexandria, VA, USA: Techniques: Connecting Education and Careers.

P.Strange, R. &. (2005, July). Plant Disease: A Threat to Global Food Security. *Phytopathology, Vol. 43*, 83-116.

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SINGLE LESSON PLAN

Teacher: Wendy Vidor	**Content Area/Grade:** Ag Biotechnology 3:	**Date:** 6/23/2015

Unit Name:	Viruses, Pathogens and Vectors of Disease

Unit Goal What unit goal does this daily lesson address?	**Standard(s)/Benchmark(s)** What standard(s)/benchmark(s) does this daily lesson address?
Students will investigate emerging plant pathogens and determine how these viruses can be tested in biotechnology to control the spread of disease on agricultural crops.	36.02 Identify pathogen-related disorders in plants. SC.912.L.16.7: Describe how viruses and bacteria transfer genetic material between cells and the role of this process in biotechnology.

Students will understand that… What should the students understand by the end of today's lesson?	**Essential Questions** What essential question(s) does this lesson address?
Identify what plants are susceptible to virus. Explain how viruses affect the immune system of plants and animals. Investigate the structure of viruses. Understand the viruses are reproduced inside the cell.	What is a virus and how does it get transmitted to the cell? What plants or genus's are susceptible to TMV? How to plants or animal immune systems react to a virus? How do viruses reproduce?

Connecting Concepts How will you review yesterday's content and connect today's lesson to it?	**Organizing Students for Learning** How will students be organized today for the lessons activities?
Review the physical structure of the virus from flipping exercise. Discuss the susceptible of specific plant genus to the virus.	Team Based Learning: The students will be grouped by grade level or Biology EOC score. They will count off in groups of 4. Students will each need a computer with Internet access.

LEARNING EXPERIENCES, INSTRUCTION AND RESOURCES

What activities or experiences (from your Unit Plan) will students engage in today?

Lesson Sequence

Activating Prior Knowledge	Students will complete a flipping exercise the night before the classroom activity. Students will watch the video on you tube: What is a virus: https://www.youtube.com/watch?v=7KXHwhTghWI and https://www.youtube.com/watch?v=CBMr142ynbk. Students will be taking notes on the video note worksheet. They will need this information for the Team Based Learning Activity (Pre-test). They will	☐ ABC Brainstorming ☐ KWL ☐ Anticipation Guide ☐ Card Sort ☐ Think-Pair-Share
Explicit Instruction	1. Students will be issued a pre-test on activity on viruses from the flipping exercise the night before. They will individually take the test and then by group retake the test and score. 2. Team Based Learning: Active Learning Strategy 3. Students will group by lab table and be assigned a role of expert on one of four topics learning about viruses. 4. Students will use the computer and open the article from the APS.net website to learn about a virus called TMV. http://www.apsnet.org/edcenter/intropp/lessons/viruses/Pages/TobaccoMosaic.aspx	☐ Motivational Hook ☐ Lecture ☐ Demonstration ☐ Note-taking Guide

Lesson Sequence				Resources and Materials
Group Processing of New Information	Part 2: 1. Each team member will gather essential information the tobacco mosaic virus from the reading and prepare a 5- minute presentation explaining the structure, function and use in biotechnology using presentation software using Smores.com. 2. Give students a rubric on the presentation	☐ Jigsaw ☐ Reciprocal Teaching ☐ Concept Attainment ☐ Think-Pair-Share	☐ Lab / Inquiry Activity	x☐ Computer ☐ LCD Projector ☐ Paper ☐ Pencils ☐ Whiteboards ☐ Markers ☐ Butcher Paper ☐ Response Cards ☐ Post-it Notes ☐ Video Clip(s):
Elaborative Questioning	Students will have to discuss only essential information that would be put on the document to create a poster presentation.	☐ Inferential Questions ☐ Analytic Questions ☐ Philosophical Chairs		
Demonstrating Understanding	Students will create a poster on their topic on Smore.com and teach the other groups in the classroom information on viruses. They will need to download their documents to Google Classroom or a class website to present their information. (Rubric link attached in website links. http://www.smore.com	☐ Graphic Organizers ☐ Picture Notes ☐ Flow Charts ☐ Concept Maps ☐ Mnemonics ☐ Graffiti		☐ Website(s): www.smore.com http://rubistar.4teachers.org/index.php?screen=ShowRubric&rubric_id=1413715&
Reflection	Students will reflect on what they learned about viruses in their lab notebook in their journal section on viruses.	☐ Reflective Journals ☐ Think Logs ☐ Exit Ticket (Student Learning)		☐ Lab Materials: Computer Readiness Test (iRAT and tRat) Scratch off cards pencil
Daily Progress Monitoring Assessment	Journal prompts will be graded with laboratory exercises. Poster and Presentation will be graded with poster rubric. Readiness Test will count as a quiz grade.	☐ Quiz ☐ Journal ☐ Exit Ticket (for Content) ☐ Response Cards		

Homework Flipping Exercise #2.
http://ed.ted.com/lessons/how-we-conquered-the-deadly-smallpox-virus-simona-zompi

Introduction to Tobacco Mosaic Virus: Lesson 1: Team Based Learning (Readiness Assurance Test)

Activity: Team Based Learning

Directions: The teacher will divide you into one of four groups.

1. You will individually take the pre-test on the video clip on "What is a Virus" from the previous night's homework assignment.
2. You will need to circle the answer on your test worksheet.
3. You will now take the same test in your team of four and use the special scoring card provided. In your team you must negotiate which answer you will choose as a "team" and have one person designated in the group to scratch off the answer your group chose.
4. If your team scratched off an answer that was not correct, you must continue discussing and scratching off an answer until you find the correct answer.
5. The teacher will direct a class discussion on the results and student will be able to write a written appeal for any questions that they got incorrect. This appeal must contain a clear statement of the argument, and evidence cited from the preparation materials.
6. Students will receive the score either from their individual test or their team score. This must be voted on and accepted by the entire team.

Readiness Assurance Test: Viruses

Please select the one BEST answer for each question.

1. What does the basic structure of a virus contain?
   A. DNA and RNA
   B. DNA, or RNA and a protein coat
   C. DNA, or RNA, protein coat and enzymes for replication.
   D. DNA and a nucleus

2. Who discovered the first virus?
   A. Alexander Fleming
   B. Louis Pasteur
   C. John Hopkins
   D. Walter Reed

3. What is the size of a virus?
   A. Microscopic
   B. Visible with the naked eye
   C. Larger than a bacteria
   D. Larger than a cell

4. The tobacco mosaic virus has what type of virus structure
   A. Bacteriophage
   B. Helical Structure made up of rod like proteins
   C. Isohedron enveloped protein
   D. Naked envelope protein

5. What is a capsid?
   A. A protein shell surrounding the nucleic acid genome.
   B. The nucleic acid and protein that gets packaged into the protein.
   C. It contains the RNA
   D. It contains the DNA

UNIT PLAN

Unit Title: Virulent Plants	**Content Area/Grade:** Agriculture or Plant Biotechnology 3
Teacher: Wendy Vidor	**Implementation Time Frame:** 4 weeks

STAGE 1: THE DESIRED RESULTS
What are my learning goals?

Unit Goal
Students will understand that…

1. Pathogens from viruses infect agricultural crops and animals including humans.
2. These same viruses can be used in biotechnology to create medicines and vaccines, genetically engineer organisms and be used in research.
3. That Immunoassays and ELISA tests are used in biotechnology to detect viruses.

Related Misconceptions
What misconceptions are predictable?

Viruses are living, they are large and they only cause disease

Essential Questions
What questions will foster inquiry, understanding and transfer of learning?

1. What is a virus and how does it get transmitted to the cell?
2. What plants or genus's are susceptible to TMV?
3. How does the immune system protect an organism from disease?
4. How do viruses reproduce? Spread?
5. How is an Immun-oassy test used to detect the tobacco mosaic virus?
6. How do you amplify and replicate a virus.

Standard(s)/Benchmark(s)
What standard(s)/benchmark(s) does this daily lesson address?

36.02 Identify pathogen-related disorders in plants.

20.01.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
25.06 Use antibodies to detect and quantify antigens.
SC.912.L.18.4 BS.02.05.05.a
26.06 Conduct an Enzyme-Linked Immunosorbent Assay (ELISA).

Students will know…Vocabulary, terminology, definitions

Vocabulary

Pathogen	**Vector**
Immunosorbent assay	**Antigen**
inoculation	**Antibody**
Protein coat	**Taq polymerase**
RNA	**Denature**
Tobacco mosaic virus	**Anneal**
Polymerase chain reaction	**Gel electrophoresis**
Primary antibody	**Secondary antibody**

Students will know…
key facts, formulas, critical details, important events, important people, timelines

Viruses can only enter a cell by a vector or by damage to the epidermis.
Viruses are either single or double pieces of DNA or RNA that can replicate causing disease

Viruses can cause major damage to agricultural and ornamental crops and occur in several genera of plants.
Tobacco Mosaic Virus is one of the first viruses researched and has become a model of study for virologists.

Students will be able to…
Specific skills students will acquire as a result of this unit

-
- Identify the physical structure of the tobacco mosaic virus and understand how vector transfer disease to susceptible plan.
- Perform an immune assay or test for the tobacco mosaic virus.
- Explain the techniques of how viruses can be controlled in agriculture.
- Demonstrate how to perform a PCR and amplify DNA.
- Inoculate a plant virus into another plant
- Inactivate a virus using heat treatment

STAGE 2: ASSESSMENT EVIDENCE

What evidence will show that my students have achieved the learning goals?

Performance tasks:

Through what specific "real-world" performance task(s) will students demonstrate their understanding of the learning goals?

- Pre and Post Test for the Unit.
- Use reflective journals to demonstrate understanding.
- Students will use technological applications and flipping methods to increase content knowledge using technology and be assessed using Team Based Learning.
- Identify virus using Immunoassay test strips
- Inoculate plants with tobacco mosaic virus using tomato, pinto bean or sunflowers.
- Demonstrate a DNA extraction of the TMV virus.
- Perform DNA Amplification-PCR
- Run gel electrophoresis on DNA from PCR and interpret results.
- Observe and identify the virus by leaf symptoms using leaf cross- sections and preparing slide mounts.
- Student will perform a DNA microarray.
- Inactivate the virus by destroying the virus through heat treatment (autoclaving).
- Explain the process of genetic engineering using a TI Plasmid and TMV virus
- Students will write lab reports and demonstrate the experimental method.
- Students will use aseptic technique and tissue culture virus free strains with the use of micropropagation.

Rubric , Summative Assessment (Written Test), Mastery Test

By what criteria will "performance of understanding" be judged?

Rubrics will be created for the PCR Lab and all laboratory activities
Rubrics will be created for the poster activity for the activity in Lesson Activity 1.
Students will peer grade their group presentations using the provided rubric.
Laboratory notebooks will be graded and a mastery test will be assessed after each laboratory procedure.
Pre and Post Test will be administered before and after unit.
Readiness Assessment Test will be used on Team Based Learning Activity

Other Evidence: What other evidence needs to be collected in order to monitor student progress on these concepts and skills along the way?	**Self-Assessment/Reflection** How will students reflect and self-assess their learning?
Student survey after the unit on content knowledge gained. Reflection Journals Mastery Tests (Skills Assessment)	Reflective journals Class jigsaw discussion Peer grading on poster presentations

STAGE 3: LEARNING EXPERIENCES, INSTRUCTION, AND RESOURCES
What activities will help my students achieve the learning goals?

What **H**ere	**What** is expected? How will you ensure that students are aware of the learning goals? **Where** are your students? How will you establish your students' prior knowledge?
	Learning goals and objectives for the activities will be provided on Google Classroom. Timelines will be provided and homework will be graded to provide feedback. Prior knowledge will be created using flipping exercises and assessed with Team Based Learning or Jigsaw activities or Exit Tickets or reflective questions.
Hook **H**old	How will you **hook** students at the beginning of the unit? How will you **hold** their attention throughout the units?
	Students will grow and inoculate the plants they are using for the lab procedures. They will also be watching video clips and interactive activities to gain their interest about viruses. Students will investigate biomedical applications on viruses and current research on how they are using it to cure disease. Technology based review games will be used to keep interest along with
Experience **E**xplore **E**quip	What critical input **experience** will help students **explore** the key ideas and essential questions? How will you **equip** your students with needed skills and knowledge?
	The flipping methods will be infused to build back ground knowledge and have them prepare for the pre test. The students will be using biotechnology skills and procedures to extract plant materials, inoculate plants and test for the virus using assays.
Reflect **R**ethink **R**ehearsing **R**evising **R**efining	How will you encourage students to **reflect** and **rethink**? How will you guide students in the process of **rehearsing**, **revising**, and **refining** their work?
	They will use jigsaw activities, reflective journal prompts along with group discussion. They will submit assignments to teacher and group for peer review. They will work as a team to grow their plants and detect the disease using the correct lab procedures and protocols.
Exhibit **E**valuate	How will you help students to **exhibit** and **self-evaluate** their developing skills, knowledge and understanding throughout the unit?
	Students will have rubrics and self -reflection activities along with rubrics, mastery test and post – tests.
Tailor	How will you **tailor** your instruction to meet the different needs, interests and abilities of all learners in your classroom?
	Cooperative groups, jigsaw, project creations, research paper on Tobacco Mosaic Virus and uses in biotechnology.
Organize	How will you **organize** and sequence the learning activities to maximize the engagement and achievement of all students?
	Flipping Activity Vocabulary Pre Test Lab or Virtual Lab Activity Post Test Skill Mastery Test

Big Idea: Viruses and the spread of disease		**Standard(s)/Benchmark(s):** 20.01, 26.05,
Unit: Virulent Plants		**Sample Activities**
Grade: 11-12		
Score 4.0	**In addition to Score 3.0, in-depth inferences and applications that go beyond what was taught.**	
Score 3.0	**The student:** **The student exhibits no major errors or omissions**	
Score 2.0	**There are no major errors or omissions regarding the simpler details and processes as the student:** • Recognizes or recalls specific terminology • Performs basic processes, such as: **However, the student exhibits major errors or omissions regarding the more complex ideas and processes**	
Score 1.0	**With help, a partial understanding of some of the simpler details and processes and some of the more complex ideas and processes.**	
Score 0.0	**Even with help, no understanding or skills demonstrated.**	