

EXPERIENCES OF EXTENSION EDUCATION VIA ONLINE DELIVERY OF PROGRAMMING RELATED TO PRECISION AGRICULTURE TECHNOLOGIES

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ABSTRACT

This paper will describe the content and experiences teaching an extension education course on precision agriculture technologies via online delivery.

The course was developed to be delivered in 16 weeks meeting on time a week online. There was also a one-day face-to-face hands-on session focused around 4 lab type activities related to GPS guidance, diagnosis, setup and maximizing the usefulness of precision agriculture technologies.

This course focuses on agricultural equipment that is commonly used in conjunction with GPS technology. Planters, combines, fertilizer application equipment and sprayer application equipment are commonly equipped with GPS equipment to control and record operational parameters. These parameters focus around the equipments geographic location and can be recorded simultaneously with the volume of product applied and weather information (wind, temperature, humidity, etc.). GPS guidance is one of the main technologies to be studied throughout the course. The management of this equipment and the GPS technologies used to control and record this information is the focus of the course.

Items to be discussed are hurdles in teaching precision agriculture technologies online. Feedback from course participants on how the course could be improved as well as what was liked the most about the method of online delivery.

Keywords: Precision Agriculture, Education, Site Specific Agriculture, Global Positioning System, Yield Monitor, Variable Rate Application, Remote Sensing, Geographic Information Systems.

INTRODUCTION

The use of technology in agriculture has become prevalent in crop production more today than ever. In the spring of 2009, a large machinery dealer servicing southeast Missouri and northeast Arkansas approached University of Missouri Extension with the possibility of providing a course in precision agriculture for their service personnel. In fulfilling this request it was decided to adapt an online course offered through the University of Missouri Agriculture Systems Management Program to a non-credit extension education course (Shannon, 2008).

This paper will describe the content and experiences teaching an extension education course on precision agriculture technologies via online delivery for the first time.

The course was developed to be delivered as a 16 week course meeting one time a week online or as an 8 week course meeting two times a week online. The online content was supplemented with a one-day face-to-face hands-on session focused around 4 lab type activities related to GPS guidance, diagnosis, setup and maximizing the usefulness of precision agriculture technologies.

OUTLINE AND OBJECTIVES OF THE COURSE

This course focuses on agricultural equipment that is commonly used in conjunction with GPS technology. Planters, combines, fertilizer application equipment and sprayer application equipment are commonly equipped with GPS equipment to control and record operational parameters. These parameters focus around the equipment's geographic location and can be recorded simultaneously with the volume of product applied and weather information (wind, temperature, humidity, etc.). GPS guidance is one of the main technologies to be studied throughout the course. The management of this equipment and the GPS technologies used to control and record this information is the focus of the course.

Outline of Course by Session (either a 16 week course or 8 week course meeting 2 times per week for 16 sessions)

1. Introduction to Precision Agriculture

A number of technologies have moved agriculture forward. Some of those technologies and innovations have included the tractor, introduction of pesticides and herbicides, crop hybridization and biotechnology. Precision agriculture technologies have been a next step in moving into the future. This session will be an overview of precision agriculture.

2. GPS Systems

Global Positioning Systems utilizing satellite coverage is the heart and soul of most precision agriculture operations. Differential positioning, or using a fixed

reference for allowing more precise measurement (RTK), allows even greater accuracy for establishing the spatial dimension of field data. Gaining an understanding of GPS terminology and principles will be covered in this session.

3. Overview of Machinery Management Concepts

Precision agriculture technologies can be tied to machinery management concepts. GPS guidance is one of those technologies. One of the main goals of adopting GPS guidance is to eliminate overlap. Overlap can be quantified by calculating field efficiency, field capacity (acres/hour), and material capacity (bushels/hour). These concepts will be the focus of this session.

4. The Nuts and Bolts GPS Guidance – Aided (Lightbars), Assisted Steering, and Automatic Guidance

- systems available
- installation procedures
- cost of various systems

5. Tractor Issues – The main items of discussion will be GPS Guidance/Auto Steer, utilizing control systems - factory installed or aftermarket, data collection issues during the growing season – agronomic and machine data.

6. Overview of Variable-Rate Technologies

All of the precision ag technologies applied to precision farming would be of questionable value if one could not vary the rate of inputs or follow a prescription over a field. Varying rates can allow one to save inputs, reduce cost, and spot apply areas of disease or pest outbreaks. Site-specific crop management becomes possible with the use of either map-based or sensor-based technologies. This session will discuss these technologies.

7. Planters – The main items of discussion will be data collection – agronomic and machine data, variable-rate technology - factory installed or aftermarket.

8. Fertilizer Application Equipment

- Granular – Pull Type and Self Propelled, Single Product versus Multiple Product
- Liquid
- Anhydrous Ammonia

The main items of discussion will be data collection – agronomic and machine data, variable-rate technology - factory installed or aftermarket. Differences in equipment technology as related to precision agriculture will also be discussed.

9. Sprayers

- Self Propelled

- Tractor Drawn

The main items of discussion will be data collection – agronomic and machine data, variable-rate technology - factory installed or aftermarket. Technologies such as automatic boom control will be part of this section. Differences in equipment technology as related to precision agriculture will also be discussed.

10. Combines – Harvesting Equipment

Yield monitoring systems will be discussed with an emphasis on the engineering aspects of those systems as related to a precision agriculture equipment system and how these systems can be used with other pieces of equipment in a production system, i.e. variable rate application and GPS guidance.

11. An Introduction to Mapping (GIS) Technologies

- How commercial precision agriculture software can be utilized in setting up agriculture machines for GPS technologies from data collection to GPS auto guidance.

12. Why Adopt GPS / Precision Ag Technologies?

- economic issues
- environmental issues

This session will focus on the bottom line in a crop production setting and explore the economics and environmental issues related to adopting precision agriculture to an equipment line. So now you have the bug, what equipment should you keep of your existing equipment line?

(Development of a Plan to Incorporate Precision Agriculture Technology into an existing equipment line)

Sessions 13, 14, 15 and 16 will be Hands-On Lab Sessions

This will be a full day of 4 hands-on lab sessions involving the following:

1 session on GPS setup and diagnostics as relates to data collection with various pieces of equipment. Laptop computers will be used for this session to show how diagnostic evaluation can be made in the field with GPS hardware.

1 session on RTK GPS setup and operation will be covered during this lab session. RTK GPS receivers are highly accurate and utilized for auto guidance on a number of agricultural machines.

1 session on GPS guidance/auto steer setup and operation on a tractor will be covered. Operation of guidance systems will also be covered.

1 session on maximizing the use of precision ag technologies from yield monitoring - combine applications to variable rate controller setup and operation. How can one piece of hardware accomplish multiple precision agriculture applications will be covered.

DELIVERY OF THE COURSE

The course was delivered via Moodle through the University of Missouri Extension Courses site. Moodle is an open source online course management system. Figure 1 shows a screenshot from one of the course sessions in Moodle. Course content was created using Microsoft PowerPoint and Camtasia Studio. Camtasia Studio allowed for content to be posted the course site as a Windows Media (wmv) file, a MP3 audio file, or iPOD video (m4v) file. For each lecture the PowerPoint of the lecture was posted as an Adobe Acrobat PDF file. Course materials were also provided to participants in a notebook and DVD.

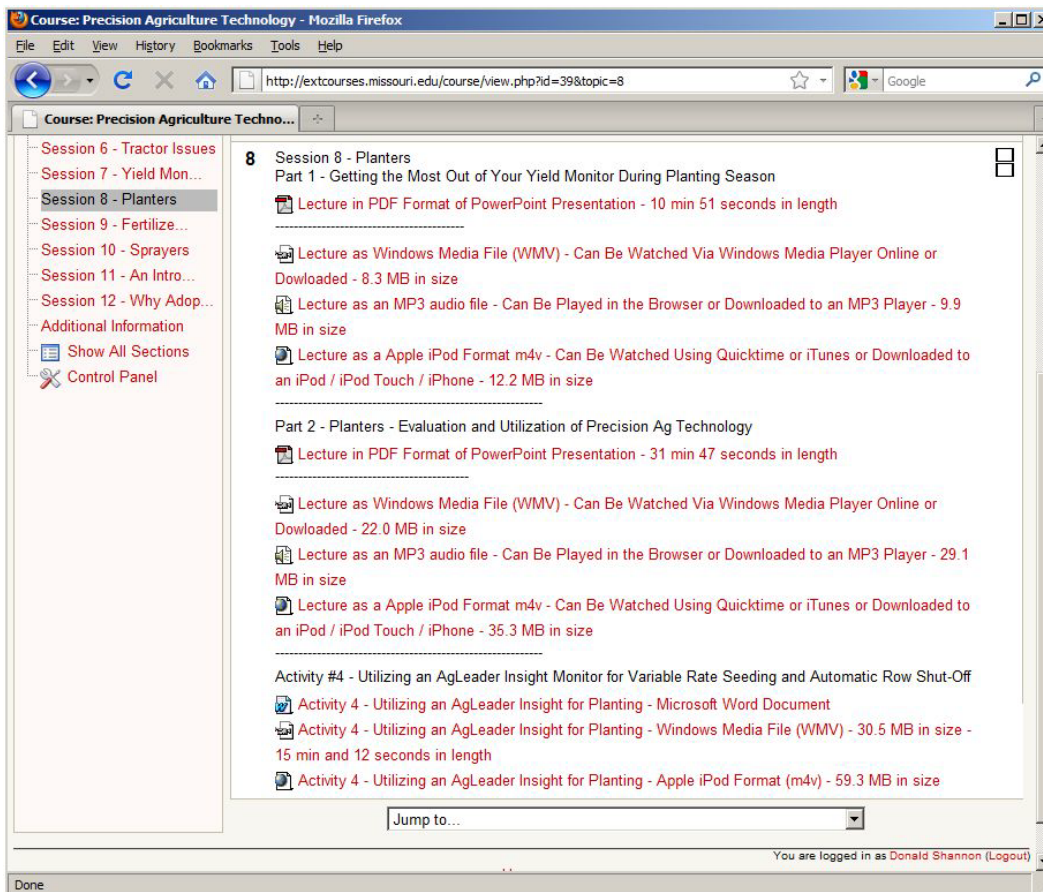


Figure 1. Screenshot of course site for Session 8 - Planters.

**EVALUATION AND COMMENTS REGARDING A ONLINE
EXTENSION COURSE WITH A HANDS-ON LABORATORY HELD ON
FEBRUARY 25, 2010**

The following is the summary of the evaluation for the Hands-On Lab Session held on February 25, 2010. This lab session was attended by only those enrolled in the non-credit extension course. There were eight questions asked of the participants.

1. This hands-on session provided me with useful information that I will use as an employee, producer, or ag service provider: 10 agreed, 1 somewhat agreed, 0 disagreed, and 0 strongly disagreed with the statement.

Please comment on areas that could be improved:

- I think everything went well.
- It's all learning process for both instructor & instructor.
- Computer & book for resources.

2. What was one thing that you will use from today's hands-on session?

- Setting up Auto-Guidance in tractors.
- Diagnostics for GPS receivers.
- Set up of a RTK GPS base station.
- How to use GPS on Case-IH Pro600
- Could use a lot of this information in troubleshooting in the future.
- Rely on computer & hand book for answers.

3. Was there enough time spent on each hands-on activity? 9 agreed, 2 somewhat agreed, 0 disagreed, and 0 strongly disagreed with the statement.

Comments:

- Needed to spend more time in showing how to set up displays.

4. Please rate the teaching effectiveness of each presenter:

| Hands-On Lab Exercises: | Excellent | Good | Average | Fair | Poor |
|---|-----------|------|---------|------|------|
| GPS Diagnostics | 6 | 5 | 0 | 0 | 0 |
| RTK GPS Setup | 5 | 5 | 0 | 0 | 0 |
| Utilization of Precision Ag Equipment beyond Yield Monitoring | 5 | 4 | 1 | 0 | 0 |
| GPS AutoGuidance Setup | 5 | 4 | 1 | 0 | 0 |

Please comment on areas that could be improved:

- More hands on.

5. Do you believe the notebook of class materials provided will be useful? 7 agreed, 1 somewhat agreed, 0 disagreed, and 0 strongly disagreed with the statement.

6. Do you believe the DVD of class materials provided will be useful? 7 agreed, 1 somewhat agreed, 0 disagreed, and 0 strongly disagreed with the statement.

7. Does there need to be more than one hands-on labs session associated with this online course? If so what would be other topics that need to be covered.

- I think there should be another lab session. No other topics, just more broad about everything. I learned a lot, but think more time in each area would've been more helpful.

- Yes – break down into smaller more intense sessions.

- No.

- It's good as it is.

8. Please rate the overall quality of the today's hands-on session: 3 rated excellent, 6 rated good, 0 rated average, 0 rated fair, and 0 rated poor.

Please provide any additional comments, suggestions, questions or concerns:

- On one of the online lectures, I had a lot of trouble with the volume of the presentation being low, but was able to work around it.

EVALUATION AND COMMENTS REGARDING A ONLINE EXTENSION COURSE WITH A HANDS-ON LABORATORY HELD ON MARCH 5, 2010

The following is the summary of the evaluation for the Hands-On Lab Session held on March 5, 2010. This lab session was attended by only those enrolled in the non-credit extension course, as well as those taking the course for 3 hours of college credit. Of the respondents only 2 were taking the course as a non-credit extension course. The same eight questions were asked of the participants as on February 25, 2010.

1. This hands-on session provided me with useful information that I will use as an employee, producer, or ag service provider: 16 agreed, 5 somewhat agreed, 1 disagreed, and 0 strongly disagreed with the statement.

Please comment on areas that could be improved:

- Working equipment.

- I would like to do a little more hands on with the technology of equipment.

- Very well organized.

- I would like to see clutches on planters & such.

- I would like to see how to hook up planter clutches to the auto boom.

- Having two of these sessions.

- Maybe a better idea of how some of the precession equipment is installed.

- Need to perform more hands-on work, toward several hours for a lecture and was somewhat disappointed.
- It would have helped if the demonstrations functional, but that is not instructors fault.
- More hands-on work with the technology.
- More hands-on would be better.
- I would like to have more hands on hands on lab session.
- I wish it would have been more hands-on type of lab.
- More audience participation.
- Possibly some more hands on actually.
- Bring in representatives of different companies with their own displays. Have round robins with smaller groups.

2. What was one thing that you will use from today's hands-on session?

- Setting up GPS systems.
- To look in some systems to see what is fit for my farm.
- Some of the procedures on how to diagnosis problems.
- Setting up an RTK base.
- Being able to pair GPS receivers with monitors.
- Selection of a monitor/controller. They are very versatile.
- Calibration of an RTK GPS system.
- Understanding more in depth of how GPS works.
- Set up on vehicles.
- The RTK info.
- Within the next couple of months I will be adding auto steer to one of our tractors.
- I will remember the setup of RTK and what each component does.
- How to set up RTK and use the components with it.
- Learning how to set up equipment.
- I know now what it takes to set up an RTK system.
- The different ways a GPS can be used in the field & auto-boom things.
- Time in the cab of the tractor.
- Info on RTK.
- Better knowledge of the way the systems work.
- Publications Information received where to go to receive information needed.

3. Was there enough time spent on each hands-on activity? 12 agreed, 8 somewhat agreed, 2 disagreed, and 0 strongly disagreed with the statement.

Comments:

- With these systems you could spend a whole day on them; but the time spent today was good.
- I have had another precision ag class and this had built up on that class and was more of the technical aspect other than mapping.
- Well spared out between labs.
- Need at least another all day lab.
- 2-3 days. Not one day!

4. Please rate the teaching effectiveness of each presenter:

| Hands-On Lab Exercises: | Excellent | Good | Average | Fair | Poor |
|---|-----------|------|---------|------|------|
| GPS Diagnostics | 10 | 10 | 2 | 0 | 0 |
| RTK GPS Setup | 10 | 10 | 2 | 0 | 0 |
| Utilization of Precision Ag Equipment beyond Yield Monitoring | 11 | 8 | 3 | 0 | 0 |
| GPS AutoGuidance Setup | 11 | 8 | 3 | 0 | 0 |

Please comment on areas that could be improved:

- Other than equipment which isn't your fault the lab was very informative. There was a lot of useful information. I have not had a prior course. Very well put together.

- RTK didn't work.

- Try to make sure everything is going to work next time.

- The fast timing was good to be done earlier.

- More hands on work.

- Seeing the RTK base station and the "Rover" in person set-up in front of me was helpful. More so than reading about or hearing it explained in a classroom.

- Maybe have one additional lab day. Have more hands on tractors available.

- Again 2-3 days are needed. Bring in reps with their own displays. Look more at trouble shooting. Have displays students can do their own setup etc.

5. Do you believe the notebook of class materials provided will be useful? 11 agreed, 8 somewhat agreed, 1 disagreed, and 0 strongly disagreed with the statement.

6. Do you believe the DVD of class materials provided will be useful? 10 agreed, 7 somewhat agreed, 2 disagreed, and 0 strongly disagreed with the statement.

7. Does there need to be more than one hands-on labs session associated with this online course? If so what would be other topics that need to be covered.

No, but perhaps split up the hands-on lab day into 2 days.

- No, I thought that everything was done well.

- Depends on the situation and the location of the students geographically in the class.

- Yes, maybe with more material.

- No, I think the time was well used.

- Yes, various types of differential corrections & satellite orbits. Include further innovations in technology.
- I felt that the course agenda went over a good wide spectrum of precision ag and the time point was adequate.
- Yes, a lot of us learned by handout of the activities.
- No.
- No.
- Possible, not for the schools farther away. (Note: This session involved students from Kansas State University.)
- No.
- Yes, I would like to cover more about GIS and mapping in addition to existing materials.
- No, this covers a lot of major topics that need to be covered.
- Yes, meet more than once per class. Meet to do another lab or two during the semester.
- Yes. Work on calculations made during online lectures and labs.
- Yes.

8. Please rate the overall quality of the today's hands-on session: 10 rated excellent, 9 rated good, 8 rated average, 7 rated fair, and 6 rated poor.

Please provide any additional comments, suggestions, questions or concerns:

I enjoy and learned things to look at with technology with this class.

- Class was very helpful and I learned a lot.
- More ride along.
- Have had other precision ag classes. This is perfect, it helped rebuild this info I have already learned.
- Allow students to become more involved.
- It would be interesting to actually retrofit an older machine w/ auto-pilot, maybe included as a hands-on session.
- Would have been helpful to setup an actual tractor and implement and see in action.
- I have had a precision ag class through Kansas State University. This class was somewhat repetitive, but does more into the hardware specifics. I like the accelerated 8 weeks instead of a full length course.
- Took a precision ag class last semester from Iowa State University. I enjoyed this more because it was a little more applicable.
- It would be helpful to get graded assignments returned to us or to get feedback.

CONCLUSION

Participants' reviews of the course were positive though improvement needs to be made. Participants by far express the desire to have as much hands-on experiences with the technology as possible. Part of the hands-on experience should also be in small groups. The need to have hands-on experiences to be as much real life as possible has been a focus of the extension teaching philosophy for the University of Missouri precision agriculture. It did seem that an 8 week

schedule of delivery was much preferred over a 16 week delivery. Follow-up with the participants is scheduled to get feedback on improvement of the online portion of the course.

REFERENCES

Shannon, D.K. 2008. Precision Agriculture Technologies Teaching Experiences at the University of Missouri – Face-to-Face and Online. 9th International Conference on Precision Agriculture.