Incorporating harvesting machine simulators in training forest engineers, foresters, and allied scientists

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INTRODUCTION

Background

Informed decision making during planning and management of forest harvesting operations take complex, dynamic, and multifaceted knowledge in forest operations. Knowledge in forest operations need to be tailored to harvest systems, equipment capability, physical and social operating environments, economics, and the environment specific to forest resource conditions. Forest operations education is offered by accredited forestry training institutions through classroom teaching, laboratory analytical techniques, and field visits to harvest units (O'Hara & Redelsheimer, 2012).

There is need to blend classroom and field learning methods with simulated environment because the training institutions are constrained by admission requirements, and are spatially distributed making it difficult for the enrolled or potential students to overcome temporal and spatial constraints (McNeel et al., 1999; Innes, 2005).

Forest operations distance education with simulated environment provide the opportunity to embed experiential learning activity such as harvest unit layout by taking guided tour of the simulated environment, watching videos of simulated logging, and operating simulator.

Objectives

1) Develop a method to connect subjects enrolled in forest operations distance education with simulated environments for experiential learning activities in the management of mechanized forest harvesting.

2) Determine the educational value of the interaction with the simulated environment using the metrics used in assessing the quality of logging plans submitted by the subjects and determine whether this trend varies with subject's experience with cut-to-length systems, years harvest planning, job class, professional qualification, and years in job class.

3) Determine whether subjects operating the simulator can implement their proposed logging plans and recommend modifications based on the capability of harvester and forwarder combination.

MATERIALS AND METHODS

1. Study area and subject recruitment

1) Simulate forest environment from selected area of the McDonald Dunn Research Forest planned for thinning using contour map obtained from LiDAR imagery and give its description.
2) Develop the study education material from the simulated environment and design an experiential learning activity to be performed by the subjects.
3) Recruit subjects from willing forestry companies and OSU students enrolled in forest harvesting operations class in fall 2020 as study participants.
4) Create distance education portal in the OSU box folder system and invite subjects enrolled in the study to access the general study instructions, education materials, and submission folders.

2. Education intervention description and sequence

The subjects will complete three online modules in sequence and one laboratory logging exercise with a harvester simulator. The subjects will prepare logging plans and provide explanation for non-treated areas for each level of involvement while taking into account the logging plan instructions and guidelines for preparing logging plans. The study sequence in Figure 1 is summarized as follows:

1) Level 1, review contour map and harvest unit description,
2) Level 2, review animated videos of walkthrough the simulated environment,
3) Level 3, review animated videos of simulated logging with harvester and forwarder combination,
4) Level 4, participate in a one day workshop and learn how to operate a harvester simulator to log a proposed unit layout.

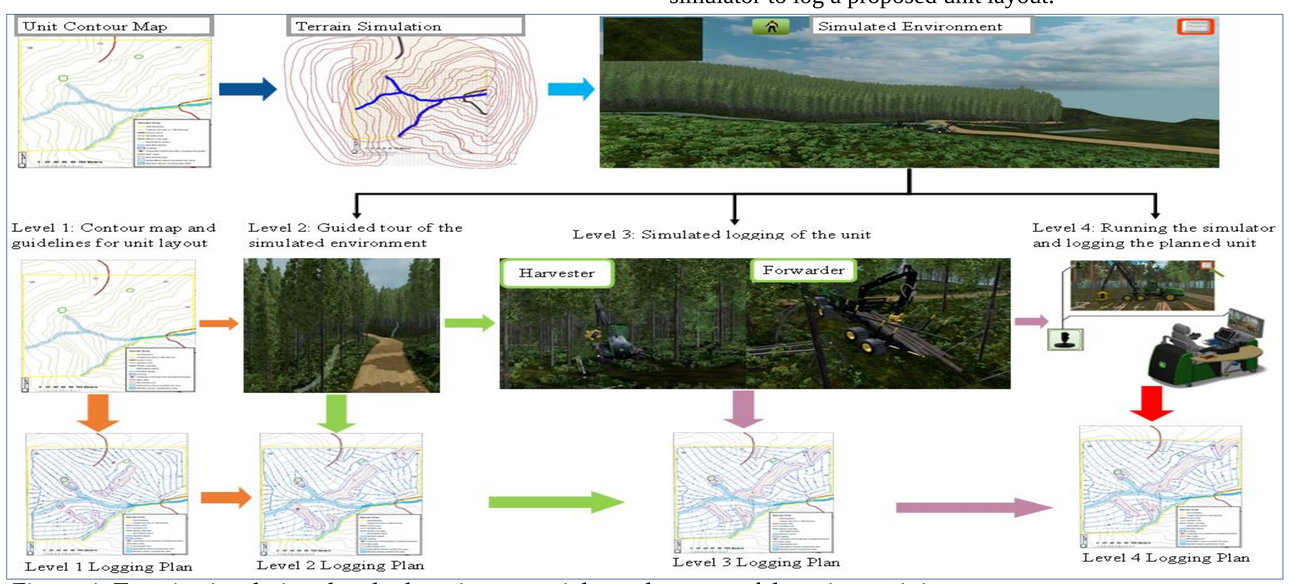

Figure 1: Terrain simulation, level education materials, and output of learning activity

3. Outcomes for the education intervention

After the interaction with the level education materials, the subject should be able to:

1) Locate safe forwarder trails,
2) Locate forwarder trail that is operational, and
3) Recognize untreatable areas for the harvester.

4. Data collection and Analysis

1) Study covariates will be obtained from subject demographics.
2) Continuous responses will be calculated from submitted logging plans and modelled using multiple linear regression.
3) Binary responses will be obtained from the explanation provided for non-treated areas in the logging plans and analyzed using logistic regression models.

5. Expected Study Outcomes

1) Create distance education portal in the OSU box folder system for enrolling study subjects.
2) Develop education intervention with experiential learning activity embedded in simulated environment for subjects enrolled in forest operations distance education.
3) Calculate metrics for assessing the quality of submitted logging plans.
4) Publish three journal papers.

LIMITATIONS OF THE STUDY

1) There is no control group that will not receive the education treatment making it difficult to infer causality between treatment and control groups.
2) The study will obtain non-independent data from the subjects, making it difficult to perform analysis of variance.

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