

Introduction to Prefabrication and Automation in Construction - Lesson Plan

Dr. Luciana Debs, Dr. Jiansong Zhang & Dr. Yunfeng Chen
School of Construction Management Technology –
Purdue University



Assembling Modular Homes (photo credits: Indy Mod Homes)

OVERVIEW

This booklet will give you information on the lesson plan to deploy the *Introduction to Prefabrication and Automation in Construction Curriculum*. This includes: descriptions and durations for activities and discussion points.

Objectives -----

At the completion of this module, students will be able to do the following:

1. Explain how using prefabrication affects the design and construction industry.
 - a. Explain what are prefabrication and modularization
 - b. Name 5 construction elements that can be prefabricated
 - c. Explain the importance of coordination and transportation logistics for prefabricated pieces
 - d. Explain how quality control for prefabricated pieces differ from those of traditional construction
 - e. Name two benefits and two challenges of prefabrication for the construction process and its stakeholders
2. Explain what are algorithms and what is automation
 - a. Explain what is automation and how it relates to algorithms
 - b. Identify simple algorithmic equations
 - c. Name at least two examples of automation technologies used in the construction industry
 - d. Explain how the increase of automation is beneficial to prefabrication in construction
 - e. Name two benefits and two challenges for the use of automation in the construction process and its stakeholders
3. Relate the importance of lifelong learning to the application of new technology
 - a. Describe how lifelong learning and technology relate
 - b. Identify ways to stay up to date with new technology
 - c. Elaborate a lifelong learning plan for learning new skills in the next five years

Version Information and Acknowledgements -----

Version 1.3, release date September 2021.

This lesson plan is free to be used for the educational purposes. This document may not be altered without the authors' consent. The images used in this document are the property of the individuals or entities listed in the image credits section and should not be used elsewhere other than in this document without their permission.

For more information, please contact Dr. Luciana Debs (ldecresc@purdue.edu).

The authors would like to thank the National Science Foundation (NSF). This material is based on work supported by the NSF under Grant No. 1827733. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the NSF.

Lesson Plan

The lesson plan contains a suggestion of how to use the ‘Introduction to Prefabrication and Automation in Construction’ curriculum. Instructors should feel free to adjust the times and breadth of activities to encompass other audiences, given that the estimated grade level for it is 10th grade.

Target Audience:

- Grades 9-12
- Non-traditional students with an interest in construction

Overview:

This curriculum is divided in three sections. Section one covers prefabrication, section two covers automation and section three discusses life-long learning in construction. It is advisable to discuss and cover the curriculum over two 1-hour sessions. The first hour should cover section 1; and the second hour should cover sections 2 and 3. This does not include preparation time, which will be expected of students.

Because of the breadth of content of the curriculum, active learning pedagogy is recommended. We suggest students are given the whole written material in advance and the significance of the material is discussed briefly before students start the unit. Students should be encouraged to read through all material and make notes where they do not understand something.

Class time: 5 min to present material and discuss significance;

Section 1 (1h):

Individual Preparation:

- Read and make notes on section 1 written material (30 min)
 - Guiding questions for reading:
 - Do you remember seeing a construction site using any of the mentioned prefabricated elements?
 - What do you think are 3 advantages and 3 challenges to using prefabrication in construction?
 - How do you think prefabrication can change the way we build today?

In class:

- Start with asking students if there is anything unclear or something they did not understand (2-10 min). Try to get class involvement in answering a student’s question.
- Review common topic terms (~5 min).
- Discuss objectives 1.0.0 (a) and (b) (~7min)

- Ask if any of the students can explain the difference between offsite construction, prefabrication and modularization using their own words. Ask if others agree or not.
- Ask students what is happening recently that has helped push towards more prefabrication in construction?
- Specifically ask about how prefabrication affects quality control and worker safety.
- Activity 1 (total ~15min):
 - Separate students in groups of 3 or 4 (no more than 4) and ask them to make a list of as many elements they can think of that can be prefabricated. This can be made into a competition. (~ 7 min). Then debrief groups' lists (ask students' input about how common those prefabricated elements are seen in construction) (~5 min)
- Activity 2 (total ~ 20 min):
 - This activity should be performed as a class, if class is ≤ 25 students.
 - Download materials for Section 1, Activity 2:
 - 1_PrecastModel_complete_R01_prompt R00
 - 1_Take off chart
 - 2_Prefab_Activity_RoutesR01
 - 2_Truck for Activity_R00
 - 3_Crane for Activity_R00
 - Present the case to the students and together, work your way through completing the take off chart. Then, as a class, discuss route, truck and crane options for the building. Make sure to discuss with students the importance trade-offs, such as the increased productivity with larger panels can make transportation and hoisting logistics much more complex. Discuss with students if they would change the proposed size of panels.
- Wrap up (~5min)
 - Review section objectives and ask if students have any questions on those.
 - Remind students to read sections 2 and 3 for next module.

Section 2 (45min):

Individual Preparation:

- Read and make notes on section 2 written material (20 min)
 - Guiding questions for reading:
 - As you read the material, what do you think the future of automation in construction will look like?
 - Have you seen some of the technology mentioned in the chapter being used in in construction? What about other areas and industries?

In class:

- Start with asking students if there is anything unclear or something they did not understand (2-10 min). Try to get class involvement in answering a student's question.
- Review common topic terms (~5 min).
- Review the concept of algorithms. Discuss objective 2.0.0 (a) (~5min)
 - Ask if any of the students can explain what are algorithms using their own words. Ask if others agree or not.
 - Introduce the concept of programming languages – what they are and what they do. Explain how pseudocode works and how it helps people think through the logic and steps necessary for writing a code.
- Activity 3 (total ~7min):
 - As a class, prepare the pseudocode for an activity. Choose the activity as a class (ask students what they want to write a pseudocode for), asking for input from students. As you write the pseudocode, make sure its steps are in logical order and very descriptive. Ask students to solve any ambiguity by providing a clearer description.
- Discussion about automation (~10min):
 - Ask students for examples of automation technologies used in construction. These can be the ones named in the curriculum or additional ones. As the technologies are mentioned, take the time to discuss benefits and challenges to their application in construction.
 - As a closing to the discussion, ask students what would be some of the consequences to the increase of automation in construction, specifically.
 - Wrap up (~3min)
 - Review section objectives and ask if students have any questions on those.

Section 3 (30min):

Individual Preparation:

- Read and make notes on section 3 written material (15 min)
 - Guiding questions for reading:
 - Do you have a plan for lifelong learning? If yes, what is it? If not, what are some activities you would consider including in it?
 - What type of learner are you? Meaning, how do you learn best?

In class:

- Start with asking students if there is anything unclear or something they did not understand (2-5 min). Try to get class involvement in answering a student's question.
- Review common topic terms (~3 min).
- Review the concept of lifelong learning. Discuss objective 3.0.0 (a) (~7min)

- Ask students about this concept. Is this something they were aware of? How do students see themselves 20 years from now, in relation to learning?
- Ask students what is the impact of technology in the concept of lifelong learning. Students might have conflicting views (technology as a way to help, but also as something that needs to be learned). Explore those conflicting views with students by providing examples (if possible, as students for examples).
- Ask students specifically how do they learn about new technology now? Use as examples some technology that is very recent and widely use by your audience.
- Activity 4 (total ~7min):
 - Guide students to elaborate a draft 5-year learning plan (you might want to adjust 5 years to a time frame more adequate for your audience) – this is figure 33 of the curriculum.
 - As students to be specific, but also to include some ideas of how to find information. Encourage students to exchange information on how they will learn.
 - Debrief: take a couple minutes to discuss the experience, some might feel overwhelmed and not know where to start. Reassure them that this is a draft that can be changed as their needs and wants change.
- Discussion about understanding self and asking for help (~5min):
 - Lead the activity into a discussion about how well students think they understand their skills and limitations in relation to learning. If possible, as them to share. If they share a limitation, ask student and others for ways to mitigate that limitation.
 - Discuss the role of mentor and asking for help. Students should be encouraged to find a mentor they trust that can guide them through the professional world.
 - Wrap up (~2min)
 - Review section objectives and ask if students have any questions on those.