A Proposed Dynamic Model for Education in Construction Project Planning

Mrs. Kristen Caroline Hurtado, Arizona State University

Kristen is a current PhD candidate in Construction Management at Arizona State University in the School of Sustainable Engineering in the Built Environment. She is also pursuing a Graduate Certificate in Instructional Design and Performance Improvement in the Mary Lou Fulton Teachers College. Kristen has experience teaching applied statics and estimating at the undergraduate level. She also instructs professionals in her work and research in value-based project delivery. The main areas of her research lie in: instructional design, online learning, measurement, professional education, higher education, the built environment, and facilities management. She is also interested in: instructional technology, learning analytics, connected learning, and project-based learning.

Prof. Kenneth Timothy Sullivan, Arizona State University
A Proposed Dynamic Model for Professional Education in Construction Project Planning

Kristen C. Hurtado and Kenneth T. Sullivan
Arizona State University
School of Sustainable Engineering and the Built Environment

Abstract

Project planning and coordination is one of the key fundamentals to executing successful project management. In the current construction industry, professionals are challenged with the planning of increasingly complex projects, while also maintaining a competitive schedule. As project teams and environments are constantly in flux in the construction industry, there is a need for education that is equally responsive to these needs. The education of professionals regarding planning is critical to the execution of successful planning activities and the utilization of the proper tools. The existing literature and frameworks, such as checklists and logs, have a more reactive approach and do not focus on how to educate a project manager to pre-plan. A dynamic model for the education of construction professionals in the area of pre-contract planning is developed and tested via a controlled experiment. The model derives its foundation from the research of key theorists in the field of educational psychology, such as Ausubel, Gagne, and Mezirow, taking a more constructivist approach. Key educational areas addressed in the model are: risk mitigation, proactive scheduling, and behavioral considerations. The proposed dynamic model is divided into three phases: Phase 1 – Principles, Phase 2 – Practice; and Phase 3 – Mentoring (PPM). The framework model proposed is a heuristic tool for individuals interested in becoming more adept in education of planning in dynamic construction environments.

Keywords: education, dynamic model, pre-planning, transformational learning

Introduction

The construction industry is wrought with complexity and dynamics, with constantly changing project teams and environments. Project planning education is important amid this environment as a means for professionals to be able to face these challenges with the proper tools. However, the current education and tools are less than responsive to the dynamic environment of the construction industry and there still remains an ongoing need for professional development. While tools abound in the industry, their ease of use and applicability to projects is less than fluid. Frequently, external educators and consultants must be hired in order to use these tools, leaving professionals behind once they have purchased these instruments. Moreover, some of these models remain in the testing phase due to their need to be redeveloped and never surpass initial testing. To be effective, education in project planning must be responsive to both the needs of the individual learner and the group. The topics must be deemed worthwhile, relevant, and readily applicable. The model to mobilize this kind of education must go beyond the current tools and instruments to create a more transformational type of learning and sustain a change in the behavior of project managers as a basis of its design.
Traditional Professional Education Models

The term continuing or professional education is defined by the Associated Schools of Construction’s (ASC) Classification of Instructional Programs (CIP) as a program that prepares individuals to teach adult students in various settings, including basic and remedial education programs, continuing education programs, and programs designed to develop or upgrade specific employment-related knowledge and skills. Professional development and education in the construction industry has been largely prescriptive and followed the advent of new technologies, such as Building Information Modeling (BIM) and LEAN methodologies. While useful tools on projects, the implementation and education of how to use these tools has largely been “technology-centered,” focusing more on the new technology than on the professionals seeking to learn. Research suggests that the needs for continuing education of construction professionals may be in more managerial topics than in new advances in technology in the industry. Nevertheless, the main methods suggested for learning in the construction industry are seen as: formal education (university or college), on the job experience, or under direction of a professional. Thus, there is little room in the way of professional education outside of traditional means or on the job training.

Planning

The notion of what “planning” means has divergent definitions across the industry, from project feasibility to a strong emphasis on schedule. While these factors are to be considered as part of the overall planning process, research suggests that there is little guidance regarding how to create a construction project plan that is usable and meaningful to both the contractor and the client. Research on observed shortcomings of plans over the past 26 years has characterized current plans as:

- Overemphasis of plans has been on schedule
- Appearance that most plans were not done by personnel with project experience
- Plans have a limited discussion of risks (largely related to internal means and methods)
- Plans do not go beyond following a type of template
- Plans are not useful to the contractor after they are approved by the client (or start executing the work)
- Plans are not useful to the client after they are approved

The method of continuing education needs to be further refined in order to meet professionals’ needs for ongoing learning, especially in the area of project planning.

The Need for Dynamic Models

To be effective, education of construction management professionals must be more learner-centered, which requires a good knowledge of the learner audience and can be a dynamic function. One of the unique characteristics of the construction industry is that it is composed of a wide range of ages, from novices to the industry to seasoned adults, and each bringing varied experiences and backgrounds. Since as early as 1883, there has been an ongoing debate as to if there is a difference between instructing adolescents versus instructing adults. The term, andragogy, was coined to describe the various facets (method, technology, theories, etc.) of
educating adults and how they differ from educating adolescents. While the definitions of andragogy may vary depending on the source, the underlining principles hold that the methods for the education of adults are very different than those for the education of adolescents. The main differences are in: the role of the instructor as a facilitator versus a source of knowledge; the role of internal motivators; and the objective of the learning. By allowing learners to use their executive control or self-concept, instructors become more facilitators of the educational environment and the goal becomes one of creating learners that are autonomous. Thus, the education of professionals in the field of planning in construction management should be centered upon enabling independent thinking and decision-making versus instructing them how to complete a task or repeating information.

Methodology

A controlled experiment was conducted wherein construction professionals were educated on the topic of construction project planning, and subsequently created planning documents for their projects. There were two educational models, the first being characterized as traditional and the second was the proposed dynamic model. The goal of the controlled experiment was to compare traditional education outcomes versus the proposed dynamic model’s outcomes.

The educators consisted of two university instructors, with over fifteen years of experience instructing at a large public university in the USA. Additionally, they were selected because they have instructed professionals regarding the concepts of construction project planning for over fifteen years and have conducted valuable research that contributed to the development of the proposed dynamic model. The educators for both models were interviewed and asked to rate criteria based on the project planning documents that were developed as a result of the education.

Project planning documents from eleven projects whose personnel were educated using the traditional model were analyzed against project planning documents from two projects whose personnel were educated using the dynamic model. Due to the timing of this research, the typical timeframe for the execution of construction projects, and the recent development of the dynamic model, the amount of projects that were analyzed was constricted. The traditional model was executed prior to the dynamic model, as findings from the traditional model was first analyzed and reviewed by the instructors prior to executing the dynamic model. Despite these constraints, the development of this dynamic model and its preliminary formative evaluation uncovered significant findings and differential between the two models.

The proposed dynamic model will first be presented, along with a description of the design and implementation of each phase. Once the model is presented, the results of the controlled experiment will be documented and discussed. As the model has been tested in Phase 1, subsequent testing will address its use on projects currently using it in Phase 2 and 3 and will be the subject of future research.

Proposed Dynamic Model

The design of the proposed dynamic model for professional education in construction project planning took inspiration from Mezirow’s principles of transformational learning.
Transformational learning is “the process of effecting change in a frame of reference” or bodies of past experiences that shape and define the way learners understand their experiences. By acknowledging the needs of professionals as learners, the model focuses on a more sustained, behavioral change in the learners. The main factors of differentiation of the dynamic model from the traditional model are in its design and implementation. The proposed model is divided into three phases: Phase 1 – Principles, Phase 2 – Practice; and Phase 3 – Mentoring (PPM) as seen in Table 1.

Table 1 – PPM Model

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Principles</td>
<td>Presentation of concepts</td>
</tr>
<tr>
<td>2</td>
<td>Practice</td>
<td>Application of concepts in a practical setting</td>
</tr>
<tr>
<td>3</td>
<td>Mentoring</td>
<td>Educating and helping others</td>
</tr>
</tbody>
</table>

Phase 1 – Principles

The structure of Phase 1 took inspiration from the concepts of Competency Based Instruction (CBI). The design begins with mapping out learning objectives that are both clear and worthwhile to the particular audience, in this case the construction professional. The greater the instructor’s understanding of the preexisting knowledge of the particular audience, the better equipped they will be in helping the learners subsume the new information into their preexisting knowledge or, if unable, reject it. Those objectives are then directly correlated to developing assessments that will be given to the learners, understanding that full realization of the objectives will ultimately occur in learners’ performance (Phase 3). Once these are developed, the lesson is designed in a way to acknowledge and harness the preexisting knowledge and experience of the learners. It is also suggested, where possible, that an exploratory survey be administered to the learners prior to Phase 1 to aid the instructor to maintain a more learner-centered design.

In the execution of Phase 1, while the instructor takes on a more traditional role as a figure at the head of the room that presents the concepts, the instructor should engage the audience more than in a traditional sense. The instructor can accomplish this by: asking questions, allowing enough time for the audience to respond, and presenting the information in a way the learners can relate to. The concepts should be presented in a more practical sense by using case studies, project examples, and industry-related information. Learners must also be given the opportunity to engage in groups and initiate discourse as a way to validate (or invalidate) their frames of reference. Thus, the execution of Phase 1 requires the instructor to serve as a facilitator and engage the learners.

Phase 2 – Practice

This phase involves the utilization of the principles presented in Phase 1 in the learners’ environment, via practice on a project. Any learning as part of Phase 1 must be incorporated at Phase 2 in order to allow the learner to “test” the concepts themselves. If the concepts were only to be taught and not used, it is suggested that the degree of retention would be low and confirmation of existing knowledge (in lieu of newly acquired knowledge) would be high. Furthermore, testing of new knowledge in a controlled setting might be perceived as unrealistic.
to the particular audience, thus it is suggested that the practice should take place in an environment that the learner can relate to and feels realistic to them.

Generally, a single instance of performance or a single project does not allow the learner to fully test and confirm their learning\(^6\). Albeit, the learner may make a decision to confirm or reject the new knowledge based on one test. Therefore, it is highly recommended that care should be taken in the execution of this phase to optimize the knowledge. Feedback should also be provided to the learner to inform them of the correctness of their response or use of the principles\(^6\). If an opportunity to practice the principles occurs again, care should be taken in ensuring that the feedback and lessons learned in the first practice are captured and used as part of continuous learning.

Phase 3 – Mentoring

The format of this phase is less formal and structured as the previous, as it relies heavily on the learner and their future mentoring relationship with another, less advanced, learner. In this phase a more advanced learner (mentor) is matched with a less advanced learner (mentee) as early as Phase 1, but usually in Phase 2. The mentor can assist the mentee in Phase 2 and/or practice on a second project. The mentor does not fully take on the role of the original instructor, rather, they are more focused on providing knowledge and insight that the instructor has not given or in reinforcing concepts that seem questionable to the mentee. This Phase is also a learning exercise for the mentor. It is likely that the project the mentee chooses to test will be somewhat different from what the mentor has seen in their experiences, thus allowing them to test the principles not only in similar situations, but also in new situations that may be different from their usual environment\(^2\).

During this time, the instructor should aid the mentor in forming a relationship with the mentee and in ensuring they are a proper match. Tools that measure more interpersonal and psychological traits might be useful in this matching process. At this point, the mentor might feel challenged and need support beyond the initial principles in Phase 1 and lessons learned in Phase 2. In this light, the role of the instructor becomes more of a coach in ensuring that the mentor is learning from this experience and benefitting the mentee.

Data Analysis

The project planning documents from eleven projects whose personnel were educated using the traditional model were analyzed against project planning documents from two projects whose personnel were educated using the dynamic model. The construction projects selected for both the traditional and dynamic model were similar in size, scope, and location. This was done in order to create a controlled experiment.

The educators for both models were interviewed and asked to rate criteria based on the project planning documents that were developed as a result of the education (Table 2). The criteria were developed based on the shortcomings of construction project plans previously discussed\(^7, 9, 10\). In comparing the documents created by personnel that was educated via the traditional model, an average of the instructors’ ratings were taken, which revealed a high level of involvement of the
instructor in creating the plan, low level of involvement of the project personnel (contractor) in creating the plan, low degree of usefulness of the plan to the contractor, low degree of usefulness of the plan to the client, and low overall rating of quality of the plan. In contrast, the dynamic model was rated at a higher level for all of these criteria, showing a large differential. The lowest differential was in the level of the instructor involvement (yet should be lower than the involvement of the project personnel), due to the need for the instructor to still act as a facilitator and coach for the personnel developing the plan. The dynamic model overall improved the project plan’s degree of usefulness and overall quality.

Table 2 - Pre-planning Document Defining Criteria (*“1” = low; “10” = high)

<table>
<thead>
<tr>
<th>No.</th>
<th>Criteria</th>
<th>Traditional</th>
<th>Dynamic</th>
<th>Differential</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Level of involvement of the instructor in creating the plan</td>
<td>8</td>
<td>5</td>
<td>-38%</td>
</tr>
<tr>
<td>2</td>
<td>Level of involvement of the project personnel (contractor) in creating the plan</td>
<td>5</td>
<td>10</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>Degree of usefulness of the plan to the contractor</td>
<td>2</td>
<td>8</td>
<td>300%</td>
</tr>
<tr>
<td>4</td>
<td>Degree of usefulness of the plan to the client</td>
<td>3</td>
<td>8</td>
<td>167%</td>
</tr>
<tr>
<td>5</td>
<td>Overall rating of quality of the plan</td>
<td>5</td>
<td>8</td>
<td>60%</td>
</tr>
</tbody>
</table>

As the model has been tested in Phase 1, subsequent testing will address its use on projects currently using it in Phase 2 and 3 and will be the subject of future research. Yet, the preliminary results of this controlled experiment reveal a large improvement in the outcomes of the project plans and usefulness of those that were educated using the dynamic model. The authors anticipate further benefit in Phases 2 and 3 of the dynamic model.

Conclusion

The current means of education in the area of project planning is not meeting the needs of professionals and project plans are deemed to be less than effective as a result. A dynamic educational model was developed out of this need and was based on leaders in the field of education, especially Mezirow’s transformational learning concepts. The model was tested as a controlled experiment in contrast to a more traditional model. The data analysis revealed the dynamic model had positive impacts on construction project plans as being primarily created by construction personnel (with the educator of the dynamic model serving more as a coach), deemed as useful to both the contractor and client, and overall higher quality, when compared to the traditional.

Additional testing of this model on more projects would benefit the research and has the potential to further cultivate this model. Future research is needed in the refinement of the dynamic model, specifically Phases 2 and 3. It is suggested that assessment criteria, evaluations (formative and summative), and learner feedback surveys be tested as tools to aid in the development of this dynamic model. This model can also assist in the creation of more practical methods of incorporating these principles into formal education. Research should also be carried out on the dynamic model’s impact on autonomous learning and empowerment. The model’s application to other concepts beyond construction project planning should also be explored.
Bibliography


