Construction Communications Simulation Through Virtual Set-Up Environments and Information Technology

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This paper describes and presents *Construction Communications Simulation through Virtual Set-Up Environment and Information Technology* which was embedded as a pilot learning module into the course *Information Technology in Construction* which is taught in the Spring term at the Asian Institue of Technology, Thailand. It was felt that while the course did justice to the theoretical aspects of information technology in construction, it failed to provide a hands on training environment exposing students to the realities of working in a complex and diverse construction project environment. Extensive course load limited the students from actually stepping out of the classroom for long periods to experience construction reality. For this the site had to be brought into the reach of the students and this was possible through an intitiative such as *Construction Communications Simulation through Virtual Set-Up Environment and Information Technology* (CCSTVSUEIT). Virtual sceanarios were created to simulate real life construction activities and to engage the students into the dynamics of decision making through information exchange and communications devices. The initial results were quite promising. As compared to the traditional output of students being equipped with theoretical knowledge, and support tools, now they were able to communicate better, utlize information technology in a meaningful manner for staisfaction of their information needs, and perhaps most important of all, they were prepared and ready to face the challenges of a complex and dynamic construction work environment.

I. Background

Time constraints, emerging technologies, and need for practical exposure for construction engineering and management students were strong issues needing addressment. Furthermore, traditional classroom environments focused only on knowledge and comprehension skills building with little focus on application. Construction communications simulation through virtual set-up environments and information technology (CCSTVSUEIT) was a learning module that aimed to extend these skills building to incorporate analysis and synthesis as well. In the long run, it aimed at helping students to extend their skill capabilities to include evaluation and decision making.

CCSTVSUEIT proposed to exploit the proper integration of communications and information technology to achieve gains at both academic and professional development levels. The underlying principles of CCSTVSUEIT were to enhance interactivity through practical exposure, case study based learning and active learning, to use online technology to break traditional classroom boundaries, and equip students with information and communication tools and techniques to provide them with better decision making skills. This was beleived necessary to

ensure that a balance was maintained between theory, practice, and technology, as compared to the traditional classroom practice of focussing primarily on theory.

It was observed that allocated classroom teachings and faculty visiting hours were limited. CCSTVSUEIT was an attempt to resolve this issue. Making use of appropriate information technology, class room boundaries would be extendable through online question-answer sessions (where there was no fixed discussion time, but students could leave a question for a faculty to answer at another time at their convenience), discussion forums to foster more interactivity, virtual classrooms to allow for time savings during regular class hours which could then be used for other meaningful purposes, etc.

Other than the conveyance of theoretical knowledge, there was a strong need to equip students with better practical tools to facilitate their professional development once they tackled the real world after graduation. CCSTVSUEIT would help bring in reality into classrooms through case study based learning using information technology. Furthermore, students would be trained to effectively use different information and communications tools and techniques to enhance their decision-making skills at both individual and group levels.

CCSTVSUEIT was a learning module aimed at not only fostering better value added teaching delivery in the construction engineering and management field of study at the Asian Institute of Technology, but to also strongly influence and promote the professional development of its graduates.

II. Towards CCSTVSUEIT

Rationale: Construction operations are characterized by dynamism which is affluent in every construction project environment. The concurrent execution of independent, interdependent, and dependent activities coupled with multiple role players from different influential parties add a certain degree of complexity to the situation.

Most decisions in construction are negotiation based and involve the interaction of different role players. Since the time available to make critical decisions is limited, effective communications becomes a critical resource for decision making and dispute resolution.

Current Curriculum Situation: The catalog description of the course, *Information Technology for Construction* is, "Information technology has a polarizing effect on business management as well as construction management. In this course, the focus is on the use of information technology in generating, processing, storing, and transmitting construction-oriented information to assist management decision making. Many aspects of information management and technology will be discussed; computerized project planning, scheduling, and control systems; analysis and design of information systems; artificial intelligence and expert systems; and construction automation and robotics".

Need for Change: This course (Information technology for Construction), as most other courses in the construction engineering and management field of study at the Asian Institute of Technology, despite imparting significant theoretical knowledge and insights into practical

situations through case studies and term projects, fails to foster a true decision making environment. Where term projects are assigned on a group basis, the focus is on one role player (such as the contractor) in the construction process under a given situation with all group members collaborating to ensure success from one perspective only. There is a need to expand this horizon further to include the influences of multiple role players and multiple discussion forums and methodologies.

Methods of Change: Methods of change are proposed through the embedding of a learning module in the name of "Construction Communications Simulation through Virtual Set-Up Environments and Information Technology". Here, students would be exposed to virtual construction scenarios and placed in managerial positions to appropriately collect and disseminate information, communicate and interact through different communication devices, both traditional and information technology based and learn to make decisions based on the collected information and the communications made. This will prepare the students for proper managerial positions as compared to traditional positions.

III. Objectives of CCSTVSUEIT

The objectives of CCSTVSUEIT were set to be:
- Identification of different information collection and dissemination methods in construction.
- Exploration of different communication and decision making tools in construction.
- Information and communication device analysis for improved decision making.
- Preparation of students to meet new challenges in a changing global environment through imparted training and exposure to different situations, scenarios, information collection and dissemination norms, and communication and decision making tools though situational simulation.

IV. Implementation

The implementation of CCSTVSUEIT was based on a sequential process, encapsulating the basic stepping stones of *Bloom's Taxonomy of Learning*. Three stages were identified for implementation. These stages were learning (stage I), doing (stage II), and assessing (stage III).
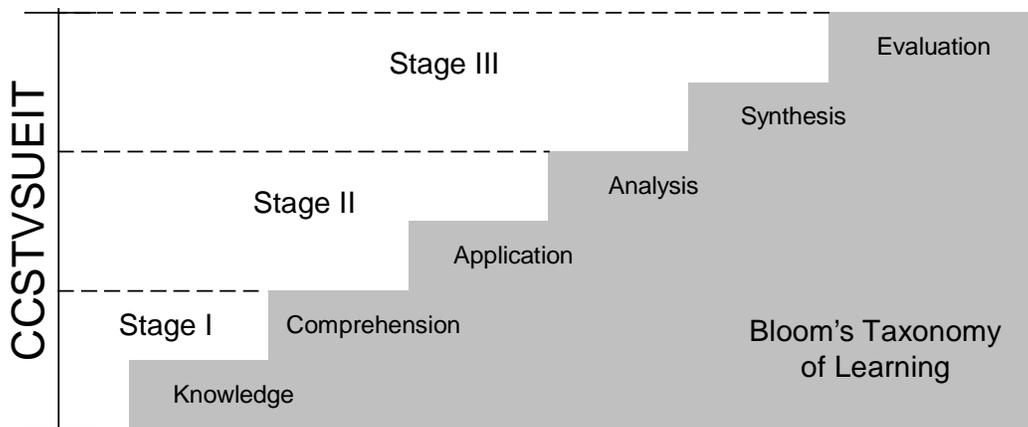

Figure 1. Implementation Stages of CCSTVSUEIT and Bloom's Taxonomy of Learning

The first stage of implementation, learning (stage I), was an attempt to capture and address the first two blocks (steps) of *Bloom's Taxonomy of Learning*. Before exposing students to virtual set-up environments, it was necessary to train and equip them with the fundamental basics of information and communications. More specifically, information analysis, and communication tools and techniques.

Information is the guiding torch in some form or the other in most endeavors. The analysis of available information in a proper and meaningful way is hence essential. For this purpose, students were exposed to the following:
- Information Sources
- Information Rationalization
- Information Classifications
- Information Requirements for Decision Making
- Information Management
- Information Details and associated Management Levels

On the communications front, communication tools and techniques were explored. Some of the important issues addressed included:
- Forms and Techniques of Communications
- Communications with Different Audiences
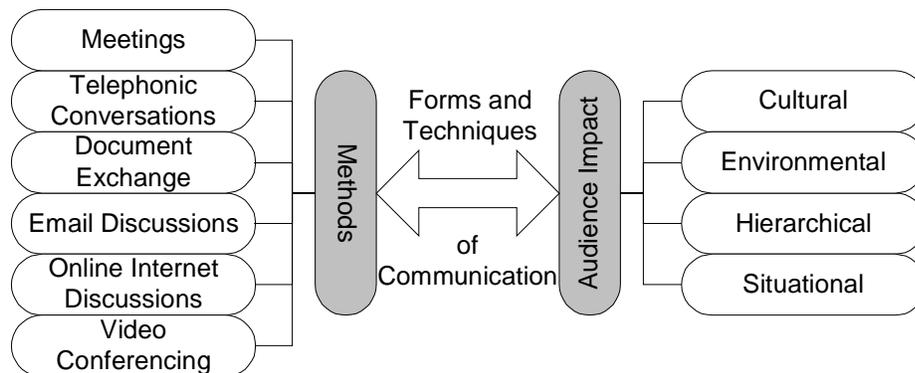- Communication Methods

Figure 2. Learning to Communicate

Once the learning stage was accomplished, the doing stage (stage II), which attempted to address application and analysis, was initiated. Since it was not feasible and practical based on time considerations to send students to construction sites and to allow them to participate in project dynamics there, situational scenarios were created through IT. Typically, video clippings were made available over the local intranet and online case studies presented. Project documentation too was made available in abundance in an attempt to replicate construction reality. Situation specific problems were created and students assigned roles to play in the debate and resolution process. Based on what they had learned during the previous stage, communication and information analysis experiments were conducted using different tools and techniques. Different groups of students tried to resolve the problem using different information analysis methods and communication tools. Overall, an attempt was made to simulate the decision making

environment at a construction project, and through the process, facilitate interactive learning. A summary is presented below:

- Construction Case Study
- Group Exercise
- Different Role Players in Each Group
- Problem Identification
- Information Analysis
- Communication Method
- Group Discussion
- Group Consensus and Decision Making

Figure 3. Situation Simulation, Role Play, and Interactive Learning

Each student involved participated in several such exercises and an attempt was made to expose each to all tools and techniques under different set-up environments.

The third stage, assessing (stage III), involved the synthesis of the lessons learned through the overall exercise and exposure, and the evaluation of different tools and techniques under different situational scenarios. Individual and group presentations followed to elaborate on the lessons that were learned and the identification of the appropriate communication method for each possible scenario.

V. CCSTVSUEIT and Value Addition

The incorporation of a learning module such as CCSTVSUEIT in the course *Information Technology for Construction* was found to be quite beneficial from several perspectives. One of the main deliverables noted after the implementation was that synergy was drawn between theory, practice, and tools. Furthermore, significant value addition was observed as briefed from different perspectives below.

Academic Perspective: Within the CCSTVSUEIT learning module, certain academic learning functions were embedded to provide students with more information and learning opportunities outside class hours. The embedded functions included online question-answer forums, and discussion forums. Through this exercise, faculty were able to better address general questions and queries put forth by students. Furthermore, everybody was allowed remote access and hence time and space were not a hindrance.

Where possible, attempts were made to create virtual classrooms online. This enabled faculty to post and teach material through the local intranet and allowed the students flexibility as to when they wanted to attend the class. One special finding from this initiative was that now more time was available to address more serious issues and focus on specific topics during traditional in class hours.

Practical Perspective: CCSTVSUEIT provided a strong foundation for the students to prepare for entry into the real world. Some of the basics with which the students were equipped after CCSTVSUEIT were the ability to:
- Identify and rationalize problems
- Filter, analyze, and synthesize information
- Use advanced communications tools and techniques
- Perform situational analysis
- Demonstrate theoretical and technological competence
- Promote and participate in group communications and decision making

It was also noted the CCSTVSUEIT would be a strong contributor to the overall professional development of the students upon graduation.

VI. Conclusions

The current dynamic work environment of construction demands more than only theoretical skills from fresh graduates. What is required is a well tuned balance between theory, practice, and application. To facilitate the satisfaction of this demand, CCSTVSUEIT was introduced as a pilot learning module into the course *Information Technology for Construction* at the Asian Institute of Technology. CCSTVSUEIT was an attempt to bridge the gap between theory, practice, and application, and to introduce and promote synergism between theses three distinct entities.

The core underlying phenomenon of CCSTVSUEIT was to bring the site into the classroom through IT and case study based learning. Student exposure to real life situations and the different communication forms that were involved was deemed necessary and these were created through the set up of virtual learning environments. Making efficient use of web based applications, and interactive learning, CCSTVSUEIT was implemented.

Initially found difficult to develop and implement, CCSTVSUEIT was found to be extremely beneficial. It was noted through the implementation that, virtual classrooms promoting enhanced learning could be enabled, better information management training facilitated, group decision making skills of students enhanced, and foremost, students appropriately furnished with the professional requirements of information analysis and communications required in a dynamic and complex work environment such as that of the construction industry.

The true value of CCSTVSUEIT will of course be measurable once the students graduate and face the real world, and a proper comparison between them and their predecessors (who entered the real world without exposure to CCSTVSUEIT). Though this will take time, there is the belief

that CCSTVSUEIT will yield to become an essential requirement of most construction courses as compared to a one time pilot test.

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