

Evaluation as a key tool to bridge CAAD and Architecture Education

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This paper reports on the findings of a study carried out at Glasgow University which proposes a framework for the evaluation of architecture curriculum once integrated with CAAD. This study investigated the evaluation of CAAD teaching methods (CTM) and the effectiveness of CAAD integration (CI) and explored CAAD employment suitability in the design studio, and what influences does it have on the design process tuition using the Kirkpatrick model as a vehicle. The related CAAD evaluation variables investigated were: CAAD Tutor, Course Materials & Contents, Class Environment, Use of Media, Delivery Methodologies, Administrative Briefs, and Overall Effectiveness of CAAD event. Several other variables investigated were the levels of students' performance, attitudes, knowledge, new-stand, creativity and skills. The paper covered briefly some of the findings of the case studies acquired over two years at MSA; both observations and questionnaire surveys were used as methods of data collection. Evaluation deficiency postulates the weaknesses of CAAD in architecture schools. Evaluation of CAAD tuition should be a fundamental approach to address CAAD integration efficiency and problems, to achieve effectiveness and productivity amongst architecture schools.

Keywords: *Evaluation, Integration, and Effectiveness*

The Evaluation of the CAAD Teaching Methods (CTM)

To evaluate CTM, CAAD integration domains (CID) must be appropriately used to define creativity and performance of the students' learning events and the teacher competency. Attaining the objectives of CID in the learning event would help to assimilate knowledge, skills, and attitudes. CID are recognized as: Cognitive: Knowledge. Psychomotor: Skills. Affective: Attitude. Creativity: Innovative. Performance: Achievement measures (Bloom, Madaus and Hastings, 1981) (QaQish 1998, a).

The Cognitive Domain: (assimilating Knowledge). Bloom, Madaus and Hastings (1981) system requires

a learner to demonstrate an increased level of processing knowledge: or cognitive skills. It tests the learner handling of knowledge, and compares different methods of evaluation in any learning events.

The Affective Domain: (attitudes) Krathwohl, Bloom and Masia (1964) suggest that the learner should know the appropriate attitudes and suitably demonstrate the event.

The Psychomotor Domain: (Skill manipulation) Sax (1980) focuses on skills associated with dexterity (proficiency, ability, manual skill), hand/eye coordination and error reduction in the human use of devices. It helps in determining whether the low level of skill demonstrated by students is due to a lack of knowledge, or attitudes.

The Creativity Domain: Creativity is the vehicle most design studios use to transfer knowledge, skills, and attitudes to the students and expressed in their project's scheme.

The Performance Domain: Achievement measures. Mager and Pipe (1981) argue that performance level reached amongst students and teachers typically indicate the standards settings in education.

What is CTM and CID Evaluation?

Evaluation is the systematic collection and analysis of data required prompting resolutions, a process in which programs engage from the beginning. A key to successful CAAD evaluation is a set of distinct, measurable, and pragmatic program objectives. If objectives are not measurable, CAAD evaluators may not be able to confirm that CAAD integration has been successful, though efficient task were rendered. CAAD course objective and means of achievement is another essential issue that should not be ignored (QaQish 1997).

To what purpose CAAD should animate coincidentally a process of innovation within an attendant condition of architecture curriculum, e.g. CAAD tutor, students, CAAD material, and CAAD learning environment. The curriculum reliance of the learning materials, refined by the teacher or higher education bodies, provided are designed to comply with specific learning objectives. The objectives of CAAD course leave an impact on the learner by the extent of its achievement level.

In architectural programs with CAAD, rationalization exists to evoke reasons to conduct evaluations, including the following (QaQish 1997):

- Decide the level of appropriateness and effectiveness of CAAD course for students,
- Furnish statistics about value delivery that will be effective in CAAD course
- Determine whether programs "make a difference,"

- Provide the means for CAAD staff to prompt effective changes.
- Advance CAAD susceptibility,
- Provide CAAD staff with information to improve service delivery.
- Explore CAAD effectiveness in practice amongst graduates.
- Report program objectives have been successful or not;

Evaluation mechanisms for architecture schools can be tailored to CAAD programs' objectives and necessity. E.g., schools with limited evaluation resources may want to concentrate on finding out how effectively they are delivering CAAD course. Other schools with limitations on CAAD programs may want to know how those limitations and constraints affect program delivery, e.g. budget, CAAD staff availability and competency, space availability, curriculum flexibility, and course structure. CAAD staff with evaluation capabilities and larger resources can enlarge evaluation use to learn how successfully they are affecting student behavior, performance, skills, knowledge, and then use the results to construct the projects' brief most successful contents. Architecture schools with evaluation results have an obligation to report on the impact of their CAAD programs on student behavior and performance in relation to design studio. A dominant and interesting argument for integrating a new CAAD course is that it made a positive difference for students (QaQish 1998, b).

CTM Activities Initiation

Through CTM activities, CAAD tutors, or administration decide what CAAD courses to offer and how appropriate they are is being carried out. The appropriate evaluation activities to be inaugurated into CAAD programs are:

Establish the value and use wanted when integrating CAAD, e.g., determine what attitudes, knowledge, skills, or behaviors' changes a CAAD course poises.

Follow CAAD program objectives, e.g., design a framework that indicates students' productiveness, how much CAAD knowledge is delivered, how students rate the CAAD knowledge they receive, and which CAAD strategies are most promptly adopted by CAAD staff.

Choose and Improve from CAAD alternative program approach already undertaken, e.g. comparative analysis of curricula or CAAD strategies to determine which ones accomplish the goals.

Experiment and appraise new CAAD program designs to determine the extent to which a specific proposal is being implemented carefully by architecture school or the extent to which it interests or engages students.

Establish CAAD course objectives and determine the specific indicators for testing, e.g. the tangible performance, skills, knowledge, attitudes, or behavior measures. This will illustrate the level and extent of success in CAAD objective effectiveness and appropriateness.

CTM Behavioral Outcomes

Architecture schools should regard process evaluations to be adequate for CAAD course assessment. They should use evaluation to determine whether delivering CAAD is being conducted in an appropriate and efficient manner to guarantee that the set goals are being met and to improve and maintain efficiency in CAAD wherever needed. They should also find out whether CAAD programs are effective in "making a difference" for future graduates and clients in the community. They should also know whether a set of interventions changes student behavior or other indicators of design studio in order to decide how to proceed with CAAD program (QaQish 1997).

Evaluating the impact outcome could identify changes that may have occurred in architectural tuition as a result of CAAD integration. Analyzing these changes may help to determine whether they are characteristic of CAAD program, which means that

the changes have occurred without the program activities. Demonstrating such instant changes in behavior occur as a result of a CAAD program is commonly difficult, because students behaviors towards CAAD such as AutoCAD or ArchiCAD are likely to change over time as the programs themselves are constantly and rapidly changing.

The Kirkpatrick's Model

The study embraced the Kirkpatrick's model (1977) in evaluating CAAD courses. The evaluation in this study relates to the measurement level of the overall impact of an innovation on the institutional environment and relates to cost improvements of employee moral; along with turn over rates and productivity on a total institutional basis. Kirkpatrick argues that an innovation in any institution will unquestionably have an effect on the institution, but will not radically change its structure. When curriculum is evaluated Teymur (1992) suggested several criteria, namely: objectives and aspects, medium, methods. Hennessy (1982) maintains that to use a curriculum's development method effectively an established performance achievement is the basic design objectives. So, specific performance standards are needed and preferred, although it is not always the case. Eraut (1969) identified three stages of curriculum development in the new area of technological education: 1) Formulate aims, 2) Develop a mechanism of achieving these objectives, 3) Select the objectives according to the aims.

The following are the criteria needed to conduct CAAD evaluation:

- Overall costs of an innovation.
- Overall improvements in staff and students.
- Measure productivity and increased efficiency versus better service in the organization.
- The evaluation of effectiveness and appropriateness of learning events, versus effects of the ability of the organization, thus attract high achievers from teachers, learner,

grants, sponsorship and academic ranking.

- Number of students before or after the department introduced CAAD courses.
- Accomplish reinforcement of the concepts of good achievement and goal creativity.
- Cost justification.

The CTM and CID Study Objectives

Objective answers built on rational and empirical reasoning to the real problems that face CAAD teaching & learning in the computer laboratories have not been embraced, when integrated with both the design studio and the curriculum in schools of architecture. There is enough evidence to suggest a deficiency on how to substantiate CAAD into the curriculum of architecture. The evidence suggests that CTM and CID are being faced with many problems when administered and substantiated in CAAD or the design studio. This study embarked on investigating four principle problems:

- Evaluating CAAD substantiation in the architectural curriculum and the methods and concepts of CAAD integration in the teaching of architecture.
- Evaluating the teaching methods in terms of effectiveness and efficiency.
- Evaluating CAAD integration in terms of its effectiveness and appropriateness of use in the design studio.
- Evaluating the use of CAL in CAAD, the different types of approach to instructions, the instructional strategies that can be employed in computing teaching when integrated with design.

CTM Evaluation Constraints Identification

One of the problems of integrating CAAD in the design studio is the teacher's lack of competence, and method of instruction. CAAD problems may lie in the organization and management of teaching and the

improper course objectives. Architecture schools must recognize the need for (QaQish 1997):

Evaluating the structure of the curriculum to successfully add a new specialty, and adapt functionality to CAAD courses, as a new and valid area in architecture.

Acquiring changes in the course objectives and assessments of the design studio to encompass CAAD.

Acquiring qualified teachers who will be able to deliver a wide range of comprehensive CAAD specialty courses.

Appropriate/positive changes in the design studio may prosper provided: a) competent students and tutors are guaranteed, b) appropriate CAAD applications are available and properly delivered through a well-established CAAD- design studio program.

The Study Methodology

The study methodology suggests a framework of evaluating CAAD integration via a series of experiments in the form of fieldwork observations and questionnaire surveys. It furnished an empirical investigation into the functional and theoretical usage of CAAD in schools of architecture via three case studies, namely (QaQish 1997):

1. A Worldwide Survey of Architecture schools
2. MSA via 3rd year AEC Course
3. MSA via 2nd year design studio

CAAD Evaluation Variables

Eight essential CAAD variables (factors) are needed to probably conduct CAAD Evaluation: (QaQish 1997)
1) CAAD Tutor 2) The Course Materials. 3) The Class Environment. 4) The Use of Media. 5) The Delivery Methodologies. 6) The Administrative Briefs. 7) The Overall Effectiveness of the event 8) The Course Contents. Evaluating and exploiting CAAD variables help bridge the problems a good integration of CAAD

within the design studio and the curriculum. The study capitalised on the significance of these variables (concepts with Likert rating scale for measurement expressed in units) using a triangulated framework of measures (nominal, ordinal, interval) embodied into the administered questionnaire. These variables are related CID domains (see section 2).

1. CAAD Tutor's (Louden 1991) ability indicators are to deliver, explain, interpret, use, design, adjust to differences in the learning styles, observe classroom patterns, produce different methods of teaching, interact with learners.
2. The Course Materials (The Course Contents) (Misanchuk 1992) indicators are: Classroom Handouts, laboratory Manuals, Textbooks, Individualized instruction-Packages, Assigned Projects, Tutorial Written Guide, Lectures, Time, Test, Exams and Quizzes.
3. The Classroom Environment (Marsh, 1973) indicators are Facilities, Class size: Physical size, Class Layout, Control of Seating, Class Light and Temperature, Class Accessibility, Class Furniture, finishes, Class availability.
4. The Use of Media (Slaughter 1990) areas are CAAD components and properties, and the actual media tutors use to deliver materials. The indicators are Computers- Screen, Mouse, keyboard and PC Case, Peripherals- Plotters, Printers, Scanners. Software: Applications packages and the use of Multi-Media. Media used in administering the learning event: Overhead Projector, Slides, and videocassettes.
5. The Delivery Methodologies (Dick & Reiser 1989) indicators are organization of the learning events, amount of materials covered during the learning events, time allocated during various parts of the events, mix of theory and practice, assimilating skills objectives and goals of course.

6. The Administrative Briefs. (Rogers 1983) indicators are availability of information to the learner, availability of the facilities for the learner, gaining information about the course, communication between the learner and teacher or administration.
7. The Overall Effectiveness of the event (Bloom, Madaus & Hastings 1981) is concerned with the applicability of the learner objectives and goals. The indicators are Developing Skills, Gaining the knowledge of the concepts and principles of the CAAD. Develop the attitudes necessary to achieve the directed goals (Standpoint of view, Viewpoint, and New aspects).

The Study Findings

Part of the evaluation process is to analyse the returns from the students who participate in the questionnaire surveys, and checklist prepared and carried out by the tutor. In this study fifteen (15) students took part in the AEC course, and the thirty-five (35) students took part in the AutoCAD course. Several types of statistical tests, such as the Qui-square X^2 , Spearman's rho, t-tests, a Kruskal-Wallis one-way analysis of variance by ranks were used. Frequency tables, Charts such as bar, line and pie charts were all used to describe the findings of this case study.

Result one

Question: How would you rate the following tutor's abilities during CAAD events?

How would you rate the effectiveness of the tutor's methods of instruction during the computer assisted learning classroom events in the following areas?

Excellent = 5, Good =4, Fair =3, Poor =2, Not Sure =1

The tutor's competence is an essential issue to appropriately incorporate CAAD in the curriculum and to advance students' skills, knowledge, attitude and performance.

There was a positive association between the tutor's methods of instruction and the students' attitudes, performance and skills. The tutor's competence is associated with his/her strengths in addressing new areas of CAAD, which proved to increase the overall effectiveness.

While, tutor's abilities were found significant in influencing CID, there was no evidence to suggest that the tutor's factors (abilities, management, and organisation) had influenced the students' creativity and point of view. The tutor's competence, management and organisation were found to be extremely significant and had a strong impact on the students' performance, attitude and skills.

Result two

Question: Please indicate how important the following criteria have been for you to determine an overall satisfaction with the effectiveness of the computer learning events.

Of great importance = 5, important = 4, of some importance = 3, unimportant = 2, not sure = 1

The impact of the learning environment was found significant on the overall effectiveness of the CAAD courses. Six areas were found significantly important for students to determine an overall satisfaction in the CAD sessions, namely: free time lab indicating the need for long training hours, lab facilities indicating the need for proper facilities in the computer lab, the accessibility and availability of information and communication with the staff and the administration. The administration of CAAD events was considered important in determining an overall satisfaction of the CAD sessions both regarding the tutors in CAL and the school in providing the appropriate information. The PC speed was another important factor. Proximity to the design studio was felt to be of great importance for the CAAD environment to be satisfactory.

Result three

Question: Please indicate the extent of CAAD effectiveness in the following criteria in the design

studio.

To great extent =5, To good extent = 4, To some extent =3, To no extent = 2, Not Sure = 1

The most significant impact was found in the production of perspectives generation modelling and isometrics (axonometrics). Time consumption came in third place. The use of CAD packages in computing teaching was found effective in the design studio activities, e.g. realms of 3D drawing, and animation. There was significant impact of the overall effectiveness of the CAAD course on skills, attitude, and performance. CAD courses were not effective in promoting the creativity aspect.

Result four

Question: Please indicate whether you have used the drawing board (Conventional Drawing), CAD applications or used both of these methods during the following stages if the design process (Inception-Intention, Feasibility- Suggestions, Outline Proposal, Schematic Design, Detail Design, Production Information).

Evidence of a trend towards the mixed method over the CAD alone method. The results of CAAD effectiveness, were: Schematic design (11.4%) production (11.4%) detail design (14.3%) and outline proposal (2.9%).

Conclusions and Recommendations

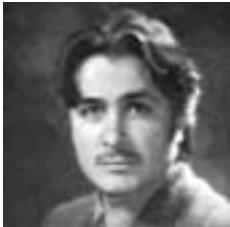
This paper suggested means for CAAD staff and architectural schools to carry out necessary evaluations under the appropriate settings they find necessary to conduct CAAD evaluation. However, its suitability is not restrained to CAAD programs since the paper illustrated the what purpose and reason of CAAD program evaluation and summarized the steps in performing mass evaluations. The main issue this paper addressed was CAAD evaluation that uses unambiguous designs that can be conducted without academic training in CAAD program evaluation,

although a body for training CAAD staff on evaluation is highly recommended for the future of CAAD teaching.

Appropriate CAAD assessments and evaluation methods should become an integral part of architecture schools curriculum. An evaluation is a significant tool in developing the characteristic of CAAD course once it is integrated into the fabric of an architectural program rather than advocated after its implementation. CAAD tutors are more likely to use the results of an evaluation when they play a role in determining what to examine, complete the evaluation, and interpret the results. CAAD staff in architecture schools and colleges may carry out evaluation successfully once they acknowledge the need for evaluation to upgrade the level of CAAD tuition and execution.

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