Exploiting Tools of Evaluation to Improve CAAD Teaching Methods

A Case Study of Inter & Intra ECTM Model

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Abstract: This paper reports on an ongoing research study model into the Evaluation of CAAD Teaching Methods (ECTM) of which a number of resolutions and strategies were attained via an empirical investigation. The first stage of the study findings proposed a framework for the evaluation of architecture courses in tandem with CAAD. The second stage was based on the Inter & Intra ECTM design model as a strategy for acquiring solutions to CAAD problems through the exploitation of CAAD evaluation tools. The ECTM model structure criteria: the Model Concepts, the Operational Context, Dialectic Meanings, Relational Context, Performing Methods and Level of Integration were illuminated. ECTM model has a twofold involvement junctures, which describe CAAD evaluation behaviour. The first involves the evaluator in an interdepartmental comparison of CAAD integration into the curriculum, and/or between schools of architecture. The second engages the evaluator in an intradepartmental study of CAAD integration, and within the institution. The study projected an attempt to validate the Inter & Intra ECTM design model in concert with evaluation. The paper presents an extended description of the objectives, procedures and testing designed for the two above-mentioned junctures composing the proposed ECTM case studies. Sequences of methods of data collection employed as a vehicle for the ECTM were Kirkpatrick model, questionnaire survey, observation (using an ECTM checklist) and experimental studies. The paper also explores variables and indicators used, and advances to shed some light on the methods of statistical analysis employment. ECTM model as a tool to attain CAAD effectiveness might redefine the role of collaborators/ team partnerships in CAAD tuition; and induce the level of technology selection and adaptation amongst schools, e.g. tutors and coursework interconnectivity. The ECTM model may also work as a framework of strategies to augment interactivity and positive learning amongst both staff and students.

1. ESSENCE OF EVALUATION INSUFFICIENCY

In recent years design schools, and CAAD tutors accustomed themselves to adapt new CAAD teaching methods but small number of those theories have been evaluated or validated. An effective tool to remedy this problem is Evaluation, which many seem to ignore and disregard as neglect. Absence of evaluation influences the efficacy of CAAD in design schools. Evaluation of CAAD instruction is a fundamental approach to address CAAD integration efficiency and problems to achieve effectiveness and productivity. As a result, the ECTM model was instigated as a structured tool of CAAD teaching and learning evaluation at schools of architecture, art and design in which it provides a framework for future self-conducted or organisational evaluation of courseware, software or curricula. The initial work involved the development of a computer-aided design case studies suite to validate such evaluation (QaQish 1997). The study anthology investigated the evaluation of CAAD teaching methods and integration effectiveness of CAAD operational suitability in the design studio. Also, to what affect CAAD influences the design process tuition using the new ECTM model for investigation as a vehicle. Ultimately, this instrument intends to provide an additional interactive learning device, to validate and improve teaching methods amongst tutors. ECTM tools have been designed in the form of inter and intra ECTM model to compare the outcome responses of different groups of students. E.g. those exposed to a CAD package in addition to conventional training, and those receiving only conventional training can now be evaluated in several methods and tools (see Table 3) based upon the confirmed hypotheses that there are fundamental differences between computer assisted tuition and conventional pedagogy (QaQish 1997). Foster and Booth (1993) proposed a twofold approach methodology of CAD evaluation; fundamental approach, by its ability to attain the most wanted learning objectives in terms of individual understanding and satisfaction of use, and overall approach, in terms of awareness of organisational aims and goals, e.g., cost efficiency and standardisation. Such proposal has been incorporated into the methodological design of ECTM model. Methods of data collection and tools of evaluation incorporated are: students profile, pilot studies, observations and questionnaire surveys. ECTM variables vehicle consist of CAAD Tutor, Course Materials & Contents, Class Environment, Use of Media, Delivery Methodologies, Administrative Briefs, and Overall Effectiveness of CAAD event (see section 3.3). Several other cross-sectional variables used as vehicle are the levels of students' performance, attitudes, knowledge, new-stand, creativity and skills.

1.1 CAAD evaluation definitions

Thorpe (1988) defines evaluation as the collection of analysis and interpretation of information about any aspect of a program of education or training as part of a recognized process of judging its effectiveness, its efficiency. Rowntree (1992) argues this definition suggesting that evaluation does not equal assessment, and that evaluation is a planned systematic and open attempt. It ought to be understood that although used interchangeably the difference between CAAD evaluation and CAAD assessment may best lay in the levels of investigation (see Table 2). Successful CAAD evaluation is a collection of distinctive, measurable, and pragmatic program objectives. To verify that CAAD integration has been successful; CAAD evaluators must define measurable objectives, even if effective assignments were delivered. Thus, effective evaluation facilitates useful CAAD course objectives design (planning) and management of achievements (course outcome)- *statistical test to use: apply for measurement a Paired-Samples T-Test procedure (compare the means of two variables for the a number students under two different states: before and after exposure to a CAD experiment or full rendered course)*. The use of this statistical test produces results when one has a small sample size (Clegg 1995). Whereas CAAD Evaluation is related to the macro or holistic level of the CAD learning event (INTER-ECTM), in relationship to the context of learning process and environment and all the factors that go with it. CAAD assessment conversely acts as the measurement of the level of the student learning and as one of the elements that chain with an evaluation process, verifying the micro-level (INTRA-ECTM).

1.2 CAAD evaluation methodology

Two distinct methods are documented for CAAD evaluation, the scientific method and the illuminative method. The measurement of the effects of specific variables against the resultant outcomes governs the scientific method. The scientific method examines the achievement of set of objectives in relation to a learner's pre-knowledge and skills, e.g. *how would you rate your gained knowledge and competence in each of the following areas of specific CAAD software?* It also engages in the measurement of the efficiency and effectiveness of the educational intervention and its outcomes, e.g. *please indicate the extent that CAAD application has in improving the over all effectiveness of the following criteria in the design studio?* In contrast, the illuminative method examines and investigates the process of the CAAD interventions on the overall course or curriculum governed by but are more qualitative, and subjective techniques, e.g. *please*

indicate to what extent would you agree with the following statements in relation to your design and CAAD events?

1.3 Reasoning and suggestions

CAAD evaluation should always be a comprehensible and clearly planned task. Both scientific and illuminative methods are used stand alone or combined in reference to CAAD course or environment complexity (General, Specific or In-depth methods in ECTM model). The level of combination is determined by time-scale and evaluation process set by the evaluator and the instigator of the evaluation. Good preparation and pre-planning should aid an evaluation case study to advance towards easier analysis and concrete recommendations; this includes defining investigation criteria. CAAD evaluation should become stimulant to improve a process of innovation within a curriculum together with factors such as CAAD tutor, students, material, and learning environment. Learning materials of any CAAD course depended mostly on refinement by tutors to comply with specific learning objectives upon which leaves an impact on the learner by the extent of its achievement level (scientific approach). In design programs with CAAD interventions, the need of validation supports the evidence after reasons to conduct evaluations, including the following factors (QaQish 1997):

1. Furnish statistics about value delivery that will be effective in CAAD course, see examples of different questions in Table 5. ECTM model capitalised on the significance of the concepts of Likert rating scale for measurement expressed in units using a triangulated framework of measurement (nominal, ordinal, interval) (See Tables 1, 3, 4).

Table 1. A suggested measuring Likert five point scale to test significance of CAAD.

5	4	3	2	1
Of great importance	Important	Of some importance	Unimportant	Not sure
Very Confident	Confident	Some Confidence	Little Confidence	No Confidence
Excellent	Good	Fair	Poor	Not Sure
To great extent	To good extent	To some extent	To no extent	Not Sure

1. Decide the level of appropriateness and effectiveness of CAAD course for students, e.g. Please indicate how important the following criteria have been for you to determine an over all satisfaction with the effectiveness of the CAAD? (See Table 1 for scale measurement)
2. Determine whether programs “make a difference”.
3. Provide the means for CAAD staff to prompt effective changes.

4. Advance CAAD susceptibility.
5. Provide CAAD staff with information to improve service delivery.
6. Explore CAAD effectiveness in practice amongst graduates.
7. Report program objectives have been successful or not.

Evaluation mechanisms for design schools can be tailored to CAAD programs' objectives and necessities, e.g., *schools with inadequate evaluation resources would concentrate on detecting how effectively CAAD courses are delivered- use internal questionnaire survey technique*. Schools with limitations on CAAD programs could identify 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 well-built resources can employ evaluation to study how successfully they are affecting student behaviour, performance, skills, knowledge, and use the results to enhance projects' brief. Design schools carrying out evaluation are responsible to report on the impact of their CAAD programs on student behaviour and performance.

2. CAAD COURSEWARE EVALUATION

Laurillard (1993) reiterates the importance of the evaluation process undertaking at every stage in the design, production, and integration of a new educational intervention whether courseware is a complete course, part of a course, or a particular session or teaching aid are all treated as equal in the process of evaluation. Teymur (1992) suggested several criteria form courseware evaluation, 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. Thus, courseware evaluation could permit CAD tutors to examine other factors than software evaluation such as aspects like productivity, user-friendliness, navigation, screen design, text layout… etc, leading to the successful integration of the CAAD course into the course itself or the curriculum. Courseware factors are namely: educational setting (Environment, facilities, staff, materials, courseware and software, and administration), aims and objectives of the CAAD course, CAAD teaching approach, CAAD learning strategies, CAAD teaching and assessment methods, and implementation of CAAD strategies. The most important objective behind using the above factors for evaluation is to support creation of a new learning experience both more efficient and effective to constantly recuperate CAAD teaching difficulties. On the other hand, evaluation is a time consuming application and effective planning can

reduce time and effort in the tangible evaluation and analysis process. Small evaluation schemes are advised in favour of a large evaluation ones. While, Romiszowski (1988) makes a distinctive analytical separation between scope of evaluation levels and depth of evaluation levels (Level 1: project level, Level 2: curriculum level, Level 3: unit level, Level 4: learning step level). The ECTM model perceives this in a rather more practical approach assigning specific inter and intra levels (see Table 2). It is important to predetermine the induction of CAAD evaluation levels at each CAAD teaching and learning stage. This works interchangeably with levels of implementations in the ECTM techniques. When looking at the behavior of ECTM, architecture and design schools could view the evaluations analysis and its process to be adequate for CAAD course assessment. CAAD evaluation determines whether delivering CAAD is being carried out in an appropriate and efficient manner to guarantee sets of goals are being met and to improve and maintain efficiency in CAAD. CAAD evaluation also determines whether CAAD programs are effective in making a difference for new graduates. Thus a post-evaluation program of graduates group is supplementary requirement to in-school evaluation. This paves ground floor to examine interventions changes into students' behavior or design studio approach to enhance CAAD program or validate the curricula need changes. Schools and educators must recognize the need for:

1. Evaluate the structure of the curriculum to successfully add CAAD.
2. Evaluate transformation of course objectives and assessments in the design studio with CAAD.
3. Evaluate CAAD teachers/tutors while delivering comprehensive CAAD.

Effective and efficient changes in the design studio arise when competent students and confident tutors are resourceful, appropriate CAAD applications are available and properly delivered through a well-established CAAD- design studio program. Evaluating CAAD, learning and teaching outcomes could identify changes that may have occurred in architectural or design tuition because of CAAD integration and implementation. Analysing these changes may help to determine whether there are characteristic and behavioural changes of CAAD program, which indicate changes occurrence in program activities. Indicative of such a direct change in behaviour transpire because of a CAAD program is commonly difficult, because students' behaviours towards CAAD software are expected to change over time as CAAD packages are constantly and rapidly advancing. E.g. *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*. Seven instruments are strategically essential as a pre-evaluation operational tool for carrying out CAAD evaluation: costs of an innovation (Courseware and Software), development needed in advancing and

improving staff and students, measure efficiency and increased competence against improved benefits in the institution, measure effectiveness and suitability of learning events, against aptitude of the institution, numerals of budget and students before or after the department introduced CAAD courses, achieve enhancement of concepts represent high-quality success and aspiration creativity and cost and expenditure validation and sustainability.

3. THE INTER AND INTRA ECTM MODEL

Autonomous response built on rational and empirical analysis to the real problems of CAAD teaching & learning has not been implemented during either the design studio and core courses or impartially the computer laboratories. At hand, sufficient indications suggest potential insufficiency on methods to validate CAAD. The evidence suggests that CAAD teaching & learning are confronting problems when administered and instructed in design studios. Thus the aim of the ECTM model is set to determine the most effective standalone or combinations of teaching and learning strategies that may be employed in the decision-making teaching and tutoring of CAD courses and students by adapting a series of CAAD evaluation techniques (see Table 2).

Table 2. Inter & Intra ECTM model structural design

Dialectic meanings	Performing methodology and level of integration			Criteria of study
		(Relational context)		
Inter-Departmental Evaluation in Depth of CAAD Integration	Experimental Quantitative Study	IN- DEPTH Experimental Survey (Conventional + CAD)	Appraisal/ CAAD Integration Appraisal/ Teaching Methods	Measurements Projects Subjects Objectives Course materials Computer labs
			Themes:	Criteria
Intra-Departmental Comparison of	Questionnaire Quantitative	GENERAL Wide Ranging Survey (No. Schools)	Labs Dept. Policies General Info	Physical Facilities Faculty Qualification

Curriculum and CAAD integration	Study	SPECIFIC Emphasis Survey (One School)	Integration Administration	Program Goals Structure of Curriculum

This research previously investigated four principle problems in conjunction with the establishment of the ECTM model toward the solution of CAAD validation:

1. Evaluating CAAD substantiation in the architectural curriculum and the methods and concepts of CAAD integration in the teaching of architecture.
2. Evaluating the teaching methods in terms of effectiveness and efficiency.
3. Evaluating CAAD integration in terms of its effectiveness and appropriateness of use in the design studio.
4. 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.

Kirkpatrick's model (1977) was used to assist ECTM. Kirkpatrick argues that an innovation in any institution will unquestionably have an effect on the institution, but will not radically change its structure. 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.

3.1 ECTM model factors

The TLTP initiative context has two main interests for evaluation both effectiveness and efficiency built on the need to justify technology-based learning. Four other factors could be integrated with those two, these are relevance, performance, timescale and creativity in relationship to the applicability and appropriateness to the intended employers and users of the technology, the teachers and students, even the department or institution. To evaluate CAAD, ECTM factors must be appropriately used to define creativity and performance of the students' learning events and the teacher competency. Attaining the objectives of CAAD in the learning event would help to assimilate knowledge, skills, and attitudes. Two ECTM factors that would contribute to achieving effectiveness are recognized as: Cognitive: Knowledge. Psychomotor: Skills. Whereas, three ECTM factors that contribute to achieving relevance and outcome are Affective: Attitude. Creativity: Innovative. Performance: Achievement measures (QaQish 1998).

3.1.1 Effectiveness factors

The Cognitive Factor: (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 leaner handling of knowledge, and compares different methods of evaluation in any learning event.

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

3.1.2 Relevance and outcome factors

The Psychomotor Factor: (Skill manipulation) Sax (1980) focuses on skills associated with dexterity (proficiency, ability, manual skill), hand/eye co-ordination 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 Factor: 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 Factor: Achievement measures. Mager and Pipe (1981) argue that performance level reached amongst students and teachers typically indicate the standards settings in education.

3.2 ECTM activities initiation

Through ECTM activities, CAAD tutors, or administration decide what CAAD courses to offer and how appropriate they are carried out. The appropriate evaluation activities to be inaugurated by ECTM model are:

1. Establish the value and use wanted when integrating CAAD, e.g., *determine what attitudes, knowledge, skills, or behaviours' changes CAAD course poises.*
2. 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.*
3. Choose from CAAD alternative program approaches already undertaken, e.g. *comparative analysis of curricula or CAAD strategies to determine which ones accomplish the goals.*

4. 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.
5. Establish CAAD course objectives and determine the specific indicators for testing, e.g. *the tangible performance, skills, knowledge, attitudes, or behaviour measures. This will illustrate the level and extent of success in CAAD objective effectiveness and appropriateness.*

3.3 ECTM b/variables

ECTM variables work as a vehicle to conduct CAAD evaluation and to help bridge the problems of good CAAD integration within the design studio.

1. CAAD Tutor's (Louden 1991) ability indicators are: to deliver, explain, interpret, use, design, adjust to differences in the learning styles, observe classroom pasterns, produce different methods of teaching, and interact with learners.
2. The Course Materials (The Course Contents) (Misanchuk1992) 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, Digital Camera. Software: Applications packages and the use of Multi-Media. Media used in administrating the learning event: Overhead Projector, Slides, and videocassettes.
5. The Delivery Methodologies (Dick & Reiser 1989) indicators are: organization of the learning events, amount of material 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).

3.3.1 ECTM methodology

Tables 3 and 4 show the ECTM methodology in which a suggestion of a framework of evaluating CAAD integration via a series of experiments in the form of fieldwork observations and questionnaire surveys is proposed. It also furnished an empirical investigation into the functional and theoretical usage of CAAD in schools of architecture via a suggested scheme of case studies (see sample questions, Table 5).

Table 3. Levels of ECTM model evaluation techniques

Level	Instrument	Design Considerations Next to Level of Implementation
LEVEL 1	Student Profiles Questionnaires	Obtain a profile to monitor changes in both attitude and opinions. Address learner's attitude towards computer-aided design as well as the use of computers in general. Address learner's academic background in the particular CAD area. Address learner's level of knowledge of CAD and Architecture, Design or graphic Design.
LEVEL 2	Global Questionnaires: Permissibility of a staged Pre and Post Tests	Proper layout and ample space for response. Reduce open-ended questions. Minimum number of questions Use standard Likert five point scale (see Table 1) Anonymous Pilot questionnaire
LEVEL 3	Semi-structured Interviews	Administer after questionnaire collection and analysis. Covers missing points in questionnaire. Initiate questions by interviewees. A focused interview diminishes overloaded data collection. Permit group interviews.
LEVEL 4	Observations	Structured observation sheet. Code or shorthand. Sense of required observe patterns. Video-taped recordings Tape-recorder synchronize students' verbal comments and interactions

Table 4. Levels of ECTM model evaluation in relation to techniques benefits and hindrances

Level	Instrument	Benefits	Hindrances
LEVEL 1	Student Profiles Questionnaires	Useful for group of stratified random sampling. Useful to test abilities in a certain group.	Virtually none
LEVEL 2	Global	Massive Info collection.	Low response rate.

Level	Instrument	Benefits	Hindrances
	Questionnaires	Simple, collection, administration & analysis.	Difficult categorization with open-end question.
LEVEL 3	Interviews	Tolerate extended answers. Instructive uncovered points.	Acquire time to arrange conduct. Surplus unwanted data.
LEVEL 4	Observations	Developed and focused sheets ascertain useful data collection.	Unexpected Occurred Events.

3.3.2 ECTM statistical tests

Part of the evaluation process is to produce the proper questions and analyse the returns from the students who participated in the questionnaire surveys, observations and checklist prepared and carried out by the evaluator. Several types of statistical tests, such as the Chi-square X^2, Spearman's *rho, t*-tests, and Kruskal-Wallis one-way analysis of variance by ranks can be used. Frequency tables, charts such as bar, line and pie charts can also be used to describe the findings of CAAD evaluation.

3.3.3 ECTM sample questions, applied statistical tests and analysis

Table 5. Sample questions, statistical tests and analysis

Proposed questions	Statistical tests	What is to be expected from analysis? (Objectives)
1. How would you rate the following tutor's abilities during CAAD events?	Use count and rate to indicate level and extents, use one sample –test. Scale of 1= poor, 2= fair, 3= good, 4= very, 5=excellent	• Examine the impact (significant or weak) of the tutor's abilities, management and organisation on the students' performance, attitude and skills. • Relationship/ Confirm or refute the hypothesis that the Students Confidence depend on the tutor's abilities (competence)

A one-sample *t*-test examines whether the tutor's abilities, management and organization mean of distribution differ significantly from the value of 5= excellent which describes a high level of tutor's ability effectiveness. E.g. *hypothesis*: incompetent teacher has contributed to unsuccessful CAD employment, *Results from analysis*: one-sample *t*-test analysis indicates that the mean percent for the tutors abilities (adjust, deliver…etc.), management and organization, were negatively higher at α =. 001 (values of 5=excellent, under 95% confidence). The null hypothesis was confirmed.

Proposed questions	Statistical tests	What is to be expected from analysis? (Objectives)
2. How would you rate the effectiveness of the tutor's methods of instruction during the computer assisted learning classroom events in the following areas?	Use correlation coefficient (Spearman's *rho*) and X^2 tests to test significance and to show relationships, if any between these variables in a tabular format.	• Examine type of association (positive- negative) between the tutor's methods of instruction or tutor's competence and the students' attitudes, performance, knowledge and skills or level of overall effectiveness. • Examine type of association (positive- negative) between the tutor's competence and his/her strengths in addressing new areas of CAAD.
E.g. hypothesis: if the teacher is competent he should be able to improve the student's knowledge, skill, attitude, creativity, new stand and performance in CAD course. Thus the null hypothesis assumes that the teacher has no effect on these student's domains.		
Please indicate how important the following criteria have been for a studenst to determine an overall satisfaction with the effectiveness of the computer learning events?	Use Paired Sample T-Test for related samples. Testing a null hypothesis: e.g. there is no behavioural differences amongst the a number of students who completed the CAD design work shop	• Examine the impact (significant or weak) of the learning environment on the overall effectiveness of the CAAD courses. Few areas of investigations are: free time lab indicating and training hours, lab facilities, the accessibility and availability of information and communication with the staff and the administration.
The paired samples statistics table displays descriptive statistics for the test variables, and followed by the correlation table, which displays the relationship between the paired differences with a 95% confidence interval of the difference of the means.		
Please indicate the extent of CAAD effectiveness in the following criteria in the design studio?	Use X^2 (Pearson's *r*) tests using the SPSS package or Minitab. Results of a *chi*-square test indicate whether or not a variable was found to be significant at the level of 0.05 in other tested variables.	• Examine the overall satisfaction of the CAD sessions both regarding the tutors and the school in providing the appropriate information with the administration of CAAD events.

Proposed questions	Statistical tests	What is to be expected from analysis? (Objectives)
Examine the significance of CAAD in your own set of design studios criteria, some of which are production of generation modelling as in parallel drawings, animation or perspectives. Examine the significance of CAAD effectiveness in design studios to promote aspects such as skills, attitude, creativity and performance.		
In one Sample T-test, critical values (Obtained from a number of previously conducted research) of t must be equal to or more than the tabulated value (obtained from t-test table, Clegg 1995 and used by the researcher), to be significant under p< 0.001. For df=30, the tabulated values read 1.697, 2.042, 2.457, 2.750 and 3.646 under level of significance for the two -tailed test respectively 0.10, 0.05, 0.02, 0.01 and 0.001. 95% C1. Please note that Confidence interval (CI) is the range of values within which the means of tutor's abilities statistical results are likely to fall, thus when a 95% confidence interval for the mean indicates that there is a 95% chance that the true tutor's abilities, management and organisation fall within the range of value 5= excellent. This means that the researcher had anticipated that the competence of the tutors is likely to fall way below the excellent range. Other researchers could use their own hypotheses to confirm or refute.		

3.3.4 Outcome evaluation samples from a case study

Students' responses indicated that they used discrepantly conventional drawings, CAD applications or both (mixed methods) during selected design stages. The results showed evidence of a significant use of the mixed method over the CAD alone method. When compared with the conventional drawings, the mixed methods were found relatively similar; there was a trend towards a mix use of methods, developing in the design studio. CAD has significantly affected a number of design areas such as production, scheme & detailed design. Detailed design stage was mostly affected and had the highest response rate from students (14.3%). The least effected stage was the outline proposal. Sketching was found to be the least influenced by CAD course (mean of 1.9 which equals the value no extent), followed by a similar impact on the analytical diagram. The most significant impact was found in the production of perspectives and 3D modelling (mean of 3.2 which equals the value of good extent) (see Table 1 for measuring scale). The tutor's competence may also be related to his strengths in addressing and presenting new areas of CAD, which had ultimately increased the overall effectiveness of the students' attitude, performance and skills. *t*-test result implies (*t*-test =-10.5, *df*=34, the tabulated value = 1.697 $p = 0.05$ for one-tailed test) that the mean for the lectures/tutorials and short briefs were negatively insignificant. Such results could indicate that the null hypothesis was not refuted and the learning materials failed to ensure successful and effective CAD teaching. The learning environment was found to have

influenced the overall effectiveness of the CAD courses, through its impact on the areas of skills, performance, knowledge, creativity, and attitude. There were significant associations between the overall attitude, and the performance level. Schools should consider changes to the design and organisation of the learning environment (computer labs or CAD labs). This will improve the overall effectiveness and thus improve the performance, and attitude of the students towards CAD and the design studio. The administration of the school and the tutor was found to have significant impact on the students' performance and attitudes.

4. CONCLUSION

The paper presented a brief description of the ECTM model, a background on evaluation and its definitions, involvement of evaluation into CAAD. A full comprehension and clear perception of the theory and background to CAAD evaluation is presented in order to achieve enhanced planning, designing and conducting an evaluation program and benefit from its analysis. This paper also suggested means for CAAD staff and architectural schools to carry out necessary evaluations under which appropriate settings they find necessary. However, its suitability is not restrained to CAAD programs since the paper illustrated what purpose and reason CAAD program need evaluation.

The main issue ECTM model addressed was evaluating unambiguous designs to be conducted without academic training in CAAD program evaluation, although training CAAD staff on evaluation is recommended for CAAD teaching and should become an integral part of CAAD administration. 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 encouraged to use the results of an evaluation to determine future extent of CAAD involvement and to upgrade the level of CAAD implementation.

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