

A Proposed Guide for Promoting Educational and Learning Techniques of CAAD

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How to cite this paper: Youssef, A.M.A. (2023). A Proposed Guide for Promoting Educational and Learning Techniques of CAAD. *Fayoum University Journal of Engineering*, 6(1),20-38.

<https://dx.doi.org/10.21608/FUJE.2022.168181.1024>

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Abstract

Computer Aided Architectural Design (CAAD) programs represent recently a significant qualification for architects, academics and students. Due to the rapid develop of relevant programs, learning processes become complicated and interconnected with many influential variables, this confirms that educating and learning these programs is not a straightforward task as predicted. This study aims at proposing a detailed guide for promoting CAAD programs educational / learning techniques, with focusing on four objectives: a) Best distribution of programs and assignments; b) Project-based learning concept; c) Best learning sources and methods; and d) Correlation analyses between relevant variables. A questionnaire-based survey have been conducted and completed by 25 instructors and 145 students from different affiliations in Egypt. Accordingly, a detailed guide with different plans and cases has been articulated to promote CAAD education and learning, also different related highlights have been discussed. This guide helps instructors, academics, architects and students in teaching and learning CAAD with more efficient process.

Keywords

Architectural Education, Learning Techniques, Computer Aided Architectural Design, Guide, Survey

1. Introduction

1.1. Computer Aided Architectural Design (CAAD)

CAD (Computer Aided Design) refers to all computer programs used in drawing and design, while Computer Aided Architectural Design (CAAD) expresses the specific character of programs related to architecture; CAAD programs are drawing and modeling software to visual-

ize, create, render and document building designs for architects (Elhardudi, 2007). Many CAAD packages are taught in architecture schools, such as Autodesk AutoCAD, Revit, SketchUp, Adobe Photoshop and others (Saighi and Zerouala, 2017; Botchway et al. 2015). Many plugins have been developed for CAAD programs (such as V-Ray, Dynamo, etc) with rapid production of annual versions (Ahmed, 2020).

The importance of learning CAAD programs is repre-

sented in their clear role in Architectural Design Education (ADE) (Abu Ghanimeh et al, 2006); CAAD programs attract students while ADE since such programs provide visualizing form development aspects, functional, spatial requirements and others (Mahmoud and Elbelkasy, 2013), as well as they help in imagining and conducting masses and details, accordingly enhancing design creativity especially in early design stages – this is why most architectural schools developed their educational methods, techniques and even schedules to integrate more CAAD courses (Zhu et al, 2016); this has well known advantages, such as providing faster design stages, easier revisions to design cases, more precise designs and intensive number of alternatives as well as saving time. This highlights the importance of setting techniques regarding how CAAD can promote ADE process – the field of the study.

1.2. Previous work in the study scope

Many computational developments to/through CAAD programs have been developed. Top CAAD programs for students have been intensively studied and reported along with relevant advices; some studies classified them to 2D and 3D projections or based on their output qualifications (Giorgobiani and Chikovani, 2013), while many reports proposed different rankings. However, ranking CAAD programs in ADE processes or even choosing best one/s is circumstantial and spatial; this is related to schools' visions and speciality, accordingly their entire bylaws, since each program has its own abilities, compatible plug-ins, requirements and limitations, while architectural staff mainly focuses on visualization via basic CAAD programs especially in the first years; further extensions may be overviewed in advanced courses.

In the scope of CAAD education, a lot of visions and concepts have been detailed and discussed. Some studies described educating such programs as a complicated matter with forked details (Boehm & Koolmonojwong, 2019), while Mahmoud and Elbelkasy (2013) referred to the simplicity of CAAD programs which attracts students to the formative aspects, irrespective of functional or

spatial requirements. Zhu et al (2016) connected the use of such software with "smart education", on contrary, Guney (2015) stated the disadvantage of CAAD programs since they may provide reducing imagination ability of students, negative impact on design creativity, less personal interaction between students and advisors, inadequate literature flow as well as following better visual outputs instead of better design. However, Olukoya Obafemi and Kuti Oluwaseun (2015) quantitatively compare the benefits and limitations of CAAD with traditional methods in ADE via respondents' interviews along with evaluating their works. Çolakoğlu and Yazar (2007) proposed an innovative ADE approach to explore new directions via a course titled "Designing the Design". These studies are useful when CAAD and ADE are integrated, while this study assumes that different attributes may be demonstrated in CAAD education independently.

Regarding developing strategies, guidelines and how to educate CAAD, Ahmed (2020) developed a road map to present guidelines and draw a model for plug-ins of digital visualizations. Selim (2019) quantitatively explored students' preferences and attitudes toward the use of CAAD tools. Many studies tested the relationship between CAAD programs and design stages via experiments on students, including when and how to educate these programs (Mahmoud & Elbelkasy, 2013; Yavuz and Yildirim, 2012), also, Giorgobiani and Chikovani (2013) described the building design processes and stages using AutoCAD. Pektaş (2007) presented structured analyses of CAAD education objectives, contents, methodology, management, different knowledge, and disciplinary levels; a framework and several proposals were presented. This highlights that educating CAAD programs is neither straightforward task nor as simple as predicted; there is a need for a detailed guide regarding CAAD processes.

1.3. Previous case studies in the study scope

Adopting the case study approach, different case studies have been analyzed as shown in Table 1; cases are varied in locations, number of universities involved and

others. However, each study provided different outcomes and concerns to be handled.

Table 1: Previous case studies in the study scope

References	Studied Location	Involved Cases	Main outcomes/concerns to be handled
Soliman et al (2019)	- Egypt - Other countries	- 8 Egyptian departments - 20 international schools	It analyzed the integration of CAAD in architectural departments in Egyptian universities compared with the top international architecture schools; however, the study recommended involving CAAD programs in ADE at least in the three final years.
Saighi and Zerouala (2017)	Algeria	4 architecture institutions	It evaluated the impact of CAAD programs on ADE; they found that CAAD programs improved students' design decisions and quality of drawings representation.
Al-Matarneh and Fethi (2017)	Jordan	3 Universities	It compared students' attitudes toward using CAAD and traditional methods via sixty graduation projects.
Botchway et al (2015)	Ghana	Kwame Nkrumah University of Science and Technology (KNUST)	It compared CAAD education with different methods.
Salman (2011)	United Kingdom	the Scott Sutherland School of Architecture and Built Environment	It analyzed the potential impact of CAAD on the design methodology of final year students; this documented the reasons of students' tendency in using CAAD at the conceptual design phases.
Abu Ghanimeh et al (2006)	Jordan	Jordan University	It investigated the distribution of CAAD programs for different purposes via tracking the beginners.

1.4. Research Problem

Based on the previous literature, the research problem can be articulated as follows: a) selecting and ranking CAAD programs are circumstantial based on schools' visions, specialty and bylaws, with no clear specifications to the best options; b) main course details depend on instructors and their attributes with no detailed strategy to be followed; c) rapid development of CAAD programs requires an updated outlines and methods to be handled; d) independent CAAD education demonstrates different attributes if integrated with ADE; and e) student attributes in this scope are varied; while one specification should adapt with this variation. Hence, educating/learning CAAD programs is not a straightforward task; there is a need to a well-studied guide.

1.5. Aim and limitations

The aim of the study is proposing a detailed guide with clear, significant and specific plans and cases for promoting CAAD programs educational / learning process, this helps instructors and students in teaching and learning CAAD programs, respectively. Accordingly, four objec-

tives have been focused and detailed in the study:

- Objective (a): Best distribution of programs / assignments in the learning process (the guide structure).
- Objective (b): The project-based learning concept (the guide concept).
- Objective (c): Best learning sources to learn CAAD programs (the guide components)
- Objective (d): Correlational analyses between all the surveyed variables (to enhance the proposed guide).

Main limitations have been determined accordingly. Autodesk AutoCAD, Adobe Photoshop, Autodesk Revit, Autodesk 3Ds Max, SkechUp and Lumion, as common programs in this scope, have been selected for this study although other programs are still useful. The study adopts the architectural domain only through these programs although they have wider uses in different fields, so ranking them has been considered out of the scope as detailed before. Due to the time limits allowed especially in undergraduate courses, basic typical use of these programs is considered in each program; details of programs durations are detailed in the study. Relevant variables to instructors and students within the study scope have been determined, while other variables related to the ed-

educational environment (such as computers' qualifications, lab capacity and other) are not included.

1.6. Study methodology and structure

To achieve the aim and objectives, a questionnaire-based survey has been conducted on architectural instructors and students; two separate questionnaires have been designed, detailed and distributed, accordingly results have been analyzed and compared to articulate a proposed guide – the survey main outcome. The paper starts with the survey design in section 2 and the survey results in section 3, respectively, and then the proposed guide has been detailed in section 4. The paper ends with the discussion and conclusion in sections 5 and 6, respectively.

2. Developing the questionnaire-based survey

2.1. Survey and questions main outlines

The questionnaire-based survey, along with the questions' details, has been designed as follows:

- Questions and answers should represent clear guidelines

and decisions to be followed for promoting CAAD education instead of generic instructions.

- Questions should match types of questionnaire takers: instructor /architectural staff and/or students.
- Minimum qualifications have been determined for instructors /architectural staff to be invited to complete their relevant questionnaire. Instructors who individually taught three different CAAD programs as minimum have been considered.
- Also, minimum criteria have been used to consider or neglect students to certify their inputs. Students who learned only one CAAD program have been neglected from the survey. Students have been surveyed after completing their CAAD courses, not during the learning process. The students' sample is representative and obtained from different affiliations and years in Egypt.

2.2. Questions and answers determination

All questions have been determined as shown in Figure 1, then separated to two questionnaires. All questions have been outlined to match the four previous objectives.

CAAD: Computer Aided Architectural Design

General Info / Classifications	Objective (a) : Best distribution of programs and assignments	Q1 Ability & Qualifications	Students	Total Grade :	Excellent	Very Good	Good / Passed	Objective (d): Correlations		
		Q2 Which CAAD programs can you use professionally ?	Instructors	In CAAD :	Excellent	Very Good	Good / Passed			
				Times you taught CAAD programs:	1 - 5	6 - 10	> 10			
		Q3 Do you like learning/using CAAD programs in general ?	Departments you taught CAAD programs in :	1	2	3	4 or more			
				Autodesk AutoCAD	Adobe Photoshop	Autodesk Revit	SketchUp		Autodesk 3Ds Max	Lumion
		Q4 What is the best distribution/number of CAAD programs in 12 weeks/36 hours?	Definitely Yes	Yes	Moderate	No	Definitely No			
			Only One	Main one + Other overviews	Two CAAD Programs (in serial)	Six CAAD Programs (just overviews)				
		Q5 What is the best distribution/number of CAAD assignments in 12 weeks/36 hours ?	12 (1 per week)	6 (1 per 2 weeks)	4 (1 per 3 weeks)	3 (1 per 4 weeks)				
			Q6 What is the best distribution of CAAD programs through the undergraduate phase?	Autodesk AutoCAD	Adobe Photoshop	Autodesk Revit	SketchUp		Autodesk 3Ds Max	Lumion
		Answer if the allowed course/s is/are:		0 - 12	0 - 12	0 - 12	0 - 12		0 - 12	0 - 12
Q7 How important is using different exercises in the same assignment to students ?	One course (12 weeks/ 36 hours):	0 - 12	0 - 12	0 - 12	0 - 12	0 - 12	0 - 12			
	Two courses (24 weeks / 72 hours):	0 - 12	0 - 12	0 - 12	0 - 12	0 - 12	0 - 12			
Objective (b): Project-based learning concept	Q8 What is the reason of the previous answer?	Absolutely Important	Important	Moderate	Unimportant	Absolutely Unimportant				
	Q9 How important is the final comprehensive project in educating/learning CAAD programs?	Short Answer								
	Q10 Which learning source do you prefer in learning CAAD programs? (Rank them)	Absolutely Important	Important	Moderate	Unimportant	Absolutely Unimportant				
Objective (c): sources	Note: most preferred (5) - less preferred (1)	Instructor / Academic Staff:	5	4	3	2	1			
		Friends:	5	4	3	2	1			
		Searching via the Internet:	5	4	3	2	1			
		Video tutorials:	5	4	3	2	1			

Questions to students
 Questions to instructors
 Questions to instructors & students
 Answers

Figure 1: The developed questionnaire-based survey

3. Selection of participants

3.1. Instructors' sample

Minimum requirements have been articulated to select qualified instructors in order to certify their inputs; they should be able to teach CAAD professionally. Instructors

should also be varied in gender and academic degrees. As shown in Figure 2, 25 instructors completed the survey; the majority of them taught many CAAD programs for more than 6 times in different affiliations.

3.2. Students' sample

Also, different samples of students from different academic years and affiliations have been invited to complete the survey; only students who learned 2 or more CAAD programs have been considered to certify their vision; it is a minimum requirement. The sample has been selected to be varied widely for diversity; it includes varied:

- Affiliations: samples from both governmental and private affiliations have been involved.
- Locations: different academic affiliations have been included (i.e. Assiut University, Higher Institute of Engineering and Technology in Sohag and others).
- Specialists/backgrounds: varied samples from different architectural programs have been involved,

such as faculty of engineering, Interior design program and faculty of fine arts.

- Academic years: different academic years have been covered (i.e. 2nd and 3rd academic year).
- Student types: different levels, grades, gender, etc.
- Distribution method: both electronic and printed versions have been used to collect the sample.

Accordingly, 108 students (out of 145 participant students) achieved the minimum requirements, accordingly have been considered via the analyses; the majority of them (more than 70% of the considered students) can use 3 or more CAAD programs professionally as shown in Figure 3. The previous requirements, items and classifications demonstrate that the sample is initially qualified and balanced.

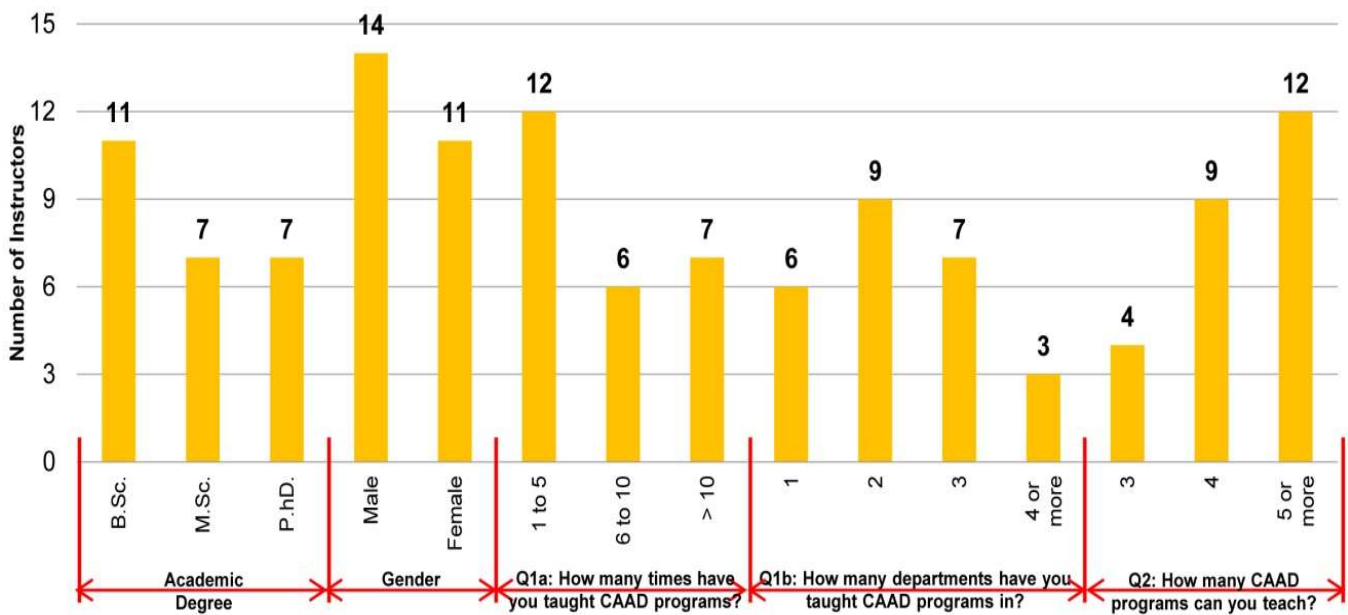


Figure 2: Classifications of instructors

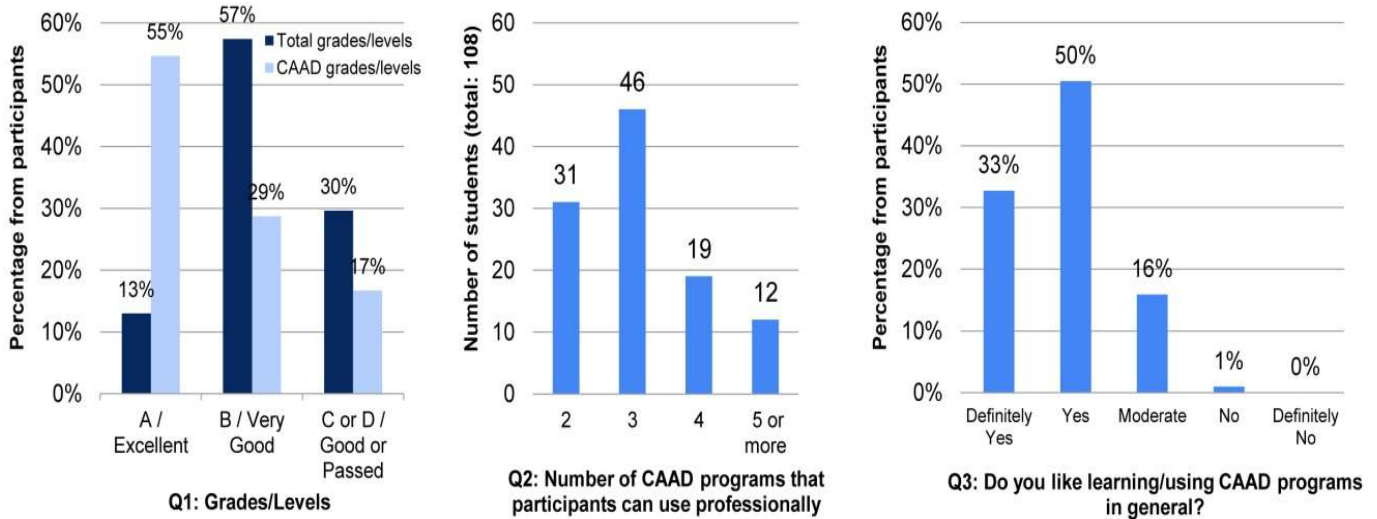


Figure 3: Classifications of students included in the analyses

4. Survey Results

All individual inputs of instructors and students are shown in Appendix (A) and (B), respectively, and analyzed via Microsoft Excel as detailed below.

4.1. Current Status

First of all, early questions refer to main features in the current status and accordingly some specifications, as follows:

- AutoCAD is an essential CAAD program in the current state; almost all the surveyed students learned it as a basic program (as denoted in question 2 (Q2) results) – this should be compared accordingly to the instructors' vision later.
- Students learned two to three CAAD programs in general; this represents a moderate number to be extended (Q2 results).
- Students like learning such programs in general regardless their abilities/levels (Q3 results) – this should be utilized; this matches that levels of students in CAAD courses are higher than their levels in total (Q1 results).

- Students prefer and use video tutorials as a main source; this should be considered in the proposed guide rather than/besides typical sources as detailed later (Q10 results).

However, these features and specifications are to be highlighted in the studied objectives and proposed guide as detailed below.

4.2. Best distribution of CAAD programs and assignments through the learning process

The survey results show a preference to adopting the approach of learning less CAAD programs in the limited time instead of learning more CAAD programs (as just overviews). Teaching one CAAD program in addition to only overview other ones is preferred by instructors, while concentrating the course on a specific program is preferred by students, and introducing many programs within the course is not preferred. The assignments should be distributed weekly or biweekly based on the survey results; adopting more explanations with fewer assignments is not preferred in the learning process.

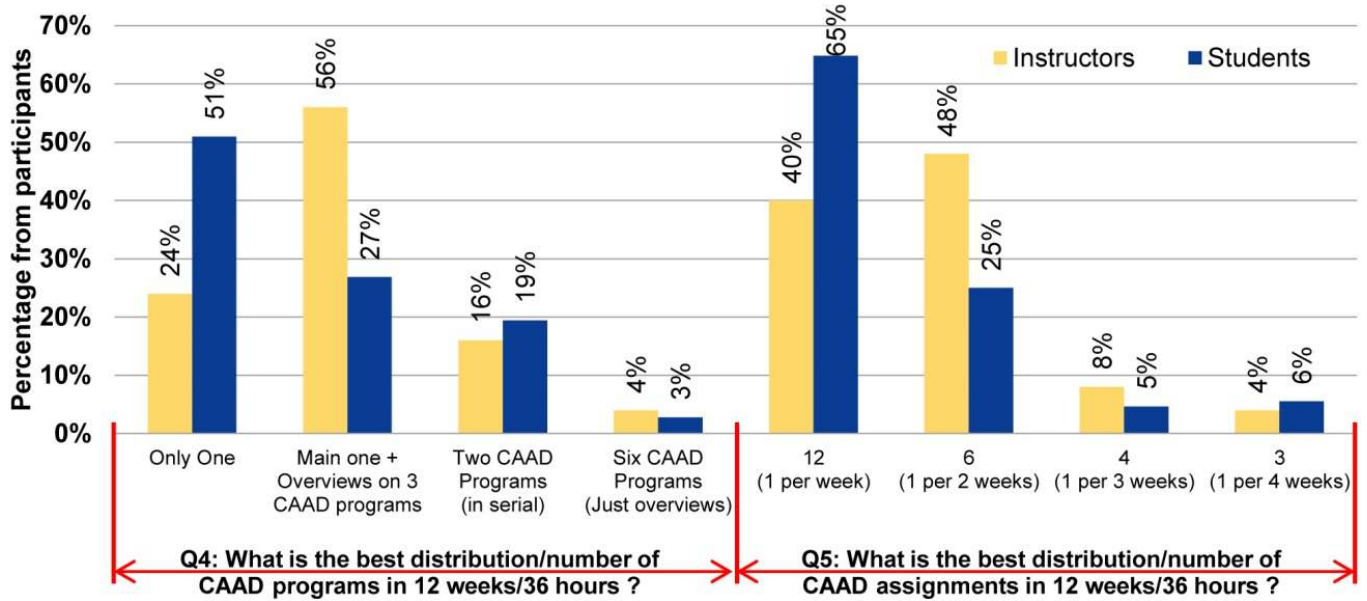


Figure 4: Best number of CAAD programs and assignments through the learning process

In the relevant departments' bylaws in Egyptian Universities, the common number of courses for teaching CAAD programs in details is one or two courses, although learning CAAD can be integrated in architectural design courses secondarily. Hence, the instructors demonstrated via Q6 different distributions to the programs surveyed either if one or two courses are allowed, and there are some salient features in their

inputs. The majority of instructors proposed teaching AutoCAD as a starting program, to be followed by Adobe Photoshop and/or a 3D program in the first or sole course. If a second followed course is allowed, Autodesk Revit or 3Ds Max are preferred to be the main programs to be handled, while including Lumion and SketchUp is also recommended by some instructors as shown in Figure 5.

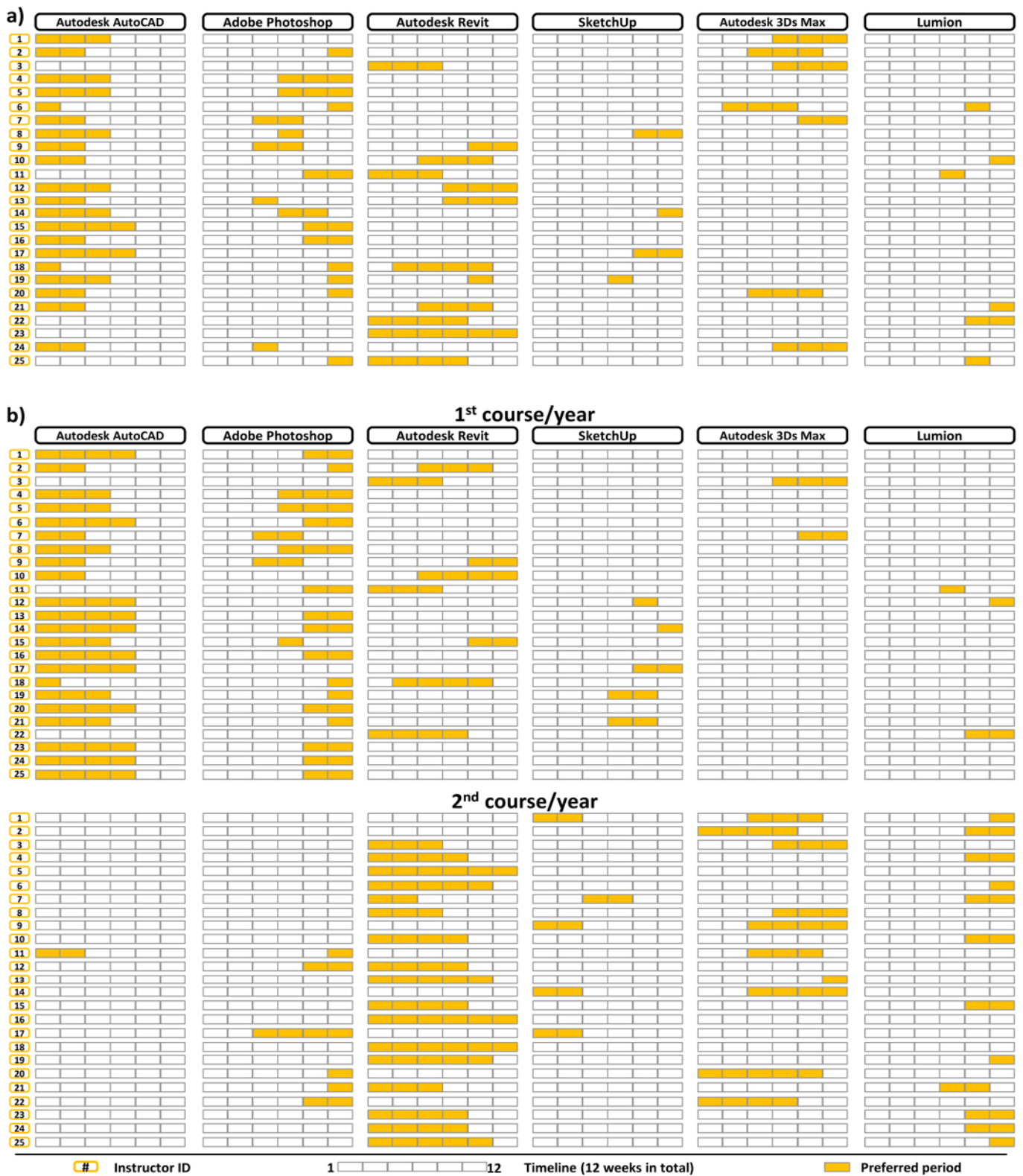


Figure 5: Proposed distributions of CAAD programs through the undergraduate phase: a) if only one course is allowed; b) if two different courses are allowed

4.3. The project-based learning concept (its effect and how to be integrated)

The survey results show a significant and reasonable importance of applying the project-based learning concept through the learning process of CAAD, while instructors recommended this concept more than students; a final project must be required at the end of detailed courses. As shown in Figure 6, using different ex-

ercises in the same assignment is highly recommended by both instructors and students; this enhances and upgrades assignments so each student has his/her own project to handle even in regular assignments in the learning process. Applying a final comprehensive project is more significant than applying different exercises through the same assignment.

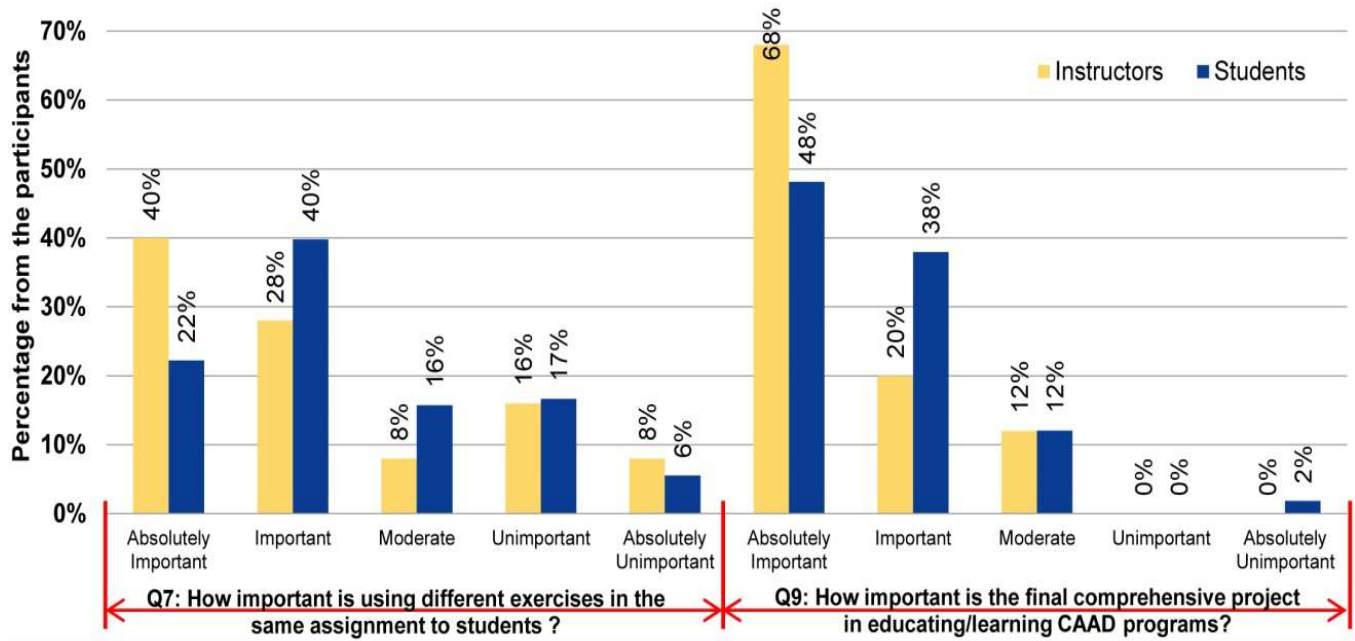


Figure 6: The importance of applying the concept of project-based learning

4.4. Best learning sources to learn CAAD programs

Different preferences have been recommended especially in different student cases. In contrast to what may be expected, video tutorials have been preferred and are more used among other sources in all students' cases; this recommend changing the plan of CAAD courses to involve video tutorials in the learning process instead of the typical process (live explanation by instructors followed by an assignment). Video tutorials can be integrated instead as a main source to switch the lecture role

or lab time for revisions, discussions, details and different problem solving, since instructors have been ranked as a second source. On the other hand, relying on friends or searching via the internet is fewer preferred/used. The results show that preferring instructors and the internet instead of friends is directly proportional with the learning desire and vice versa; this is reasonable. Also, learning more CAAD programs and excellency are correlated with preferring using the internet as a learning source in solving problems.

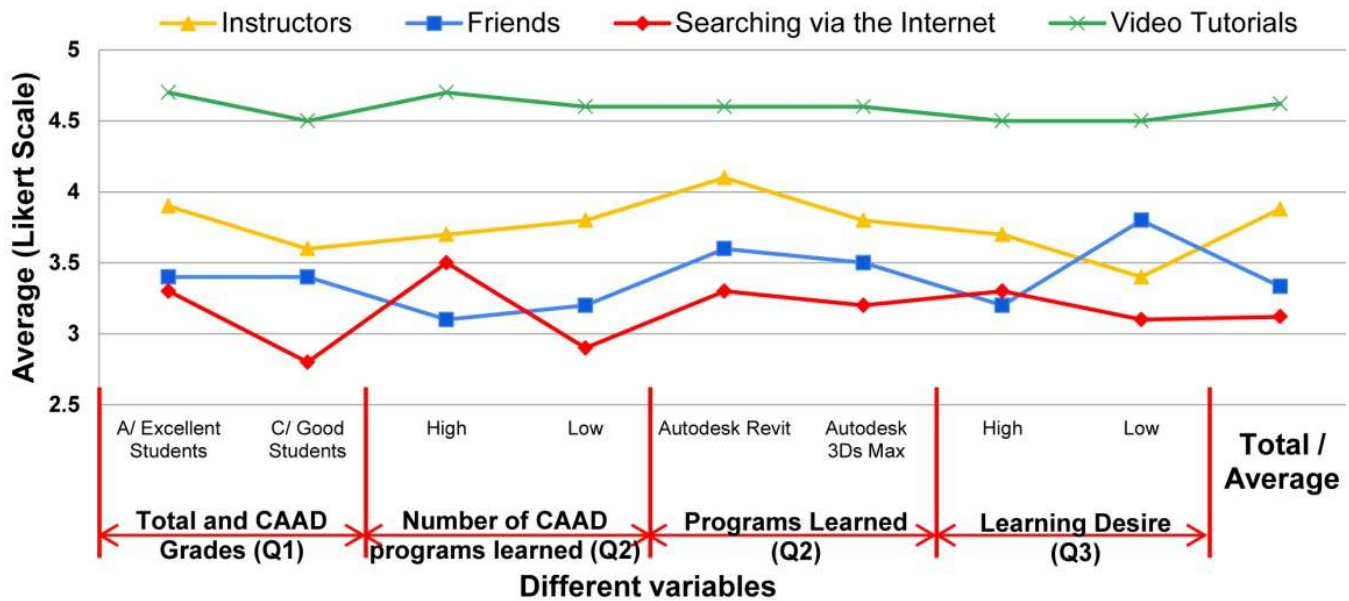


Figure 7: Average of using learning sources by students to learn CAAD programs

4.5. Correlational analyses between the participants merits, attributes and preferences

It is reasonable to assume that the investigated variables are inter-linked. As shown in Table 2, the Pearson Correlation Coefficient (PCC) has been calculated for each two variables based on students' responses. This shed light on many characteristics, details and rationality as follows:

- Total grades, CAAD grades, total programs learned and learning desire are clearly correlated; this correlation reflects the validity and accuracy of the survey inputs, although the correlation itself is logic and reasonable. The same reflection is applied to the negative correlation of preferring different exercises in assignments and relying on friends as a learning source.
- Learning from video tutorials and searching via the internet are also correlated, and this matches results detailed in the previous section.
- CAAD grades are correlated to preferring project-based learning; excellent students prefer having a

final project rather than typical learning process, and this confirms the positive effect of such concepts as detailed before.

- CAAD grades and applying different exercises in the same assignment are correlated; this confirms the importance of varying the tasks to be achieved by students, accordingly students concentrate deeper on solving their individual task problems – this enhances the learning process in different directions. The same vision is extracted from the negative correlation between applying different exercises and preferring to learn directly from their friends – this is the lowest negative correlation among others (-0.2).

Table 2: Correlations between different variables as per the survey

	Preferences						Total Programs learned	Level of learning desire	CAAD Grades	Total Grades
	Learning via video tutorials	Learning via the internet	Learning from friends	Learning from instructors	Different exercises in assignments	Project-based Learning				
Total Grades	0.05	0.05	0.14	0.05	-0.14	0.01	-0.02	0.04	0.37*	1
CAAD Grades	0.05	0.14	0.02	0.17	0.20*	0.26*	0.32*	0.23*	1	
Level of learning desire	0.01	0.02	-0.14	0.00	0.08	0.21	0.25*	1		
Total Programs learned	-0.01	0.20	-0.07	0.02	0.08	0.14	1			
Preferences	Project-based Learning Preference	-0.03	0.14	0.08	0.06	0.04	1			
	Different exercises in assignments	0.01	0.10	-0.24	0.10	1				
	Learning from instructors	-0.19	-0.05	0.02	1					
	Learning from friends	0.02	0.01	1						
	Learning via the internet	0.38*	1							
	Learning via video tutorials	1								

Bold numbers (*): Higher positive correlation (≥ 0.2)

Bold underlined numbers: Lower negative correlation (≤ 0.2)

5. A Proposed guide to promote CAAD education and learning

Based on all the previous results and recommendations, a detailed guide can be articulated to promote CAAD education and learning either for undergraduate students or generic learning; the whole proposed guide has different plans, concentrations and number of courses allowed; these plans also considers different students' levels. As shown in Figure 8, the proposed guide extracted from the survey results have been articulated as follows:

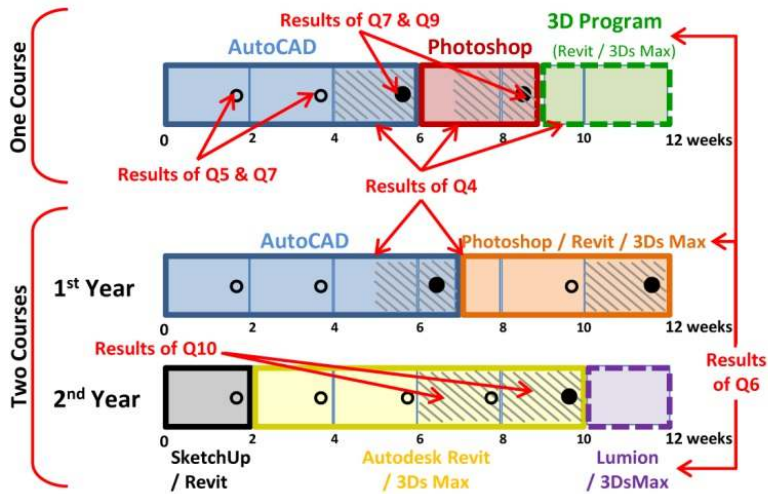
- As shown in Figure 8a (Plan A), many CAAD programs with less concentration on each have been ordered based on the survey (Q6 results), with applying the previous guidelines based on the surveyed results (Q4 to Q10). If more concentration on less number of programs is required, a medium concentrated plan can be applied as shown in Figure 8b (Plan B). Figure 8c shows the order of learning CAAD programs regardless time limitations as proposed by the majority of instructors (Q6 results).
- In all plans and cases, assignments should be distributed biweekly (as surveyed in Q5), also a final project (as surveyed in Q9) should be required from students

at the end of each program education especially programs that require long durations. Both assignments and final project should be designed to reflect different tasks or exercises within the same assignment (as surveyed in Q9).

- Proposed plans have been also designed to match different students' levels. If the majority of students in a course are outstanding students or even moderate students, plan (A) is much better for them which requires self-learning and allows possible extension to learn after the course. On contrary, it is better to adopt plan (B) with struggling students, hence concentrated and focused learning process are applied with fewer CAAD programs. Plan (C) is generic in terms of student level while it is only applied with no/flexible time limitations.
- Also, video tutorials should be integrated in CAAD courses as a main source same as instructors (Q10 results); instructors may revise, discuss and explain details of such tutorials, which is in contrast with the common CAAD teaching and learning.

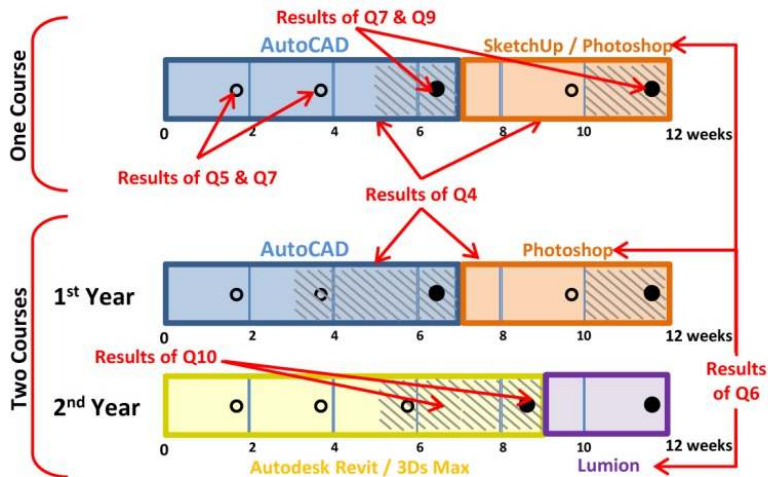
Plan (A): A less concentrated plan

(More programs with just an overview on some programs)



Plan (B): A medium concentrated plan

(Less programs with more concentration on each one)



Plan (C): A high concentrated plan

(All programs in a specific order with no time limits)

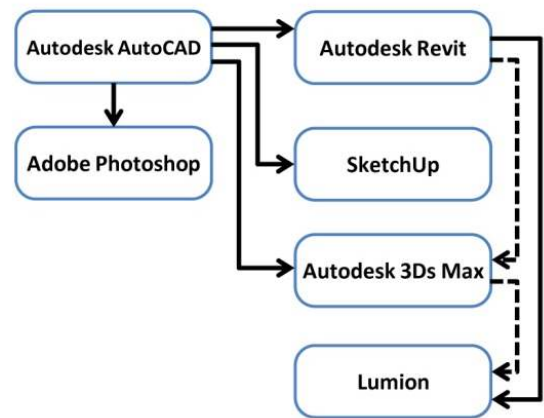


Figure 8: Proposed guide conducted from the survey results

6. Discussion

The four surveyed objectives, the questionnaire-based survey, students and instructors have specific aspects to be discussed. The survey results show a preference to learn less CAAD programs instead of overviewing more CAAD programs in the limited time, and this can be generalized if the time is extended; however, this is reasonable since learning less program upgrade students to conduct an architectural project, while overviewing

more programs do not allow that although it expands the knowledge scope. In the same perspective, adopting more explanations with fewer assignments is not preferred in the learning process; this matches the results of Yang et al (2021) which studied the effectiveness of project based learning in the learning process.

The majority of instructors proposed teaching Autodesk AutoCAD as a primary program then Autodesk

Revit with many different tracks around; this highlights that educating CAAD programs is neither straightforward task nor simple as predicted – the same results appeared in the literature. As per the survey, video tutorials are useful for different students for memorizing steps, solving problems and advanced techniques in CAAD. Using video tutorials has been adopted within COVID-19 pandemic; the survey confirms continuing enhanced using such tutorials. All correlations are reasonable since they confirm: a) the validity of the survey inputs; b) the usefulness of learning such programs accordingly, and c)

their inter-linked guidelines for CAAD education.

Specific guidelines are highlighted by analyzing the excluded sample of students' (who learned only one CAAD program) and comparing them with the involved sample. The excluded sample has less learning desire as shown in Figure 9; this confirms that CAAD learning desire is directly proportional with the number of CAAD programs learned. Accordingly, project-based learning also is less preferred by students who learned only one program – this is why the exclusion of this sample is positive.

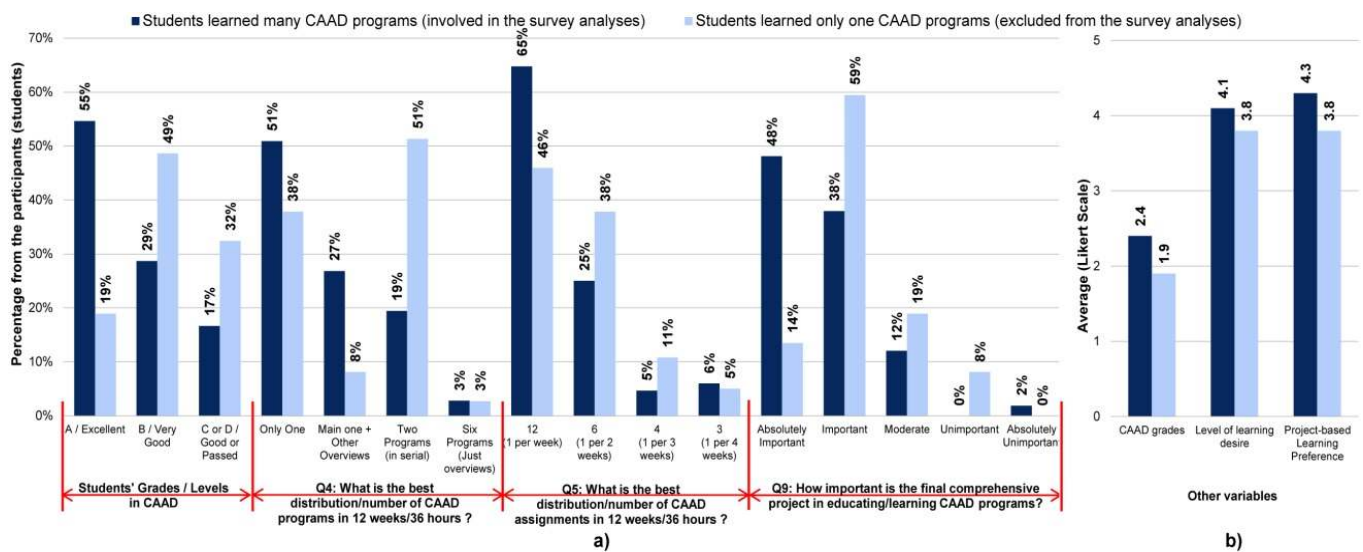


Figure 9: Comparison between students learned one and many CAAD programs

7. Conclusion

This study aims at proposing a simple guide for promoting CAAD programs educational / learning techniques, with focusing on four objectives: a) Best distribution of programs and assignments; b) The concept of project-based learning; c) Best learning sources; and d) Correlation analyses between the participants' merits, attributes and preferences. Accordingly, a questionnaire-based survey have been conducted and completed by 25 instructors and 145 students from different affiliations in Egypt with setting minimum criteria to confirm the validity and qualifications of the surveyed participants.

The survey results refer to learn less/concentrated CAAD programs instead of overviewing more CAAD programs. Tasks should be distributed weekly or biweekly; adopting more explanations with fewer assignments is not recommended. Instructors proposed different programs and orders for serial courses, while the majority recommends teaching AutoCAD then Adobe Photoshop and/or a 3D program in the first or sole course, to be followed by Autodesk Revit or 3Ds Max in a second course, while involving Lumion and SketchUp are also recommended. Project-based learning concept has a significant positive effect; a final project must be required at the end of detailed courses. Also, using different exercis-

es in the same assignment is highly recommended. Video tutorials are the most used sources in all students' cases; this recommend changing the plan of CAAD courses to involve video tutorials intensively in the learning process instead of/in parallel with the typical explanation by instructors. Many correlations have been found to be considered, for example, learning more CAAD programs and excellence are correlated to preferring using video tutorials and the internet. Also, CAAD grades are correlated to preferring project-based learning, and CAAD grades are correlated to applying different exercises in the same assignment, while applying different exercises and preferring to learn directly from their friends are negatively correlated.

A detailed guide has been accordingly articulated to promote CAAD education with different plans; the guide included all the recommended and required techniques that enhance CAAD learning desire as surveyed. So, assignments, final projects, programs orders and durations, video tutorials have been structured and discussed through the guide in different plans of learning concentrations and students' levels. This proposed guide helps instructors and students in teaching and learning CAAD programs, respectively. Many extensions can be studied to widen the study scope. Advanced simulation and specialized programs can be added if the courses durations are extended. Different variables can be involved then such as computers' requirements, lab environments, furnisher and students' detailed cases.

List of Abbreviations

CAD	Computer Aided Design
CAAD	Computer Aided Architectural Design
ADE	Architectural Design Education
PCC	Pearson Correlation Coefficient
Qi	Question number (i), where (i) varies from 1 to 10 and some questions have subdivision (a and b).

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Appendices:

Appendix A: Instructors' inputs in the survey

Survey objectives, questions and Instructors' answers																																				
Instructor ID	General Info / Classification										Objective (a) :Best distribution of programs and assignments		Objective (b): Project-based learning concept																							
	Initial		Q1			Q2					Q4	Q5	Q7	Q9																						
	Academic Degree	Gender	Ability & Qualifications			Which CAAD programs can you use perfectly?					What is the best distribution of CAAD programs in 12 weeks/36 hours?	What is the best distribution of CAAD assignment in 12 weeks/36 hours?	How important is using different exercises to students in the same assignment?	How important is the final comprehensive project in educating/learning CAAD programs?																						
	B.Sc. M.Sc. P.h.D.	Male Female	How many times have you taught CAAD programs?	How many departments have you taught CAAD programs in?	AutoCAD	Photoshop	Revit	SketchUp	3D Max	Lumion	Others	Total Programs	Only 1 Main One + Overviews 2 in serial 6 overviews	12 (1 per week) 6 (1 per 2 weeks) 4 (1 per 3 weeks) 3 (1 per 4 weeks)	Absolutely Important Important Moderate Unimportant Absolutely Unimportant	Absolutely Important Important Moderate Unimportant Absolutely Unimportant																				
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Total	11	7	7	14	11	12	6	9	7	3	25	25	15	13	16	15	2	4.4	6	14	4	1	10	12	2	1	10	7	2	4	2	17	5	3	0	0
% Average	44%	28%	28%	56%	44%	48%	24%	36%	28%	12%	23%	23%	14%	12%	14%	14%	2%	4.4	24%	56%	16%	4%	40%	48%	8%	4%	40%	28%	8%	16%	8%	68%	20%	12%	0%	0%

Appendix B:

Students' inputs in the survey

Student ID	Survey objectives, questions and students' answers													
	General Info / Classification							Objective (a) : Best distribution of programs and assignments			Objective (b): Project-based learning concept			Objective (c): Learning resources
	Q1		Q2			Q3		Q4	Q5		Q7		Q9	
	Total Grades	In CAAD	AutoCAD Photoshop Revit SketchUp 3D Max Lumion Others	Total Programs	Extremely Yes Yes Moderate No Extremely No	Level of learning desire	Only One Main One + Overviews 2 in serial 6 overviews	12 (1 per week) 6 (1 per 2 weeks) 4 (1 per 3 weeks) 3 (1 per 4 weeks)	Extremely Yes Yes Moderate No	Extremely No Different Exercises' preference	Extremely Yes Yes Moderate No	Extremely No Project-based Learning Preference	Lecturer Your friend searching via Internet Video Tutorials	
A / Excellent B / Very Good C or D / Good or Passed Total Grade Levels	A / Excellent B / Very Good C or D / Good or Passed CAAD Grades													
1	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
2	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
3	✓	3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
4	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
5	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
6	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
7	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
8	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
9	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
10	✓	3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
11	✓	3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
12	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
13	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
14	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
15	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
16	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
17	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
18	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
19	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
20	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
21	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
22	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
23	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
24	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
25	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
26	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
27	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
28	✓	3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
29	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
30	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
31	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
32	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
33	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
34	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
35	✓	3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
36	✓	3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
37	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
38	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
39	✓	3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
40	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
41	✓	3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
42	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
43	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
44	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
45	✓	3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
46	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
47	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
48	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
49	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
50	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
51	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
52	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
53	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
54	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
55	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
56	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
57	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
58	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
59	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
60	✓	2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
61	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
62	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
63	✓	1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
64	✓	3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

ارتباط المتغيرات ذات الصلة. تم إعداد دراسة مسحية عبر استبيان على 25 مدرب/قائم بالتدريس و145 متدرب/طالب من جهات مختلفة في مصر. بناءً عليه، تم صياغة دليل مفصل يشمل عدة خطط وحالات مختلفة لتحسين عملية تعلم والتصميم المعماري المدعم بالحاسب، وكذلك تم مناقشة الاعتبارات المختلفة ذات الصلة. يساعد الدليل المقترح المعماريين والمدربين/القائمين بالتدريس وكذلك المتدربين أو الطلاب في عملية تعلم وتعلم التصميم المعماري المدعم بالحاسب بشكل أكثر كفاءة.

الكلمات المفتاحية: التعليم المعماري، أساليب التعلم، التصميم المعماري المدعم بالحاسب، دليل، دراسة مسحية

دليل مقترح لتحسين أساليب تعليم وتعلم التصميم المعماري المدعم بالحاسب

ملخص:

تمثل برامج التصميم المعماري المدعم بالحاسب مؤخراً أحد أهم عناصر كفاءة المعماريين والأكاديميين والطلاب. ونظراً للتطور السريع لهذه البرامج، أصبحت أساليب تعليمها أكثر تعقيداً وتداخلاً مع متغيرات مؤثرة أخرى، وهذا يؤكد أن تدريس وتعلم هذه البرامج ليست مهمة مباشرة كما هو متوقع. تهدف الدراسة إلى تقديم دليل مقترح لتدريس أو تعلم برامج التصميم المعماري المدعم بالحاسب، مع تفصيل ما يلي: (أ) أفضل توزيع للبرامج والمهام، (ب) مفهوم التعلم المعتمد على مشروع تطبيقي، (ج) مصادر وطرق التعلم، (د) تحليل