Quantitative Insights on trends and directions of Egyptian architectural students toward civil curricula - a longitudinal study

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ABSTRCT

The study aims at forming quantitative insights into the trends/directions of Egyptian architecture students in civil courses. This was done by monitoring the averages of success-rates/grades, in architecture/civil courses; the study is a quantitative, longitudinal cohort study. The multi-level model was adopted, the study sample was chosen by purposive sampling, the study sample students were selected by the homogeneous sample method, the number of the study sample is 176, their grades were collected/purified and then analyzed by statistical methods/tests, the most important of which is, Boxplot, matrix scatter plot, Logistic regression, and Paired t-test. Post-hoc tests (Scheffe's) conducted for some tests, the practical significance was examined. The results showed the highest success-rate was in the engineering survey 83%; the success rates of females in civil courses were higher than the male's success rates, the highest average score in the steel structure (70.82), the relationship between students' grades in architecture/civil courses is a positive relationship. The highest grade in the students' results is in the architecture courses, the odds ratios of student's success in the civil courses increased by 10.44%. The equation for regression between students' grades in architecture ACAG/civil ASGOCC can be represented in the equation: ASGOCC=0.415(ACAG). It is evident from this that the higher ACAG, the higher is ASGOCC by 42%. Eventually, there are differences between the final grades of students at different academic levels, the biggest differences are between a medium- and low-student, with 20,017 grades. Eventually, the study presents theatrical implications, represented in a procedural road map for application of longitudinal quantitative studies in architectural education. Furthermore, the study proposed implications for practice to deal with these quantitative insights, it can be summarized in encouraging students to balance academic performance between the two majors (architecture-civil), in addition to the need to present an awareness plan in all design studios to students, given the importance of achieving high grades in civil courses, and spreading this culture among students.

Keywords:

Architectural students' success rates- Architectural students' success grades- The correlation between architectural and civil courses.

1. INTRODUCTION

Recently, Egypt is targeting to be an international educational center, by granting and encouraging many foreign universities licenses and facilities to establish branches in Egypt. The quality of education in Egypt is ranked the 130th out of 137 educational systems in various countries of the world by Economic Forum. University education in Egypt includes 2.8 million students. The biggest problem facing university education is that the courses are not entirely new and need further development[1].

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The architectural profession has appeared irregularly since the dawn of history. The profession of architecture was practiced in the ancient Egyptian civilization, and it was not known how they were trained and taught profession of architecture at that time, the architectural sciences were inherited from father to son so that the profession of architecture had families that practiced it in a specialized manner[2]. Thus, the long tradition of the architectural profession in Egypt is evident since ancient times. Architectural education in Egypt began many years ago. It is worth noting that teaching the profession of architecture in Egypt in a systematic way began in 1900[3].

Architectural education faces various challenges, these challenges must be confronted to achieve the objectives of architectural education that aim for sustainable development and improving the quality of life. Approaches of students' thinking must be shaped to fit the positive trends towards an architectural education that is in line with careful and scientific development[4]. All architectural and non-architectural courses serve and support the skills of architectural design, teaching the architectural design process is the main goal of architectural education, teaching architecture students' architectural design without regard to structural principles, systematic error, for contradicting the actual practice of the architect's profession, the structural elements and principles have a huge impact on the architectural design process[5]. Undoubtedly, the overlap between the architecture and civil disciplines is a large and influential overlap; it goes without saying that architectural professional practice requires knowledge and awareness of the foundations of civil knowledge. Continuous communication between architectural education and engineering education is an important requirement for the development of architecture and engineering[6], therefore the present study's main aim is to study the integration between architectural and engineering education, and this is to study the performance of architecture students in civil courses. Civil discipline is the most closely related discipline with architecture.

1.1 Review of the literature

Recently, many studies have dealt with architectural education; the most important of these studies will be reviewed to identify the knowledge gap that the study aims to fill, the reviewed literature as follows:

The results of a previous study showed the negative impact of students' social factors on the architectural education process, besides these negative effects may result in differences of viewpoints/conflicts on urban and architectural issues[7]. As such, other research deals with measuring the satisfaction of users of urban spaces, and its application as a technique in architectural education, this study emphasized the necessity of simulating architectural education of the mechanisms used in the actual design process[8]. A large body of literature focuses on the incorporation of modern environmental trends in architectural education, in addition to, measuring environmental aspects in architectural courses in some countries[91] . Establishing societal equality values, and taking into account all segments of society in architectural design has been emphasized in some studies[1] . Although the percentage of architectural software is large, architectural education in Asia does not include a large number of environmental applications, which casts a negative shadow on urban society[1] .

Architectural education aims to expand student's knowledge and perceptions, hereafter develop their level in dealing with societal urban and architectural problems. Architectural education

within colleges is insufficient; however, rather it needs various non-traditional educational methods that take place outside the design studio, such as student participation in scientific conferences and workshops with well-known architects, in addition to attending architectural seminars and forums[1] . Architecture students[3] overall grades were tested before and after conducting an experiment, this experiment aims to develop the use of the right hemisphere of the mind for architecture students, the results indicated the development of students' abilities after the experiment[1] . Models of architectural[4] education and approaches based on the principles of practice of the profession were taken into consideration[1] . The future of Egyptian[5] architectural education, in light of modern architectural design trends, has been the subject of a previous study[1] . Another study examined[6] the effect of the relationship of architecture students with time and place, and how to form positive or negative experiences and their direct impact on architecture students, the same study also clarified how to employ this in architectural education[1] . Integration of structural[7] principles in architectural education is argued[1] .[8]

The inclusion of modern architectural trends in architectural education courses has been studied, and the article indicated that the best timing for this is in advanced years, after the theoretical foundations of modern trends in the early years are clarified with architectural education[1] . Methods for clarifying courses and visual layouts for architecture courses are explained[2] , in this section, numerous studies discuss the different teaching methods adopted in the design studio, in their (2017) paper Steinø, N., & Khalid, M. S., focus of the integration of traditional educational methods with e-learning methods, and the results showed an increase in the efficiency of communication between members of the architectural design studio through this approach of education[2] . In theory, some studies[1] clarified the characteristics of architectural education, moreover, compared them with modern educational trends, likewise, the characteristics of architectural education were clarified in the light of contemporary theories of teaching and learning[2] . Elrayies, G. M. (2017)[2], argued that architectural education should be built on long-term methods, similarly the author suggested architectural education experiment based on “how to meet future challenges”[2] . An attempt has been made[3], to approximate what is taught in architectural education and what is required by practicing architects and AEC firms, this study focused on architectural software of its various types. Many architectural schools have taught the content of the courses based on the appropriate architectural software[2] . Developing architecture to fit the future has been discussed[2] .[5]

In all, few studies have dealt with some topics that affect the final degrees of architecture students, additionally, the effect of these degrees on civil courses students’ grades, for example, Hegenauer, J. (2018) explained the effect of architecture students’ negative emotions on success rates[2] . Other studies have also[6] indicated that the nature of teaching in civil program courses differs from the nature of teaching architectural courses. Few studies have examined the relationship of structural courses of the architecture program, and its modern teaching aids[2 2] . Architectural education in private educational institutes was discussed[2 3 3 3] . Architectural courses require more research and scrutiny; different studies have been conducted on architectural courses, the integration of modern architectural trends into architectural curricula was explained, the findings of the previous study were appropriate at the level of producing architectural ideas and solutions for students' projects[3 3 3] . It’s evident from the above[3 4 5] that few studies dealt with the quantitative methodology of architectural education in general, and the performance of students in architectural and civil courses in particular.[9 0 1 2]

1.2 Contribution of the study

Quantitative studies were used in previous studies related to the field of education[33]. A previous study indicated that quantitative studies can be adapted and employed in the field of architectural studies, literature review revealed the lack of sufficient scientific papers on it[3]. Though some studies have taken up courses in architectural education, their proportions, and types[34], however, there are not enough studies on architectural and civil courses in detail, and from here comes the difference of this study from other studies in the field of architectural education. Due to the lack of time for architecture educators, given that the architectural education courses require large contact hours, and require an excessive effort that is consumed in the process of critiquing projects/students' works, the author tried to carry out this applied study and to present simple statistical concepts for quantitative studies in general and longitudinal studies in particular. Longitudinal studies in university education utilized in some previous studies[44]. The current study also used the boxplot, which is one of the modern graphic representation methods. The study also aimed to present a simplified explanation of the appropriate statistical tests to check the study variables in general and the student's final grades in particular, despite the attempt to simplify the utilization of the statistical concept, these concepts require prior experience, architecture tutors can easily follow the adopted roadmap, thus, the research steps represent a direct linear method to reach the same results. The study also provided a summary of the conditions of applying and selecting the parametric/nonparametric statistical tests, furthermore, these conditions also require tests that were conducted and clarified in the present study result, in addition to inspect the study's results, the author did not depend only on statistical significance, but also on practical significance. Comparison tests such as the ANOVA test required the so-called post-hoc tests. These tests also required certain conditions for their application that were examined. The current study provided numerical statistics on students' performance in the study's courses, accordingly; the study proposed implication for the practice for architecture/civil educators and all architecture program's stakeholders. The current study providing a theoretical framework to convert the concepts and tests to an integrated action plan. The study developed solutions/suggestions to implement the results of the study; these solutions/suggestions can be considered solutions that can be generalized to future research samples, architecture tutors can apply these mechanisms in Egypt or any other country without the need for much experience in the field of architectural education studies.

1.3 Study variables

The basic variables of the study can be summarized in two main types:

Independent variables: It consists of the following variables:

I. Architectural curricula Academic performance (ACAP) is a categorical variable, and the categories of this variable are: The students achieved a grade from A to B- in the first category, which is the category of high academic performance (HAP), while students with a C+ grade were included with a D-grade in the second category, students with Medium academic performance (MAP), while the third category represents students with Low academic performance (LAP), students who are students whose results are less than D.

II. Architectural curricula Academic grades (ACAG), this variable is a continuous numeric variable, consists of the final grades of architecture students in the architectural courses, which are the (architectural design courses, the technical courses, and the architectural theory courses).
III. Architectural students' academic level (ASAL), this variable considered as a categorical variable in which the academic levels are classified into three levels: 1. Freshmen students (FRSS), 2. Sophomore students (SOPS) and 3. Juniors' students (JUNS).
IV. High school certificate (HSC), this variable is a categorical variable, in which the types of high school certificates for the students of the study sample were classified into five categories: governmental high schools MATH, governmental high schools Science, Private high schools, Azhar high schools, High Schools in Arab countries.
Dependent variables: It consists of the variables mentioned below:
I. The success rate of architecture students in civil courses (SRASCC), this categorical variable was expressed by the success rates of civil courses, which students studied in order of enrollment, namely: Structure analysis success rate (SASR), Behavior of materials success rate (BMSR), Reinforced concrete success rate (RCSR), Steel structure success rate (SSSR), Engineering surveying success rate (ESSR), the first three courses are taught by students at the Freshmen level, while the fourth course study at the sophomore level, and the fifth is taught at the Junior level.
II. The Architecture students' gross outcomes for civil courses (ASGOCC), numeric variable has been divided into sub-variables, representing the final grades of sub-disciplines in a civil discipline: Structure major grades (SMG), and the courses covered in this major are: Structure analysis grades (SAG), Behavior of materials grades (BMG), Reinforced concrete grades (RCG), Steel Structure grades (SSG), then Public works major grades (PWMG), which represented in Engineering surveying grades (ESSR).

1.4 Study importance and questions

There's no doubt that Egyptian architectural education suffers from many problems, for example, separation from the society needs, distance from the method of the actual practice of the profession in the method of education, lack of educational bylaws on contemporary architectural issues, imbalance of proportions and topics of contemporary architectural courses, lack of courses that enrich human values and ethics are required in architecture, etc., clearly, architectural education in Egypt requires more in-depth studies aimed at developing architectural education, and looking for an in-depth understanding of its various components[4] . Architectural education encounters many problems that require further studies, aimed at developing architectural education in Egypt[4] . [4]
Evidently, from the literature, few architectural studies discuss the architectural courses' results, and their relationship with the rest of the courses to determine the trends and directions of students, furthermore, understand their tendencies along with determining the mutual effects between these courses, and thus research questions can be formulated in:
Q.1: Is there a correlation between SASR, BMSR, ESSR, RCSR, SSSR, and SRASCC vs. gender, ACAP, ASAL?
Q.2: Are the SRASCC impacted by ACAG?
Q.3: Are the associations between ASGOCC vs. gender, ACAP exists?
Q.4. Is there an impact of ACAG on ASGOCC/ SMG/PWMG?

Q.٥. Are there differences in averages of ASGOCC and ACAG?
Q.6. Does the academic level of architecture students in architecture courses differ according to ASGOCC?

1.5 Study objectives and Hypotheses

The objectives of the current longitudinal study focus on several axes that can be summarized as follows:
1. Illustrating the overall grades and results of architecture students in civil courses during the study period.
2. Examining the trends and directions of the success rate of architecture students in civil courses (SRASCC).
3. Exploring the trends and directions of the Architecture students' gross outcomes for civil courses (ASGOCC).
The first objective will be reached in result 3.1, in which descriptive statistics will be presented on the final grades of the students. As for the second objective, it will be achieved by answering Q.2, Q.1. From hypothesis H1 to H19 responding to Q.1, while hypothesis H20 and H21 respond to Q.2. The answer to Q1 and Q2 will be presented in a result 3.2, while the third objective will be achieved by answering Q.3, Q.4, Q.5, and Q.6, from Hypothesis H22 to Hypothesis H36 responds to Q.3, as for Q.4 translates H37, as for Q.5, Q.6, it is responded by hypotheses H38 and H39 respectively, and their results will be explained in result 3.3. The methodology of testing hypotheses to measure correctness/error is a widely used statistical method[4] , this methodology has been adopted in the current study, and the following are the hypotheses employed in the study:
H1, till **H18**: The correlation exists between SASR, BMSR, ESSR, RCSR, SSSR, SRASCC vs.) gender) ,) ACAP) and) ASAL) .
H19: The relationships that have been proven between SRASCC vs. (gender), (ACAP) have a practical significance.
H20, H21: The SRASCC impacted by (ACAG)/(HSC).
H22, till H35: The correlation exists between SAG, BMG, RCG, SSG, SMG, EGS, PWMG, and SRASCC vs. (ACAP), (gender).
H36: The relationships that have been proven between ASGOCC vs. gender, ACAP have a practical significance.
H37: There's an impact of ACAG on ASGOCC/SMG/PWM.
H38: There's a difference in averages of ASGOCC and ACAG.
H39: The academic level of architecture students in architecture courses differs according to ASGOCC.

2. METHODOLOGY AND PROCEDURES

The idea of the current research stemmed from a recommendation in a previous research, that more studies are needed on the final degrees of architecture students[4] . Then the current study[6] began by reviewing the literature to determine the knowledge gap in this area, since civil discipline is the closest discipline to architecture, a study of its impact on architecture courses and vice versa was proposed to study the trends and directions of the architecture students.

Accordingly, research questions, objectives, and hypotheses were developed, then the study was done successively through the following steps:

٢،١ Study design

The quantitative method was chosen in the study due to its scarcity in architectural studies, thus the study is a quantitative deductive article, longitudinal studies are applied to observe trends/directions/behaviors for a group of people for a short or long period of time[4 4] , in which the influence of architecture students is measured at the academic level/grades in architecture. Longitudinal studies are retrospective, meaning they look at previous, or prospective, require current data, one of the most important types of longitudinal studies is cohort studies, it's about studying a group of people who share the same conditions[4 5] . A multilevel modeling approach[5] has been adopted, which is an appropriate method for dealing with quantitative studies in general, and with final grades of students in particular at different academic levels. The study also needs the prior approach, due to the categorization of students' grades based on different performance levels.

٢،٢ Sampling procedures

The study population is the students of the architecture program in Cairo city, Egypt, it was not possible to obtain data from the governmental/private educational institutions that provide the architecture program, therefore there was difficulty in obtaining data and grades of students, additionally, for that reason, the study was carried out on students of the architecture program on the Cape Breton University branch in Egypt, Cairo, because of the possibility of obtaining information from it, and it is worth noting that, all students according to the Egyptian education system can enroll in engineering institutes based on the high school grade only, all students have equal opportunities to enroll in any architectural institute. Thus, it can be said that the students of the research sample are a random sample, which is an expressive sample of architecture students in Cairo. The research sample was chosen based on a purposive sampling method[5 5] , which is a methodology used previously in the field of architectural education[5] . It is a method used when selection randomization is difficult. This method of selection is called typical-case sampling[5 5] . The individuals of the sample were also selected by the "homogenous sampling" a methodology which is used when the characteristics of the study sample are similar. It was also made sure that the majority of architecture institutes in Cairo adopt the same educational bylaw. The study was conducted on a study sample of 167, the number of males (N = 103, 61.7%), and the number of females, (N=64, 38.3%), in the time frame from Fall 2013 Semester to Fall 2019 Semester.

٢،٢ Data Management & statistical tests

The data management process was carried out in the beginning stages that were collected, subsequently, separated or merged based on the student and academic-level, then, the data was reviewed, and the incorrect data was corrected by reviewing the old results files, consequently the collection and classification of success rates in SRASCC, ACAP, into 3 categories. Statistical operations were made on the final grades of the students' research sample, such as calculating averages for the architectural courses to come up with a general average for ACAG, the data were entered into Spss v.25, and in this software, the study variables were classified and the categories were coded according to the abbreviations used in the study, as mentioned

previously in the variables of the study, afterward, the next stage is the stage of conducting the statistical tests that have been selected as follows:

Correlation tests such as the chi-square test[5 5 7 8] were relied on for their suitability for the type of study variables. The Pearson test is applied to examine the relationship between two variables; previous tests have been utilized to clarify the relationships and their direction in addition to the strength of the relationship between SRASCC vs. gender, ACAP, the previous tests have also been utilized to determine the relationships between ASGOCC vs. gender, ACAP. Multiple linear regressions are utilized in recent statistical studies[5 9] , regression tests were performed to measure, the impact of ACAG, HSC on SRASCC, which is predictors of SRASCC, multiple linear regression tests also have been utilized to investigate the impact of ACAG on ASGOCC. The ANOVA test was applied to test the equal means[6 6 6 0 1 2] of the study variables, thus, it was applied to determine the differences between ASGOCC vs. ACAP. Paired-t-test was also conducted to answer the question, Does the academic level of architecture students in architecture courses differ according to ASGOCC? Paired-t-test is widely used for testing of mean differences[6 6 3 4] . Examination of the effect size of the statistical tests used in the current study to determine the practical significance of the results[6 5] . The practical significance differs from the statistical significance[6 6] . The statistical significance values may be small so as not to indicate the importance of the results[6 7] . The practical significance must be taken into consideration after calculating the statistical significance, which is a response to a fundamental question that is: Are the differences between the study samples have a significant practical value? [6 · 8] Impact size values for chi-square tests 0.1,0.3, and 0.5, and these numbers can be translated in the following order: weak medium strong effects[6 9] , there are no statistical tests to definitively determine the practical significance, the current study will adopt the smallest effect size if the results are smaller than it, then the practical significance are neglected and vice versa[7 0] . Finally, the tests require some conditions for their application. These conditions were addressed before implementing the statistical tests, as indicated in the results.

3. RESULTS

3.1 Descriptive statistics (Arch. Students' results in civil courses)

The present study examined the final results of the students in terms of two main types: 1. The overall success/fail ratios, 2. The final overall grades for students in architecture and civil courses.

The success/fail rates of architecture students in civil courses were monitored in the time frame of the study. Table (1) shows the total success/fail rate, in addition to the success/fail rate for males (Ma.) and females (Fe.). The highest success rate was in the engineering survey course, while the lowest success rate course is steel structure, and in general, it is clear that females have higher success rates than males as illustrated in table (1).

Table (1) Male and female success/fail students' rates and total success/fail students rates.

	(SASR)			(BMSR)			(RCSR)			(SSSR)			(ESSR)		
	Ma.	Fe.	**Total**	Ma.	Fe.	**Total**	Ma.	Fe.	**Total**	Ma.	Fe.	**Total**	Ma.	Fe.	**Total**
Fail	37 %	36 %	**37 %**	30 %	22 %	٢٧ **%**	37 %	19 %	٣٠ **%**	53 %	48 %	٥٢ **%**	11 %	6%	**17 %**
Success	63 %	64 %	**63 %**	70 %	78 %	٧٣ **%**	63 %	81 %	٧**0 %**	47 %	52 %	**٤%** ٨	89 %	94 %	**83 %**

Table (٢) the Descriptive Statistics of architecture and civil courses.

	N	Minimum	Maximum	Mean	Std. Deviation
(ACAG)	167	26	92	58.77	11.141
(SAG)	162	7	98	56.14	19.676
(BMG)	156	13	94	57.94	14.302
(RCG)	136	19	92	61.54	15.174
(SSG)	141	7	100	70.82	20.023
(ESG)	154	13	92	62.45	19.812

Similarly, in the same table, (N) represents the number of students who joined the courses, in addition to the lowest score (Minimum) and the highest score (Maximum) that a student scored. The number of students enrolled in civil courses varies, as some students of the study sample have not yet completed all the civil courses.

The final grades distribution for civil courses was examined in detail by box plot[7] , and it is one of the most modern and important methods of representing values, and it is suitable for all sciences and is applied to compare students' grades in terms of location, skewness, and outliers[7] , and with it, the distribution of grades can be visualized in a graph, through which some phenomena can be observed. The grades are divided into four quartiles, each quartile includes 25% of the grades, Q1 includes 25% of the lower grades, then Q2 includes 25% of the grades higher than the previous one, and likewise in Q3, Q4, the midline in the box represents the median, the small circles are outliers, Figure (1) shows that the ACAG's boxplot is small for the SAG's boxplot, and this means the final grades of students agree with each other in a large sector of students in terms of ACAG and vice versa in SAG. Clearly, SSG's boxplot is larger than ACAG's boxplot, and SSG's median is outside ACAG's boxplot, this means that the differences between SSG and ACAG are statistically significant, the same between ESG and ACAG, therefore, the different groups of students must be examined through the ANOVA test.

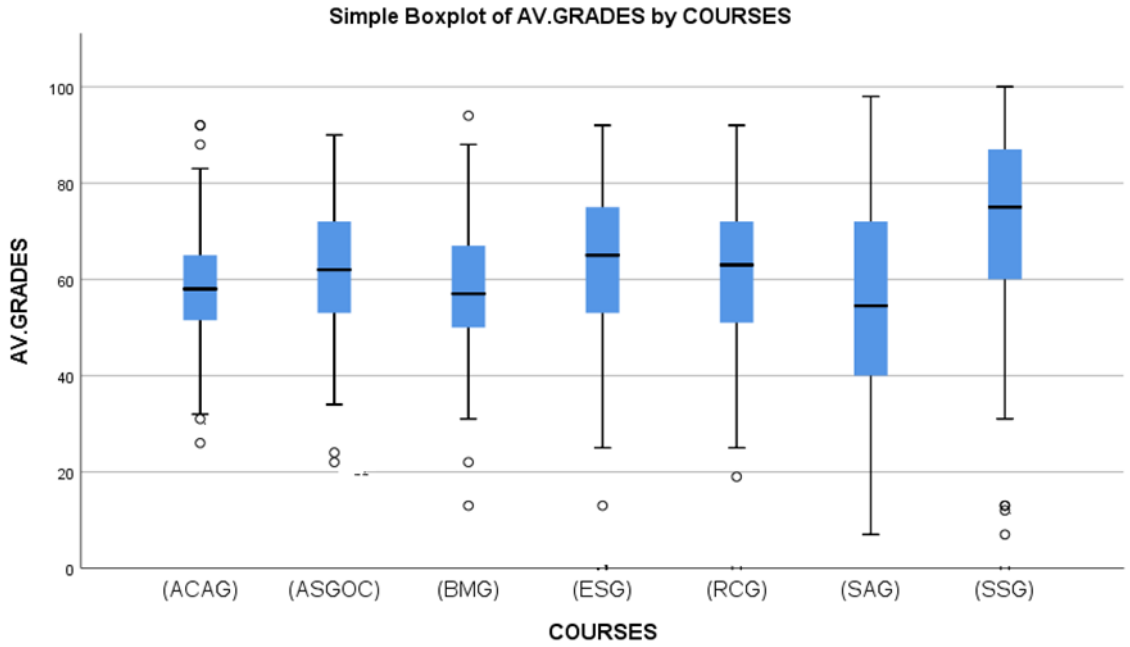

Figure (1) Box plot for final grades distribution of ACAG, BMG, ESG, RCG, SAG, and SSG.

The relationship matrix between ACAG, SAG, BMG, RCG, SSG, and ESG shows that most relationships tend to be direct relations, and concerning the relationship between ACAG and civil courses, it's direct relations, and the strongest of these relationships is the SAG, ACAG relationship, as the trend line tends to the top right significantly, then the next relationship in strength is the relationship between ACAG and BMG. As for the relationships between students' grades in civil courses, it's positive, except for some courses that do not have relationships between them, as between BMG and SSG, as the trend is almost horizontal as it is presented in figure (2). These preliminary results will be checked by the subsequent results in which the regression test will be used.

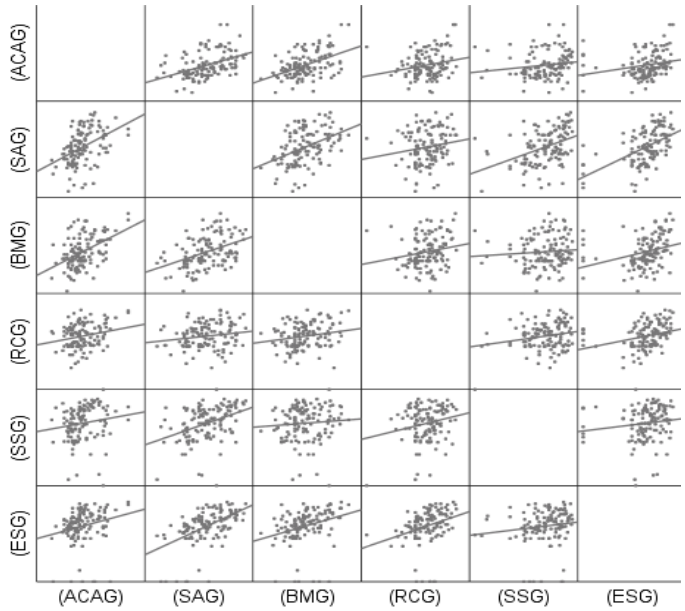

Figure (2) Scatter plot matrix for (ACAG, SAG, BMG, RCG, SSG, and ESG).

٣،٢ Trends and directions of SRASCC

3.2.1 SRASCC vs. gender, ACAP associations.

Table (3) SRASCC vs. gender, ACAP associations.

	FRSS						SOPS		JUNS	
	(SASR)		(BMSR)		(ESSR)		(RCSR)		(SSSR)	
	p	Eta	p	Eta	p	Eta	p	Eta	p	Eta
Gender	0.900	0.010	0.244	0.090	**0.023**	**0.176**	**0.013**	**0.193**	0.533	0.048
(ACAP)	**0.000**	**0.370**	**0.015**	**0.223**	0.571	0.082	0.126	0.157	**0.033**	**0.200**

Because the variables measured in this test are categorical variables, the chi-square χ^2 test will be used. Specifically, the gender variable is the nominal variable while the ACAP variable is the Ordinal variable, the effect size was determined by the Eta test[7] . While it was made sure that confidence intervals[7 7] were not exceeded by[4 5] preferred value in cases where the relationships were approved, with regard to the relationship of Gender and SRASCC, it is clear that there are no approved relationships except the relationship between gender, ESSR and RCSR, as the p-value<0.05 as in Table (3), thus, the hypotheses H3, H4, H6 are correct hypotheses. As for the relationships between ACAP and SRASCC, the relationships H7, H8, H11, and H12, have been proven, and the rest of the relationships have not been proven. Likewise, the relationships between ASAL and SRASCC are correct relationships as there are relationships between all academic levels and SRASCC. Thus, the hypotheses H13, H14, H15, H16, H17, and H18, are valid. To consider the practical significance among all elements of SRASCC vs. Gender, ACAP, the Eta value was checked, it was found that all values are not less than 0.1, therefore, hypothesis H19 is a valid hypothesis.

The relationships between SRASCC and the students' success rate were evident in the architectural courses in the SASR, BMSR, and SSSR courses. The strength of the relationships is, Eta=0.370, 0.223, and 0.20, respectively, which is a moderate relationship with the structural analysis course and weak in the rest. Generally, the relationship between SRASCC and ACAP has been proven, which is what indicates the effect of success rates in architectural courses and civil courses, in addition to the relationship between academic levels and the success rates of architecture students in civil subjects is a correct relationship, and this relationship will be clarified in detail in the following tests.

3.2.2 ACAG, HSC impact on SRASCC.

To find the effect of independent study variables on dependent variables, Logistic regression model analysis (LRMA)[7] was used, which is utilized[6] to explain the effect of one variable or group of variables on one or more dependent variables[7 7] , and it is distinguished[7 8] from linear regression in that it deals with binary variables[7] , and this variable is represented[9] in the current study in the variable SRASCC. (LRMA) which is an appropriate and effective way to predict odds ratios for nominal independent variables, the difference between the probability and odds ratios can be explained as being the probability of the variable's outcome occurring versus the probability of not occurring[8] . In general, the regression[10] equation is:

$Y=a+b_1X_1+ b_2X_{2+\ldots}$ Where, Y=the dependent variable, b1,2,=Weighted coefficients, $X_{1,2,=}$ Independent Variables[8] . Spss results showed that[1] the addition of architecture grades improves

the model as Sig=0.046, meaning that the presence of the variable of architecture degrees contributes to predicting the percentage of students' success in civil courses in a statistically significant manner.

.Table (4) Cox & Snell R Square table.

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	**125.978[a]**	**0.025**	**0.046**

25% of the variation in the success rate in civil courses can be explained by the information of the average architectural courses grades, as in the third column of the table (4).

Table (5) Variables in the equation.

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Architectural_curricula_Avrage_Grades	**.043**	**.022**	**3.975**	**1**	**.046**	**1.044**
	Constant	**-.586**	**1.223**	**.229**	**1**	**.632**	**.557**

There is a positive relationship between the success rates of civil courses and average architectural courses grades since the value of Exp(B) is positive. If the architecture student's grades increase by one degree (1%), then the odds ratio of the student's success in civil courses increases by 1.044 degrees (10.44%) as in Table (5). This confirms the result previously reached in the scatter plot matrix in result 3.1. The effect of the HSC type on SRASCC was studied, and the results showed that the type of certificate did not affect SRASCC.

3.3 (ASGOCC) trends & directions

3.3.1 ASGOCC vs. gender, ACAP associations.

There are differences between the tests that examine relationships, which is the Pearson and Spearman's test. The necessary tests were carried out to determine the use of one of it by ensuring the normal distribution of the study variables[8], and to determine this, the Kolmogorov[8] test was used, and it was clear from the test results that the p-value is less than 0.05, thus the data has no normal distribution, and then the spearman's test[8] will be used, which is a test that measures the relationship between two variables in addition to clarifies its direction for non-parametric data[8], in the spearman test, correlation coefficient demonstrates the type of relationship between the variables (positive or negative), and the strength of the relationship depends on the proximity of the value of this parameter to 1 in the positive correlation and from -1 in the negative relationship[8], all relationships between SMG vs. gender is not proven, so the following hypotheses are not proven, H22, H23, H24, H25, and H26., while the relationships between PMWG/ASGOCC vs. gender in existing relationships and so the hypotheses H27, H28 are correct relationships, with respect to the relationships between the detailed elements of ASGOCC vs. ACAP/SMG/PWMG, they are existing relationships where all p-value values are less than 0.05, a single relationship has not been proven which is the SSG and ACAP relationship. Accordingly, hypothesis H32 is an incorrect hypothesis, so the hypotheses H29, H30, H31, H33, H34, and H35 are valid hypotheses, as to the practical significance of the

approved relationships between ASGOCC vs. gender, ACAP was not less than 0.1, as indicated by the COR.CO values in Table (6). Therefore, hypothesis H36 is valid.

Table (6) The spearman's results for relationships between ASGOCC vs. gender, ACAP.

	(SAG)		(BMG)		(RCG)		(SSG)		(SMG)		(ESG)/(PWMG)		(ASGOCC)	
	COR.CO	Sig.	COR.CO	Sig.	COR.CO	Sig.	COR.CO	Sig.	COR.CO	Sig.	COR.CO	Sig.	COR.CO	Sig.
(Gender)	-.021	.790	.148	.066	.110	.202	-.030	.721	.069	.373	**.222****	**.006**	**.167***	**.031**
(ACAP)	**-.369****	**.000**	**-.263****	**.001**	**-.276****	**.001**	-.122	.150	**-.350****	**.000**	**-.365****	**.000**	**-.388****	**.000**

3.3.2 ACAG impact on ASGOCC.

To determine the effect of ACAG on ASGOCC, the linear regression test will be used. Firstly, the effect of ACAG on the SMG will be determined, meaning that the student's grades in architecture courses explain the change in the SMG, and it is clear from the table (7) that R2=0.178, meaning that the independent variable ACAP explains 18% of the change in the SMG, as shown by the table (7) Sig.=0.00 and the standard regression coefficients (B)= (0.421) and the non-standard regression coefficients (Beta)=(0.489). Secondly, the effect of ACAG on PWMG was studied, it was found that R2=0.079, and then the independent variable ACAP explains 8% of the change in PWMG grades, and it has been proven that Sig. is less than 0.05, (B)= (0.281), (Beta)= (0.496).

Overall, it was found from Table (7) that ACAG affects ASGOCC, and R2=0.173, and the independent variable ACAP explains 17% of the change in ASGOCC and Sig. Less than 0.05, (B)= (0.415), (Beta)= (0.466).

Table (7) Regression parameters.

	R2	Sig.	Beta	B
SMG	0.178	0.000	0.489	0.421
PWMG	٠,٠٧٩	0.000	0.496	0.281
ASGOCC	0.173	0.000	0.466	0.415

٣,٣,٣ Comparison of ASGOCC vs. ACAP

The ANOVA test was executed to test the averages differences between ACAP and ASGOCC, the ANOVA test is used after reviewing some conditions[8 9] . Table (8) shows the results of the one-way analysis of variance, and from that, it is determined that there are statistically significant differences in the ASGOCC based on the ACAP where the value of F=15.504, and since (i.e., p=0.00) which is less than 0.05, also HAP has a value greater than MAP, LAP, as is evident from the mean value in the second column in Table (8), which agree with the result 3.1, which shows the shape of the boxplot of the students' results, so the hypothesis H38 is a valid hypothesis where the mean HAP was 75.50.

Table (8) ANOVA test for ASGOCC vs. ACAP

	Mean	Std. Deviation	F	Sig.
HAP	75.50	9.487	15.504	0.000
MAP	62.45	12.266		
LAP	55.48	9.062		

to determine the reason for the statistically significant differences, a Post Hoc Tests Scheffe[9] is performed, and it is evident from Table (9) that the differences are due to the difference between HAP and the lower grades of students with a significant difference of 13,049 from MAP and a significant difference of 20,017 from the LAP, where the probability value was equal to 0.000. While the difference between MAP and LAP was 6.968, it was also statistically significant, as it was Sig.=0.016.

Table (9) Post Hoc Tests Scheffe for ASGOCC vs. ACAP

	Mean Difference (I-J)	Sig.
HAP vs. MAP	13.049*	0.000
HAP vs. LAP	20.017*	0.000
MAP vs. LAP	6.968*	0.016

3.3.٤ Comparing ACAP via academic level based on ASGOCC

To find out whether the performance of architecture students in civil courses affects ACAP, the Paired-t-test will be used, to measure this hypothesis, new conditions will be set for the study sample selected, these conditions are that the student must have crossed all academic levels and actually have graduated from the program, 111 students met the new condition, Paired-t-test, which is a parametric test[9] , ACAP was used at freshmen level as a pre-test and ACAP at senior level as post-test, some conditions must be met to apply Paired-t-test, the normal distribution of the study samples is the most important conditions of this test[9] , it was tested by the Kolmogorov-Smirnov test[9] , from this test emerged that the pre-test's p-value=0.057 and the post-test=0.20, both of which are greater than 0.05, and thus the test can be applied. The average ACAP for freshmen level students was 72.92 S.D.=11.31, while the average ACAP for senior-level students was 74.32 S.D.=8.24, and the P-value=0.175, which means that H39 is a rejected hypothesis.

٣,٣,٥ Forecast ASGOCC based on ACAG

To examine the direction of architecture students' grades in civil courses, a scatter plot was utilized to forecast the future relationship between ASGOCC and ACAG.

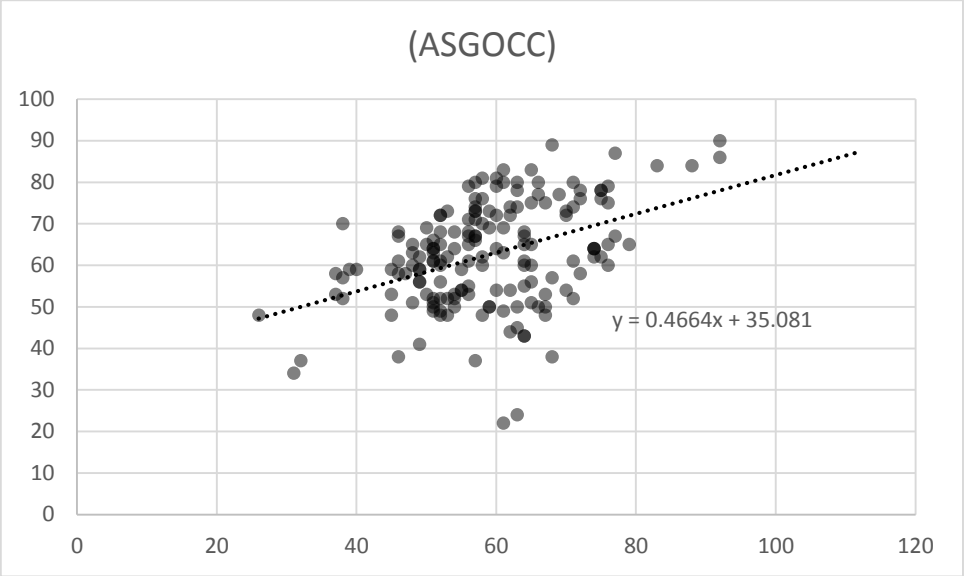

Figure (3) the trend line forecast (ASGOCC) based on (ACAG).

Figure (3) shows that, in the future, the more students' grades in architectural courses, this will be reflected positively on the grades of civil courses, with an increase of 46.6%, as in the equation in Figure (3), and this is consistent with what was previously explained in the table (7), the fifth column is called standard regression coefficients (B). It is clear from Figure (3) that the horizontal trend line is heading upwards, which indicates the future increase in students' grades in civil courses as the students' grades increase in architecture courses.

4. DISCUSSION

The key purpose of this longitudinal study is to attempt to comprehend and analyze the results of the study sample's students over six years, furthermore, to identify the trends and directions of the success rate of architecture students in civil courses, besides, examining the trends and directions of architecture students for their final results in civil courses.

The success rates of the study sample were examined, and the results indicated that the highest success rates among students were in the engineering survey course 83%, then the behavior of materials 73%, followed by the success rate of reinforced concrete 70%, then the success rate of the structural analysis course 63%, and finally the success rate of steel structure 48%. Concerning the success rate of males and females in the structural analysis course, the success rate of females is 64% greater than the success rate of males 63%, also the success rate of females is 78% greater than the success rate of males 70% in the course of material behaviors, with regard to the success rate of females in the course of reinforced concrete was 81% while the male success rate is 63%, similarly, the female success rate in the steel structure course is 52% greater than the male's 47% success rate, at the same time the female success rate is 94% greater than 89%, which is the male success rate in the engineering survey course, it is evident that the success rate of females is higher than males in civil courses, which requires raising the level of male students academically and taking some procedures that lead to that. The results of architecture students were monitored in civil courses, and the results indicated that the highest average final grades of students were in steel structure course and it was as follows (M=70.82), followed by the engineering survey course (M=62.45), then the reinforced concrete course

(M=61.54), then the behaviors of material course (M=57.94), and finally the Structure analysis course (M=56.14), while the final average scores of the students in the architectural courses were (M=58.77), these averages were calculated for the first time that students registered the subjects regardless of success or failure. The results of the box-plot of the final results revealed that the grades of the students are approximately 50% (Q2, Q3) and ranged between 52, 64 degrees in architecture courses, while in the civil courses the scattering of degrees appears as shown in the structural analysis course in which 50% (Q2, Q3). Students' grades range between 40, 74 degrees, as shown in Figure (1), and this may be attributed to the convergence between architecture students and their tutors, and criticism of their projects in a one-to-one form, unlike civil courses that teaching process is being done collectively, and this is consistent with previous studies[9 9] . It also agrees with the findings of Khodadadi, A. (2015,), Campanyà, C., Et. al (2018)[9 9] . The relationship between students' grades in architecture courses and civil courses is mostly positive. Strong positive relations appear in the relations between ACAG and SAG in the largest way. The relationships between students' grades in civil courses together are positive in most of them, except between BMG and SSG, there is no relationship. Evidently, from the above it becomes clear that the great impact of excellence in architecture courses and its effect on increasing final grades in civil courses, while some civil courses are not affected by other courses, this may be attributed to the fact that the nature of these courses differs based on the basic sciences on which this course is based on, as the behavior of material course relies heavily on engineering chemistry while the steel structure course depends on mechanics.

Some relationships between the student's gender and ESSR, RCSR is established, and the strength of the relationship between these variables and gender have been proven weak as the value of Eta=0.176, 0.193 and this is evident in Table (3), and in general, the relationship between the success rate of architecture students in civil courses and gender is an approved, however, yet, it's a weak relationship, and this reveals that there are no statistically significant variances in civil courses' success between females and males. This is not agreeing with a previous study by Górska, R… Results of A., Wojtowicz, A., & Wojtowicz, B. (2018, August) showed that males differed from females in the freshman stage in spatial abilities[9] . It also examines the practical significance of SRASCC vs. Gender, ACAP associations, it turns out that all of the elements have practical importance and therefore they are taken into account. It became clear from the results that the influence of ACAG on SRASCC is statistically and practically significant, and that demonstrates the importance of student excellence in architectural courses and its impact on success in civil courses, along with 25% of the variance in SRASCC due to ACAG. The more an architecture student scores one grade in ACAG, the odds ratio increased in civil courses by 10.44%. This is consistent with the previous result that was presented initially in the descriptive statistics section on the relationships between final grades for students in architecture and civil courses.

Furthermore, the effect of the type of high school certificate on SRASCC was not clear. Similarly, no effect was shown for the high school total grades of the study sample on SRASCC. As for the relationships between ASGOCC, gender did not prove any relationship between SMG elements and gender, while the relationship of PWMG to gender was proven, which is a weak direct correlation that shows the difference between males and females, in performance in the engineering surveying course, similarly in academic performance in civil courses, and since the engineering survey course is based on Mathematics and Mechanics, likewise are the

rest of the civil courses except for the BMG, this result needs to be further studied and scrutinized in future studies. As for the detailed relations between ASGOCC and ACAP, some relationships appeared at a very strong level of significance 0.01, meaning that the level of confidence is 99%≥, and all the relationships tend to be moderate, negative relationships between SAG, BMG, RCG, SMG, PWMG, ASGOCC, except for one course that has no relationship with the students' academic performance in the architectural courses, which is the SSG. It is evident from the above that students' performance levels differ between architecture courses and civil courses, in addition to the general average in performance in the SMG major, and in general in the average performance of students in ASGOCC civil courses, as in Table (6), and there is a clear indication of these results which is the interest of students with great inclinations for architectural courses in these courses and their lack of interest or tendencies towards civil courses, and it is worth noting in this regard the need to amend this concept among these students, especially since the distinguished students in architectural courses are the most likely to work in the field of architectural design. Consequently, they should be alerted to the need to pay attention to civil courses and their great impact on the architectural design process.
The linear regression utilized to determine the impact of ACAG on ASGOCC/SMG /PWMG. Regression is applied to determine the effect and predict the future relationship between two variables[1 1] . To use linear regression, some conditions must be met[1 1] . The effect of ACAG on SMG is proven. The regression equation was concluded as follows. SMG=0.421(ACAG), this means that the higher the ACAG, the SMG increased by 42%, and the effect of ACAG on the PWMG was also evident, and from the results, the regression equation can be formulated as follows: PWMG=0.281(ACAG), which demonstrate that the higher the ACAG, the higher the PWMG by 28%. In general, the effect of ACAG on ASGOCC has been proven, and the regression equation can be represented in the equation: ASGOCC=0.415(ACAG). Obvious from this that the higher the ACAG, the higher the ASGOCC by 42%. This indicates the mutual relationship between excellence in architectural and civil courses.
The results of the ANOVA test to determine the differences between the mean grades of the ASGOCC based on the ACAP, showed that there is indeed an advantage in favor of the HAP students over the rest of the student levels, and this can be explained by the fact that the excellence in the architectural courses is associated with the superiority in the civil courses. A multi-level model was utilized to determine the results of different types of students, post hoc tests are conducted to determine the areas of differences between the averages specifically, the Scheffe test was chosen, which showed that the largest difference between a medium- and low-student, where the difference between them was statistically significant and amounted to 20.017 as in Table (9). Thus, it becomes clear that the group of students is responsible for the differences between the grades that were mentioned previously in the results of boxplot regarding the degrees of architecture and civil courses.
The multi-level model results indicated that there are no differences between the averages of the students' grades in the architecture courses before and after passing the civil courses, which indicates that the civil courses do not affect the students' grades in the architectural courses, and it may be attributed to the influence of project jury in the architectural design and architectural technical courses, with the aesthetic aspects more than any other aspect.

4.1 Theoretical framework Significance

Overall, the beginning of methodology and procedures and all its sub-point can be considered as a road map, which can be followed by the implementation of the study again, the study tried to adopt quantitative methodologies in architectural education due to the scarcity of quantitative studies in architectural education, in addition to that the study tried to apply the concepts of longitudinal cohort studies, additionally, this study applied various quantitative statistical methods, and statistical tests were applied, and these tests require assumptions and conditions for their application and to distinguish between parametric and non-parametric ones. To achieve the above, the multi-level model was executed to specify the different grades of students based on the academic level of the student. Furthermore, the study adopted tests are rarely used in architectural studies, for example, logistic regression, paired-t-test, were applied to reach the results of the current study, with an explanation of the ways to apply it for future benefit.

4.2 Implications for the practice

When considering the results in Quantitative Insights on trends and directions of Egyptian architecture students toward civil curricula, it proposes many solutions and policies that, when applied in the architecture program, lead to the integration of the performance of the students of the architecture program in the architectural and civil courses. The implications for practice can be summarized as follows:

Among the prominent results that became clear is that the success rates of females are higher than males in civil courses, and this result requires an awareness plan for male students about the importance of civil courses, and convincing them that civil courses are of the same importance as architecture courses, because of their impact on developing the perception of civil concepts for architectural projects. The convergence of the results of at least half of the students in civil courses is an important result, and the explanation for this may be due to the students' affinity with their educators/tutors in the architectural courses, and it is possible to coordinate with educators/coordinators of civil courses to develop the teaching methodology for architecture students so that their success rates rise. With regard to the final grades in civil courses, it became clear that the civil courses do not influence each other to the same extent, and perhaps the reason for this is the different nature of the courses, and from this, architecture students should be aware of the great importance of all civil courses, in addition to, effective strategies can be designed, especially in the design studio, such as heavily confirmation of civil concepts in architecture courses, similarly providing an explanation of the concepts of the courses that show the low success rates in the civil course, namely the structure analysis, steel structure. It became clear from the above that whenever an architecture student scored one degree in ACAG, the success rate in civil courses increased by 10.44% , Which shows the mutual relationship of superiority between the two majors and their mutual importance, and this result can be built on and promoted between architecture/civil instructors, in order to encourage between instructors of the two majors the necessity of making understandings and coordination between them in teaching policies for architecture students. It is not preferable to encourage a specific type of high school certificate to enroll in the architecture program, as the relative importance of the type of high school certificate has not been proven. Some negative associations have also been evident in the final results of architecture and civil courses, for example, steel structure, which indicates the importance of changing the culture of non-interest

in civil courses among some students of the architecture program, who are interested in architecture courses and neglect civil courses, and who must be made aware of the importance of changing this concept, and it can happen, that's in architectural design studios, for example. In general, a problem appears in the results of a steel structure course, hence it has the lowest success rate (**48%)** in civil courses, while it has the highest average grades **(70.82)** among all civil courses, and this contradiction reinforces the necessity of developing a strategy to address the problem of this course, as there is a clear disparity between students, where students are divided into two basic groups, one of whom fails, and one of them succeeds with high grades, hence it needs to alert these course coordinators to trying to develop training and educational solutions for students to overcome this problem. The regression equation between students' final grades in architecture and civil courses showed that the higher the degrees of architecture courses, the more SMG, PWMG, and ASGOCC courses are increased by 42%, 28%, and 42%, respectively, and this result shows that students excel more in SMG courses than PWMG courses. This indicates the importance of integrating the basic principles of PWMG courses within the architectural courses in which this can be done, especially in the design studio. It became clear that HAP students showed superiority in architecture and civil courses together, unlike the rest of the students, furthermore, the results showed clear differences between the grades of medium and low-level students, and this became clear after a post-hoc test to determine the reason for the differences, and these important results are of great importance in developing incentive plans, in order to work with medium and low-level students to encourage them to increase their achievement as a result of the differences in the final grades in architectural and civil courses, eventually, from the above, it is possible to summarize the procedures to be taken in encouraging students to balance academic performance between the two majors, furthermore, the necessity to clarify an awareness plan in all design studios, given the importance of achieving high grades in civil courses and spreading this culture among students. The importance of developing a teaching and learning strategy for architecture students in civil courses is also evident.

4.3 Limitations & Future studies

The current study is concerned with studying the results of the success and grades of the architecture program students, in the architecture courses and the civil courses, the sub-disciplines in which the students' results are studied in the architecture program are the architectural design courses, the technical courses, and the architectural theoretical courses, while the civil courses that were taken into consideration in the study are structure analysis, behavior of materials, reinforced concrete, steel structure, and engineering survey.

The research sample was only studied during years 2013 and 2019, as the next step for this research, the researcher proposes a future study based on determining the basic sciences on which civil courses are based, which are as follows according to the content of each course bylaw and the opinions of civil experts: Structure analysis=Mechanics, Behavior of martials=chemistry, Reinforced concrete= mechanics/math, Steel structure= mechanics/math, Engineering surveying=Math. Thus, the study recommends studying the grades of the same study sample in basic sciences to verify the results.

4.4 Delimitations

Non-architectural and non-civil courses, such as basic sciences and humanities are outside the scope of the research.

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