A World-wide Questionnaire Survey on the Use of Computers in Architectural Education:

A Case study of CAD use in the USA, UK, Israel, Australia, Canada, Sweden and the Netherlands.

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Key Words: CAD Integration, Employment, Users and Effectiveness.

The paper reports on a study which examines the impact on architectural education needs arising from the changes brought about by the implications of CAD teaching/learning (CAI/CAL). The findings reflect the views of fifty-one (51) architecture schools through a world-wide questionnaire survey conducted in mid 1996. The survey was structured to cover four continents represented by seven countries, namely the USA, UK, Israel, Australia, Canada, Sweden and the Netherlands. Structurally the main findings of this study are summarised under five areas, namely: 1) General Information, 2) Program of Study (curriculum) and CAD course, 3) CAD Laboratories: Hardware, Software, 4) Departmental Current and Future Policies, 5) Multi-media and Virtual Reality. Principally, there were three main objectives for using the computers survey. Firstly, to accommodate a prevalent comprehension of CAD integration into the curriculum of architecture schools world wide. Secondly, to identify the main key factors that control the extent of association between CAD and architectural curriculum. Thirdly, to identify common trends of CAD teaching in Architecture schools world-wide and across the seven countries to establish whether there are any association between them. Several variables and factors that were found to have an impact on AE were examined, namely: the response rate, the conventional methods users and the CAD methods users amongst students, CAD course employment in the curriculum, age of CAD employment, the role of CAD in the curriculum, CAD training time in the Curriculum, CAD laboratories/Hardware & Software, computing staff and technicians, department policies, Multi-Media (MM) and Virtual-Reality (VR). The statistical analysis of the study revealed significant findings, one of which indicates that 35% of the total population of students at the surveyed architecture schools are reported as being CAD users. Out of the 51 architecture schools who participated in this survey, 47 have introduced CAD courses into the curriculum. The impact of CAD on the curriculum was noted to be significant in several areas, namely: architectural design, architectural presentation, structural engineering, facilities management, thesis project and urban design. The top five CAD packages found to be most highly used across universities were, namely, AutoCAD (46), 3DStudio (34), Microstation (23), Form Z (17), ArchiCAD (17). The findings of this study suggest some effective and efficient future directions in adopting some form of effective CAD strategies in the curriculum of architecture. The study also serves as an evaluation tool for computing teaching in the design studio and the curriculum.

1. Introduction

To evaluate computer utilisation by architecture schools with regard to the curriculum structure, assessments must be made considering all aspects of computers involvement and integration Also, all areas of the curriculum that computers are involved in must be addressed whether it is architecture design or urban planning, etc.. (QaQish 1997). As a result, the study examined how should CAD be best integrated in the curriculum by looking at where about and what areas in the curriculum should it be integrated with? This study explored the integration of CAD into architecture schools by examining the utilisation of CAD across the curriculum of architecture in seven countries, whether it is a subject based or a design based course. A great deal of information yet was needed to be examined and updated in relation to CAD integration and utilisation in the curriculum. Thus, this questionnaire survey presented an objective view of the recent computers' use in architecture schools from the original source, also gathered some useful information on the recent practice of CAD teaching in schools today. The study as result carried out an empirical analysis on the data obtained from this questionnaire.

2. The Objectives of The Study

The questionnaire has attempted an in depth investigation on some important issues of teaching CAD allowing a more objective and measurable survey. The main objectives for the use of computers in architectural education survey recognised and sought after were, namely:

1. to accommodate a prevalent comprehension of CAD integration into the curriculum of architecture schools world wide.

2. to identify the main key factors that control the extent of association between CAD and architectural curriculum.

3. to identify common trends in Architecture schools across the seven countries to establish whether there are any association between them.

4. to provide an insight on the recent development in architectural education when integrated with CAD education and schools of architecture.

3. The Design of the World-wide Questionnaire Survey

A wide-ranging questionnaire survey was chosen as the method to explore computers use in architectural education. It was carried out by means of a postal questionnaire. A random stratified sample of world-wide population determined by world continents was drawn using four continents. The four continents stratified sample was decided to be represented by seven countries described in Table 1.

Table 1: The CAD in Architectural Education Stratified Sample Survey Analysed by Continent and Universities Numbers.

Continent	Country	Number of Universities	Percent of each Country	Percent of each Continent
North America	**USA**	59	55.66 %	60.376 %
	Canada	5	04.716 %	
Europe	**UK**	37	34.905 %	
	Sweden	1	00.943 %	
	The Netherlands	1	00.943 %	36.791%
Australia	**Australia**	2	01.89 %	01.89%

Asia/ Middle East	**Israel**	1	00.943 %	00.943%
	Total	**106 Univ.**	100%	100%

The number of universities was determined according to the size of the continents and the list of the universities' names and CAD tutors that was available to the researcher from computing books or literature. The random stratified sample provided a representative numbers of universities in each continent, covering almost all universities according to size and age.

4. The Structure of the World-wide Questionnaire Survey

The questionnaire was divided into four sections:

A) The first section gathered general information about architecture schools. It consisted of five main questions, collecting information ranging from the university name, the name of person answering the questionnaire, the number of students in the department, the date the department was founded and the degrees offered at each department were also gathered. This section was correlated with other sections in the questionnaire, i.e., the relationship between the department age and the date CAD introduced in the department was examined.

B) The second section gathered information on the program of study and CAD courses offered at the department. It also consisted of five principle questions, all of which collected information about the current and future situation in the department in relation to CAD importance in the curriculum. This section also gathered information about CAD courses and in what stage are being taught. Finally the numbers of hours offered to students relevant to each course were also examined.

C) The third section gathered information about CAD laboratories in the department in terms of both hardware and software, and the departmental current and future policies. It consisted of sixteen questions, covering the numbers of CAD labs and the type of hardware and software used in department, the number of staff and technicians. Other question concerning the department decisions making and CAD polices were included, such as who makes the decision on who teaches and what to teach.

D) The fourth section was dedicated to the use of Multi-Media and Virtual-Reality in the architectural department in the current and future situation.

5. The World-wide Questionnaire Survey Areas of Investigation

Six principle areas of analysis were developed to examine CAD use in architectural education in terms of its utilisation across the curriculum.

A) The first area examined the importance of the role of CAD in architectural curriculum within each department in twenty six areas of architecture, science and research, namely: architectural design, architectural engineering, architectural history, architectural presentation, architectural technology,

architectural theory, building management, civil engineering, construction, environmental design, environmental, facilities management, interior design, land management, land surveying, landscape architecture, regional planning, structural engineering, thesis project, town planning, transport planning, urban conservation, urban design, urban estate management, urban planning. So, the role of CAD utilisation in architectural curriculum was an important variable used by this study to better understand architectural computing teaching. Also it identified the areas in architectural tuition that CAD is likely to have an impact on.

B) The second area investigated whether or not relationships exist between architecture schools size within the selected countries and both the extents of CAD implementations and integration and the use of software in CAD courses. The age of CAD in the department was examined.

C) The third area examined whether there are any differences in attitudes and perception between the Gender of CAD tutors towards the importance of CAD labs' proximity to the design studio.

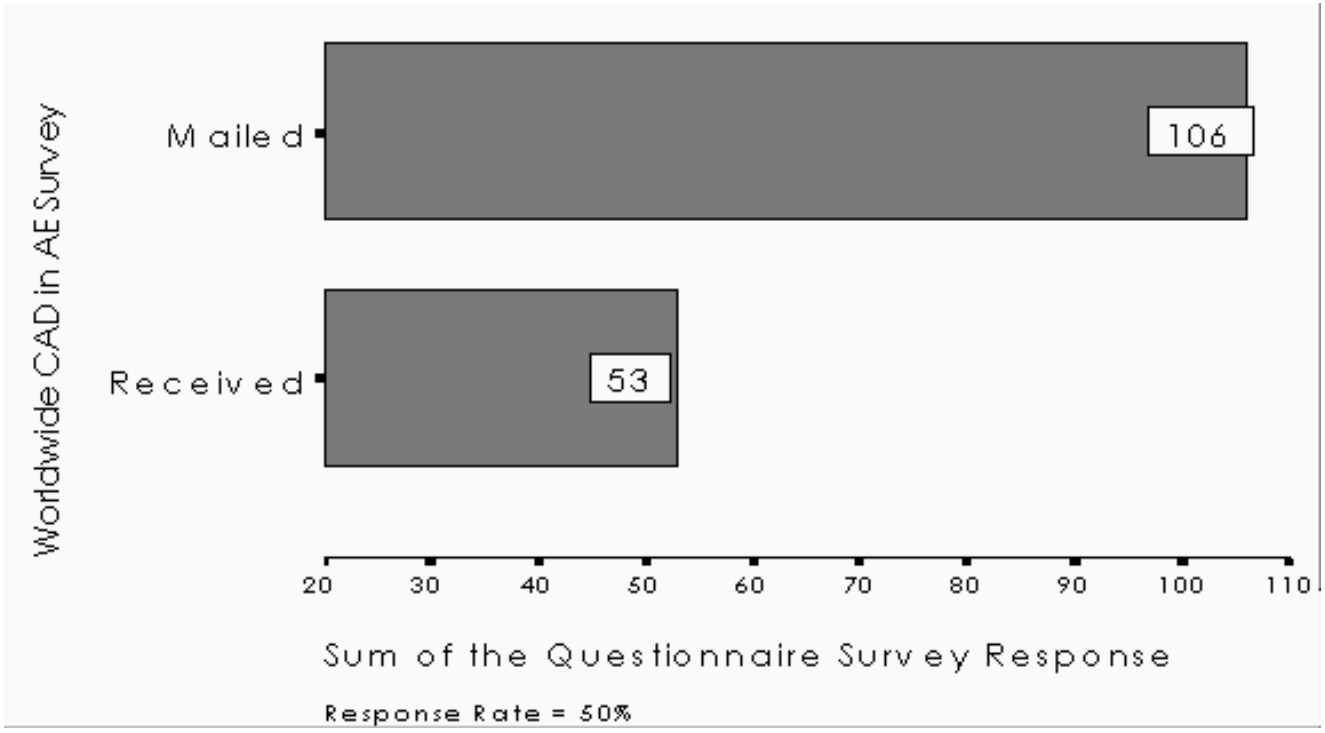
D) The fourth area explored the stages of CAD course employment in the curriculum relevant to years and terms, and the total hours of training for each course and as a whole (Curriculum). This analysis intended to explore whether there are any trends in teaching CAD courses across the curriculum either in stages or hours of training.

E) The fifth area investigated the importance of CAD labs' proximity to the design studio. Also, the number of students who are considered as CAD users were examined relevant to the number of students in the department in each year. Another important area explored was the use of software in CAD courses on a scale of 1-5 (low use and high use).

6.1.The World-wide Questionnaire Survey Response Rate (Analysis and Results):

The survey of CAD use in architectural education invigorated esteemed interest and the response was much greater than the authors had originally anticipated. A genuine interest in CAD and architectural education was noted amongst all respondents.

Figure 1: The Sum of the Overall Mailed and Received Questionnaire Survey.



An ample care by the respondents in answering the questionnaires was also regarded as a positive sign that has reflected a need amongst educators and universities to assist the problems of CAD integration in architecture education. From the 106 questionnaires mailed, fifty-three (53) responses were received, resulting in a 50% positive response rate (Figures 1).

6.1.The Questionnaire Survey Gender Response Rate

The response to the questionnaire from female tutors was 16.98% compared with 83.02% of male tutors (Table 2). Evidently, there are more female tutors who teach CAD in architectural schools than reported in this survey. Earlier studies by the authors suggested that one of the reasons why gender differences existed in architecture school was taught to be the lack of female role model amongst schools of architecture (QaQish & Hanna 1996).

Table 2: A Comparative Analysis of the Gender Differing Response Count to the Mailed and Received CAD Questionnaire Survey in the Seven Countries.

		Gender Response	Gender Response Rate Relevant to Questionnaire Overall Response

Country	Questionnaire Received	Male	Female	Male	Female
USA	25	21	4	39.62%	7.55%
UK	21	17	4	32%	7.55%
Australia	2	2		3.77%	
Canada	2	2		3.77%	
Sweden	1	1		1.88%	
The Netherlands	1	1		1.88%	
Israel	1		1		1.88%
Total	53	44	9	83.02%	16.98%

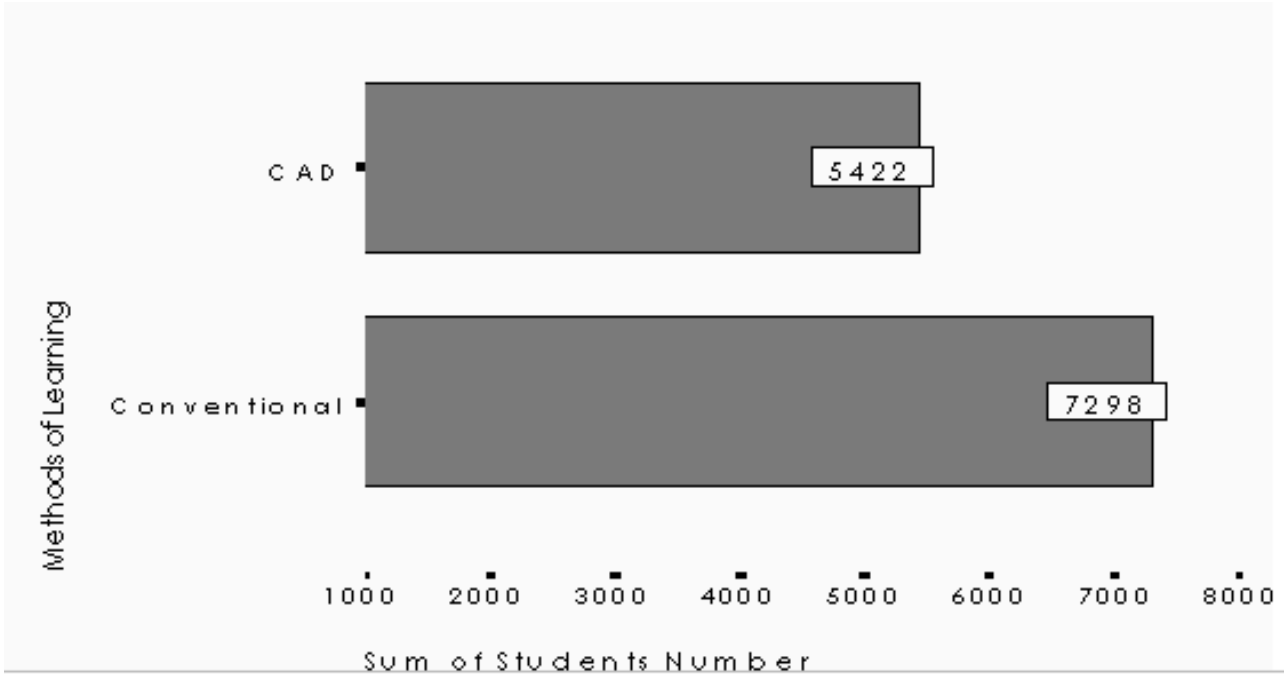
7. The Conventional Methods Users and the CAD Methods Users amongst Students Across Architecture Schools in Seven Countries.

The overall conventional users accounted for as much as 57.37% of the total students number, while CAD users accounted for only 42.63% of the total (Figure 2 & Table 3). There is a progressive trend among architectural students to convert from the conventional method to the CAD one (QaQish & Hanna 1997,a). The future increase of CAD users may encourage more schools to invest larger sums of money on CAD labs improvements and seriously evaluate their current curriculum to adopt to the new CAD trends.

Table 3: The Differences in the Students No. of A Typically Mixed Conventional and CAD Curriculum.

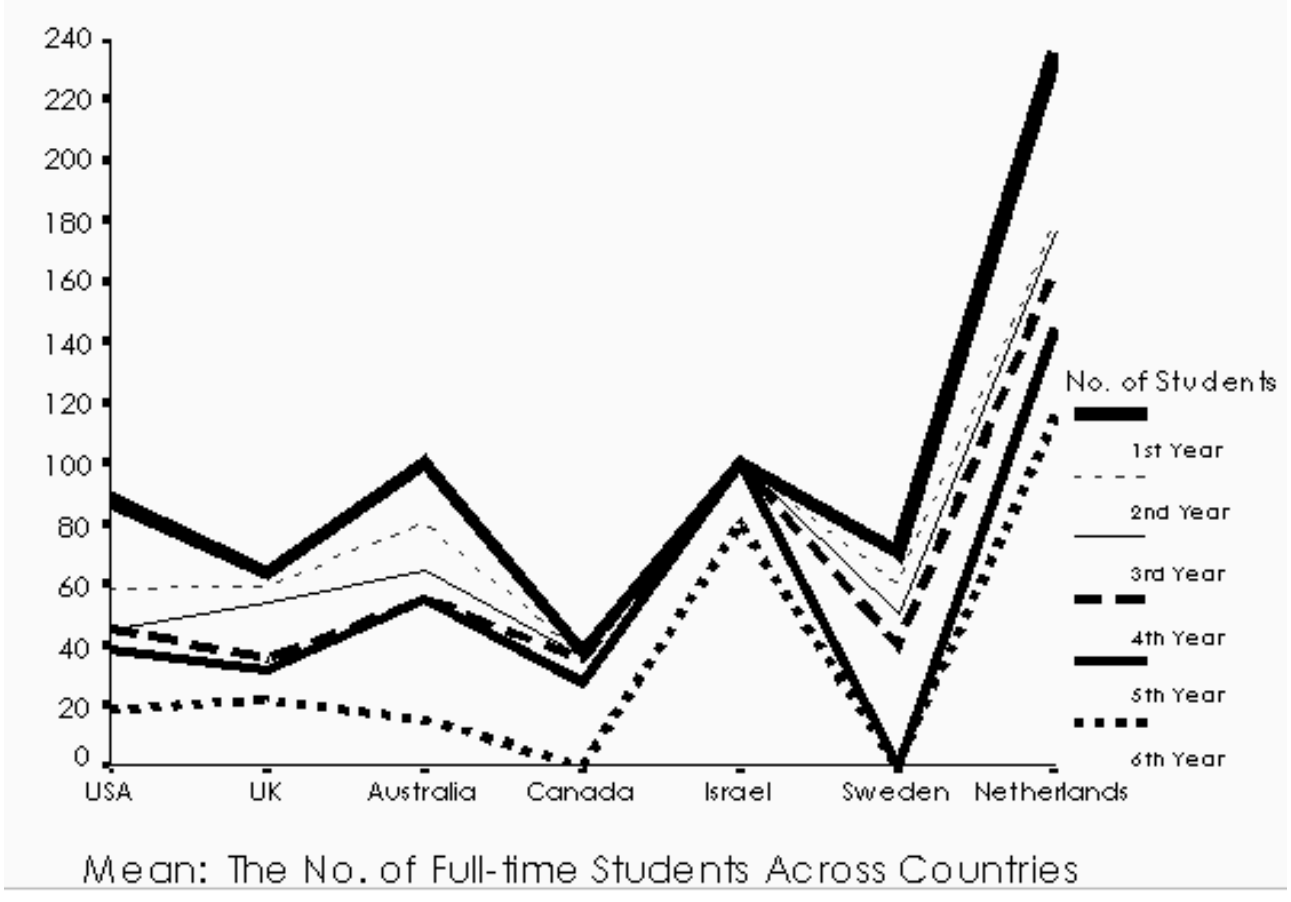
Response	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total	Percent
No. of Students	4003	3104	2606	2255	1919	1088	12720	100%
Conventional	3171	1832	1388	1384	1036	742	7298	57.37%
CAD	832	1272	1218	871	883	346	5422	42.63%

Figure 2: The Sum of Students Numbers in Both the Conventional and CAD Methods

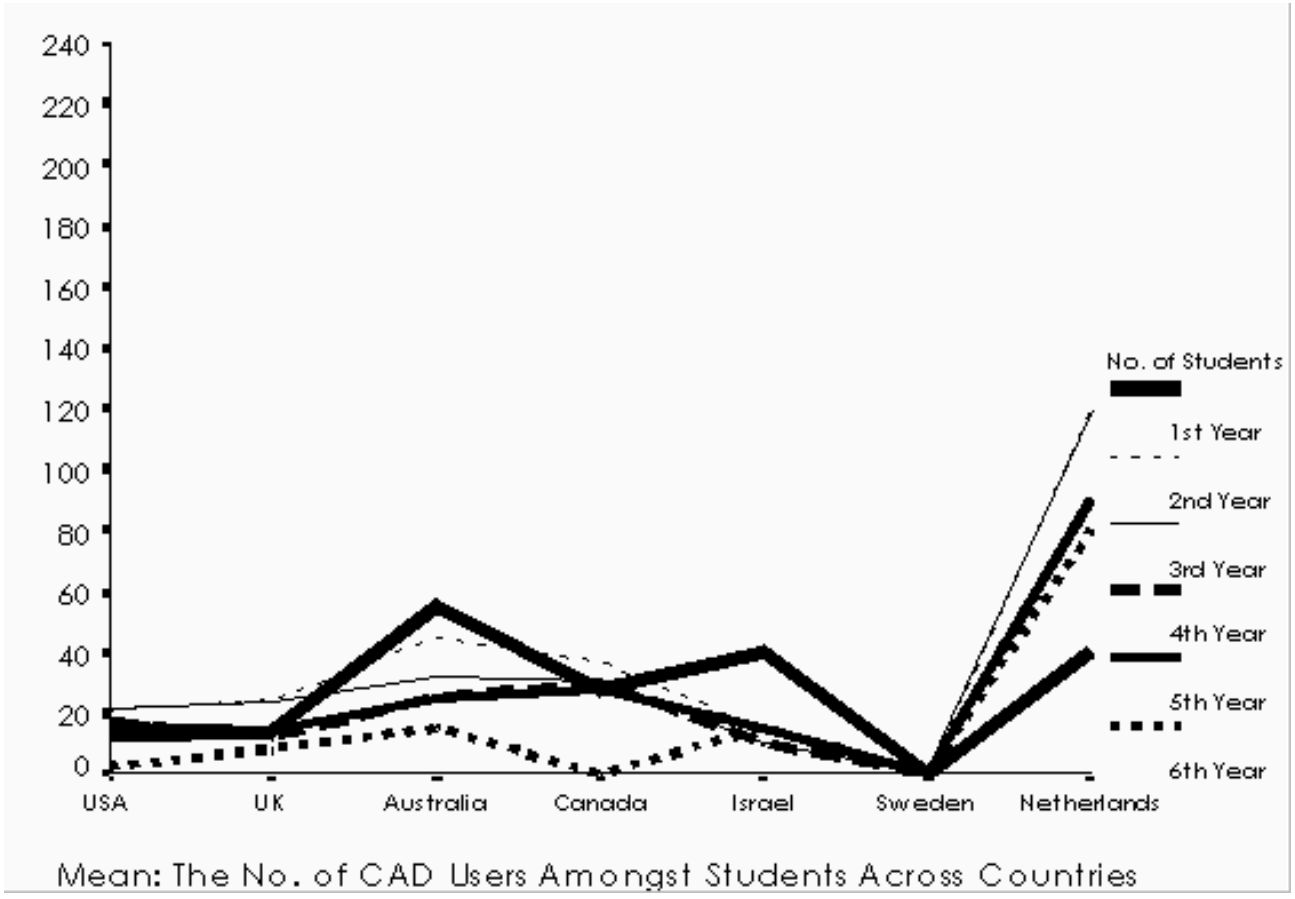


On the other hand, there are new trends evolving among the differing types of students enrolled in architecture schools in terms of computing utilisation. There is a tendency amongst students to adopt new trends of problem-solving strategies in the design studio by utilizing CAD (QaQish & Hanna 1997,b). Thus the students' transformation from conventional to CAD students is ought to have an impact on the future of architectural education, which suggest that schools should consider a framework to reconcile the old curricula to fit the new form of CAD students (QaQish 1997). Besides, when the statistical mean of the CAD user number and the overall numbers is examined, marked differences were uncovered. The trend clearly indicates a decline in students numbers as they attain higher years in the curriculum (Figure 3). There is a clear trend in both Sweden and Australia universities, where CAD users scored higher means in almost all years level. The CAD users at the UK have shown a lower mean numbers in higher levels, whereas the highest mean numbers in the same country were noted in the first year students. In this study the variable CAD use among students was reasoned to be associated with the level of CAD integration and the methods of CAD teaching in the department (QaQish & Agabani 1994). Why do architectural schools across countries differ in CAD users numbers? This may be looked at in relation to differing students' attitudes, also the differing gender attitudes, both may be examined in relationship to the tutor's competence and abilities and many another (QaQish 1997).

Figure 3: The Mean of Overall Students & CAD Users Numbers in Architecture Schools Across Seven Countries.



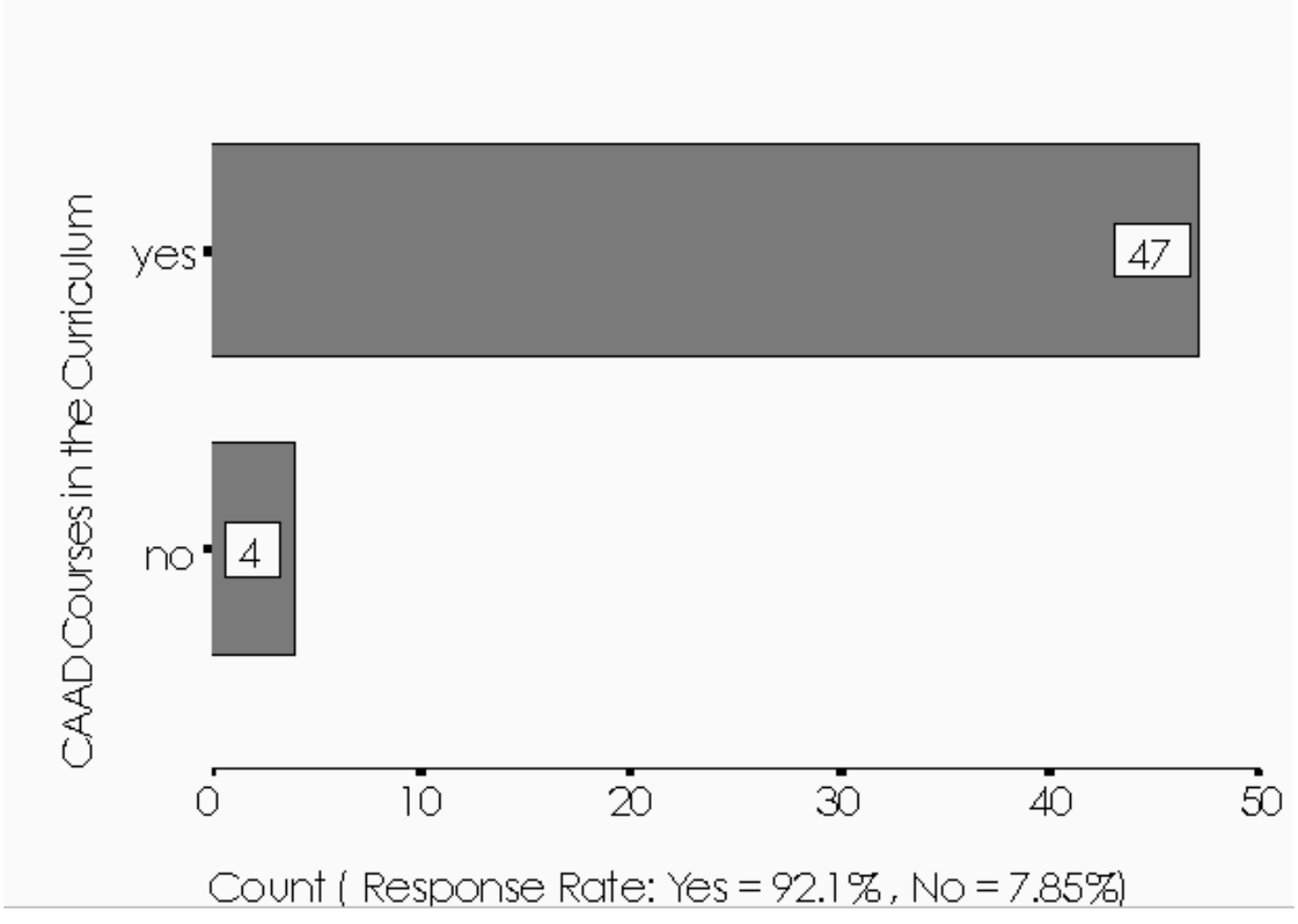
Mean: The No. of Full-time Students Across Countries



8. CAD Course Employment Across the Curriculum of Architecture Schools

The respondents were asked whether the school curriculum includes any CAAD courses, and if not, does the school have any future plans to do so? While architecture schools are, on balance, seeking better future levels of CAD integration, this objective is assisted by more schools attempting to integrate CAD into the curriculum.

Figure 4: CAD Across the Curriculum.

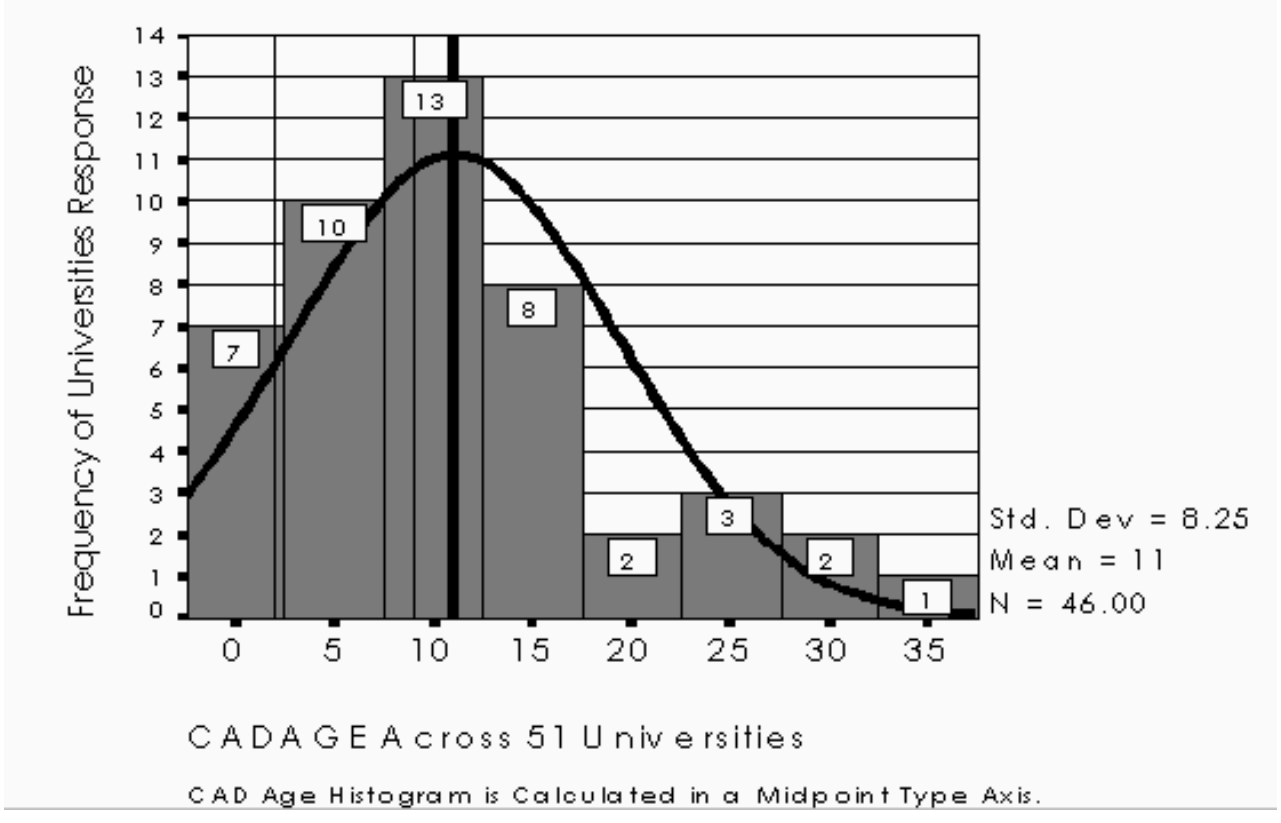


On the whole, there is a strong trend developing amongst architecture schools to adopt and employ this new technology (Figure 4). The results also indicate, that 3.9% of the respondents have shown no interests to employ CAD in future plans compared with 9.8% who have indicated interest in introducing and improving CAD in the future. The response rate in terms of CAD course across the curriculum in the seven countries did not show any significant difference amongst the seven countries. Most of the universities in the seven countries have similar strategies and interests towards employing CAD in the curriculum (Figure 5). It is fairly certain that there is tendency across the 51 universities to employ CAD now and in the future.

9. Age of CAD Employment Across the Curriculum of Architecture Schools:

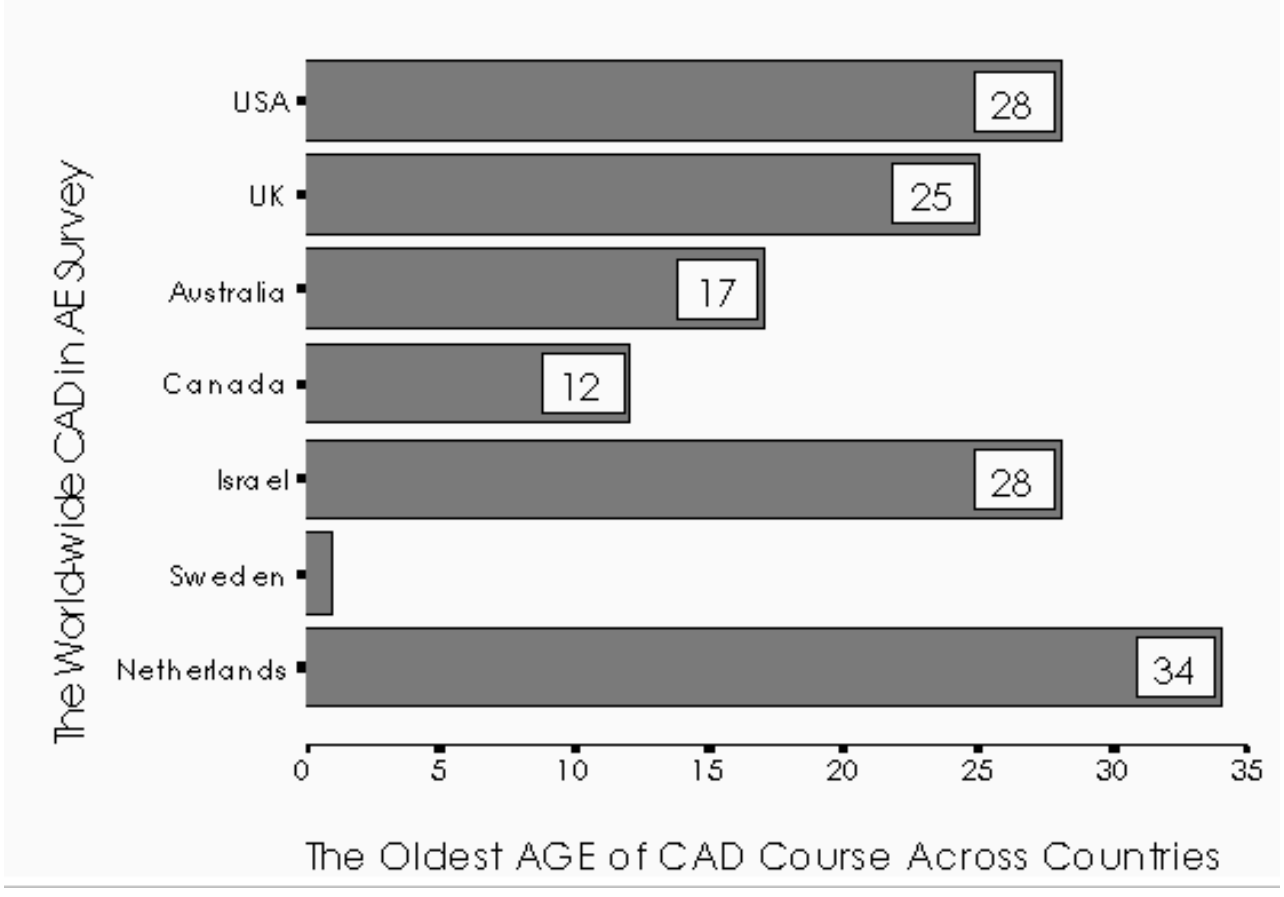
The age of CAD employment is calculated from the questionnaire response on the question: when were CAD courses introduced to the department? The respondents answered by defining year of employment.

Figure 5: The Skewed Distribution of CAD Age Enrollment in Architectural Departments World-wide.



The majority of the universities has CAD program aged about 13 years, a slightly more than a decade (Figure 5). The Netherlands with the mean age of 34 years was found to have the oldest CAD programs compared with the mean age of 28 years in both the USA and Israel. Sweden and Australia have the youngest CAD programs age group amongst the rest of the countries (Figure 6).

Figure 6: The Oldest and Youngest CAD Course amongst the Seven Countries.


The Worldwide CAD in AE Survey
USA
UK
Australia
Canada
Israel
Sweden
Netherlands
28
25
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20
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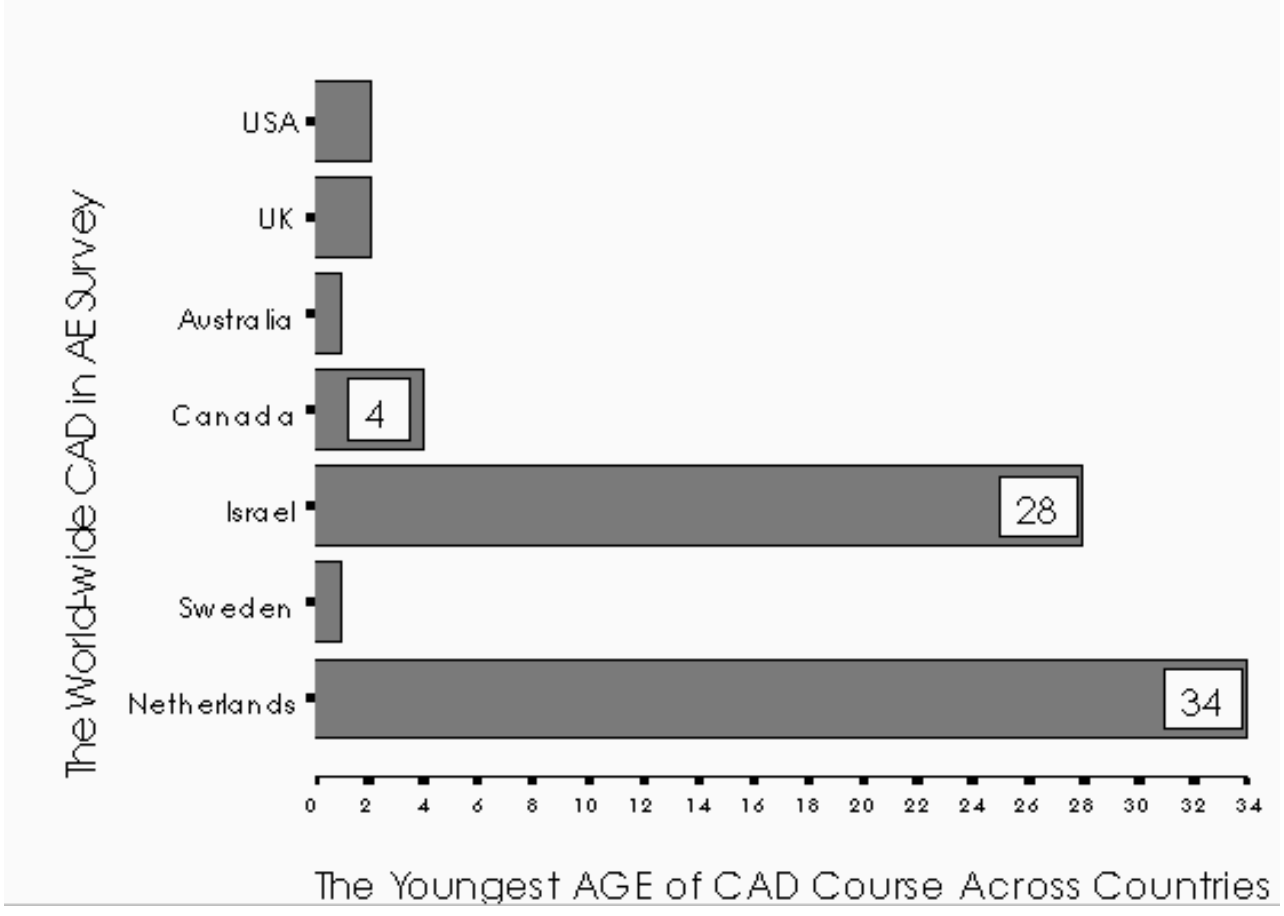
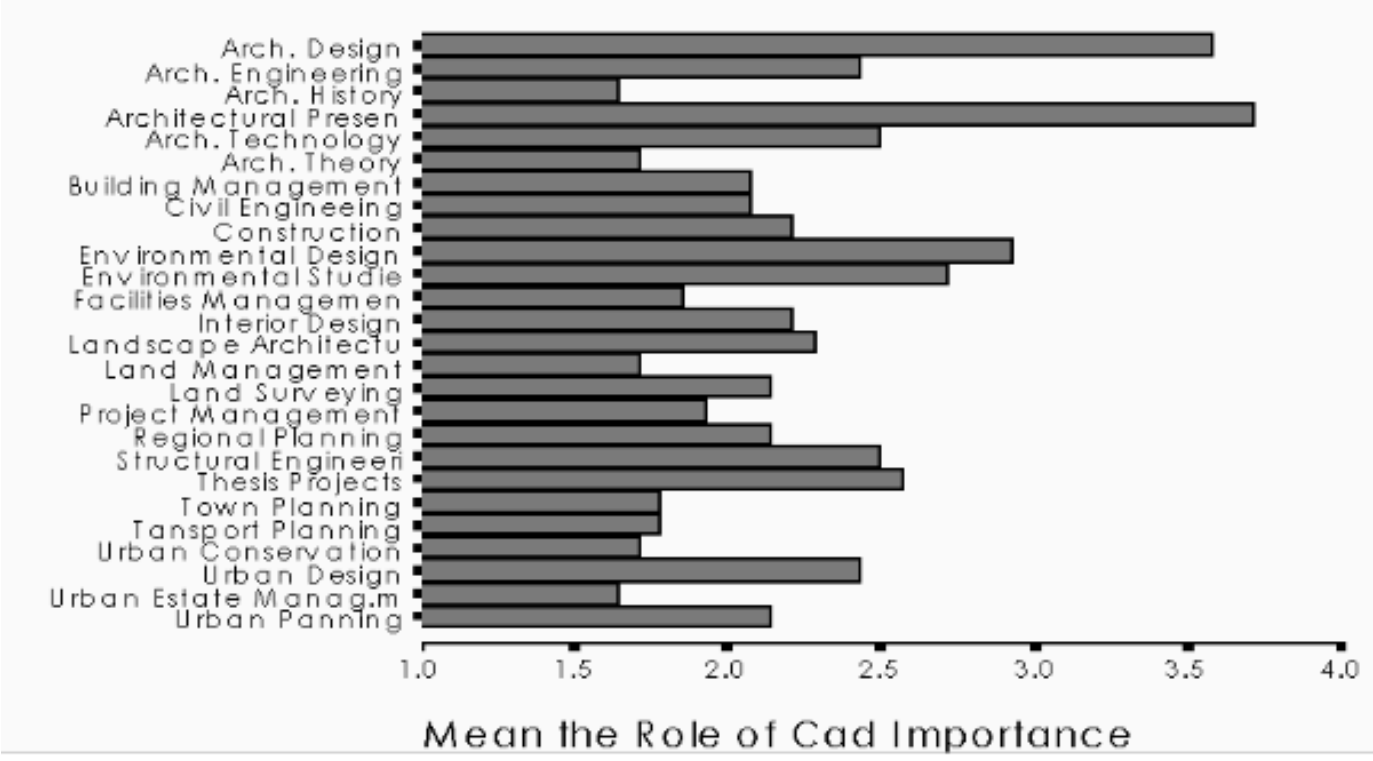
The Oldest AGE of CAD Course Across Countries



10. The Role of CAD Course Across the Curriculum of Architecture Schools.

Respondents were asked to identify the importance of CAD role in their department in twenty-six areas (on a 1-5 scale, with 1= Not important, 2= Fairly important, 3 =Important, 4 = Very important, 5 = Essential) see section 5. The results suggest that CAD performs an extensive role in five prevalent areas in architectural curriculum, namely, design, presentation, thesis projects, structural engineering and environmental design. So, to answer to, why CAD plays a different role? It is was found that the lack of competent tutors in different CAD areas may be the one cause of such a problem (QaQish 1997). The learning environment is still another factor that affects the overall CAD role importance in the department, some universities are still offering CAD courses through other departments' labs. The proximity of the design studio to the computer labs was determined to be a significant factor in the over all importance in assuring proper CAD integration, thus contribute to a bigger role of CAD in the curriculum.

Figure 7: The Mean Rating of The Role of CAD Importance

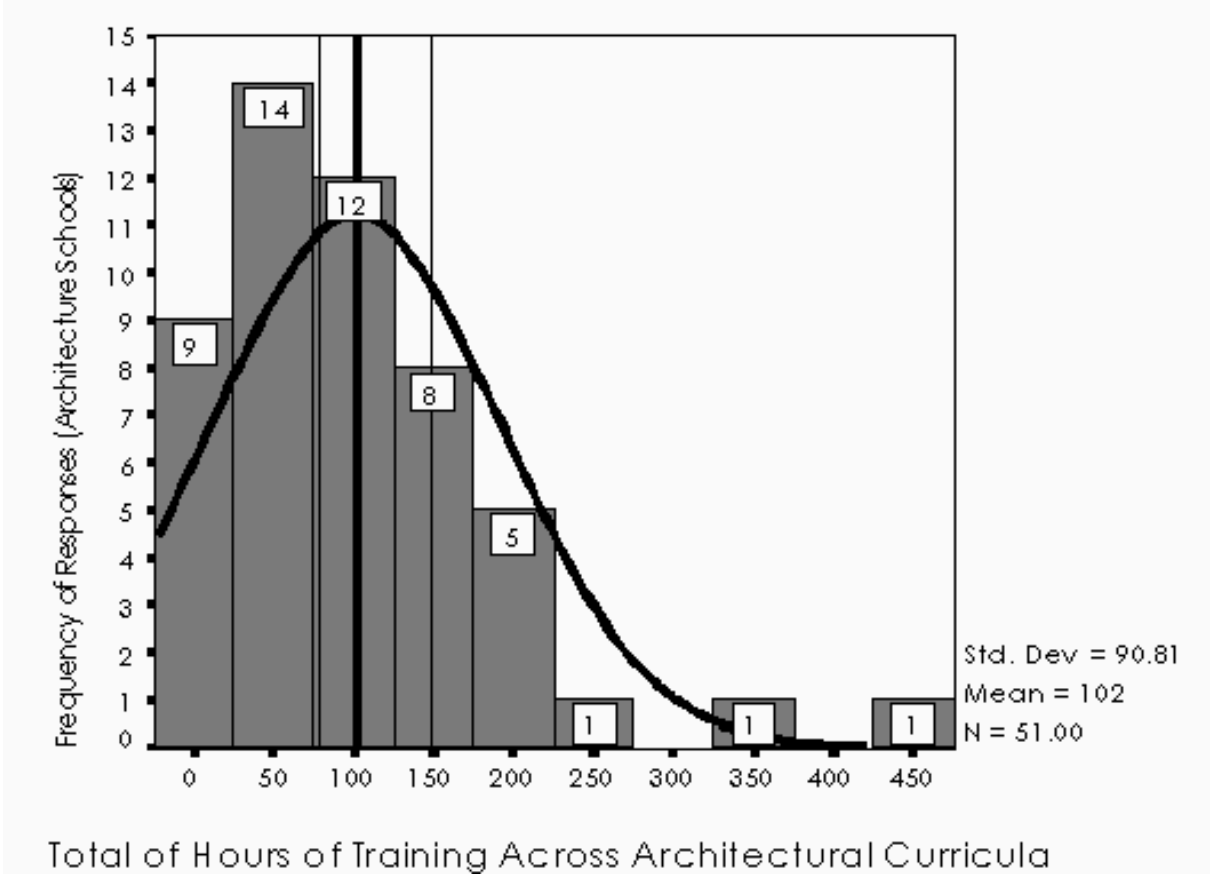


The analysis carried out on the role of CAD in the twenty-six areas has revealed that both the architectural design and architectural presentation areas reported the highest mean of approximately 3.4 which indicates that CAD plays an important role in the design courses and in the presentations of projects.

11. The CAD Training Time in the Curriculum.

Twelve (12) respondents indicated that their students receive an average of 100 hours of training. Whereas 14 respondents indicated that they offer 59 hours of training to their student, and only five respondents indicated that they offer more than 200 hours of training.

Figure 8: The Skewed Distribution of the Total Hours of Training in Architectural Curriculum World-wide.



There were three extreme high values, the first offers an average of 450 hours, the second offers about 350, and the last offers about 250 hours of training (Figure 8). The respondents from Sweden reported that their students receive an average of training hours three times (440) as high as the students from the USA (111) do (Figure 9). In fact, the average of the students at the Swedish universities accounted for as much as the average of training hours received by the student from the rest of the countries combined.

Figure 9: The Mean Distribution of the Total Hours of Training in Architectural Curriculum Across Seven Countries.

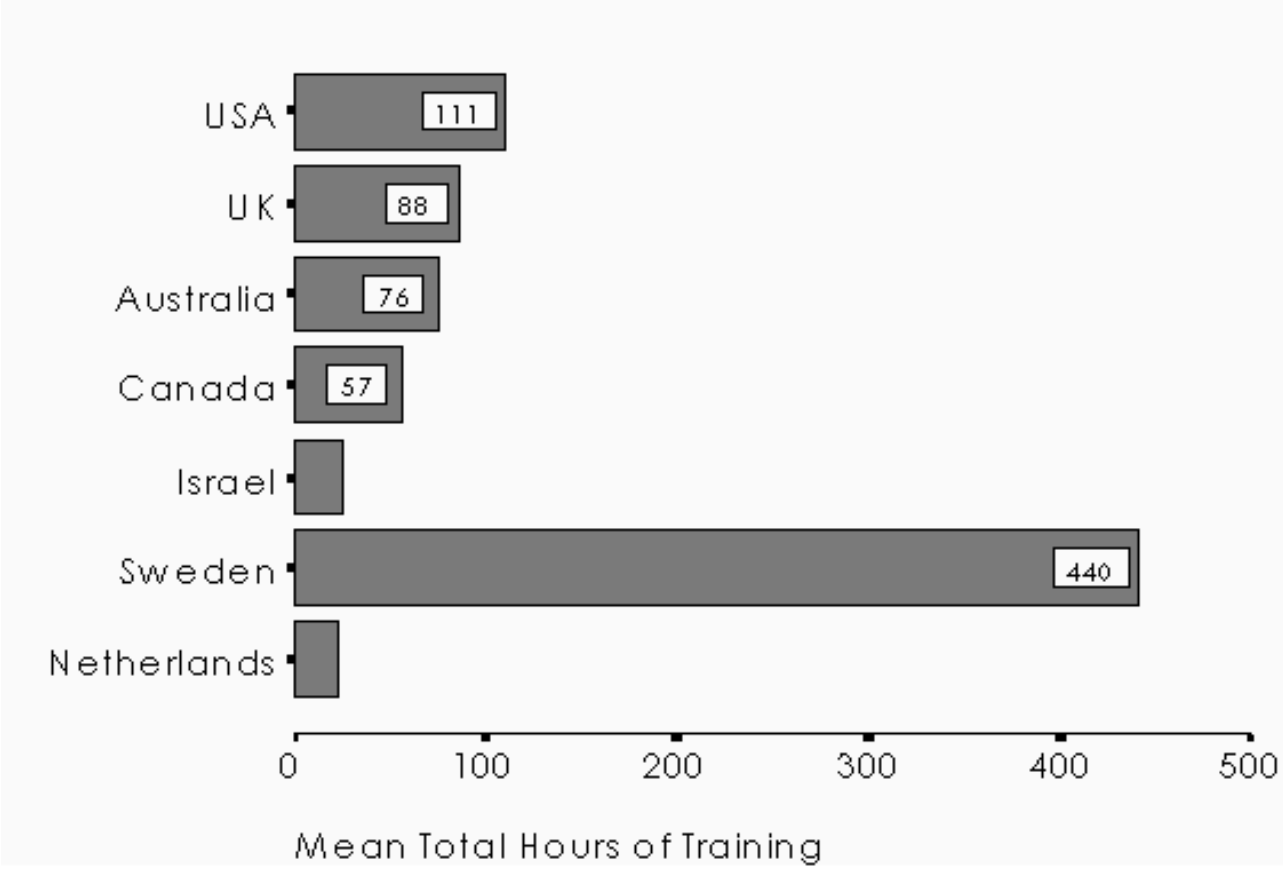
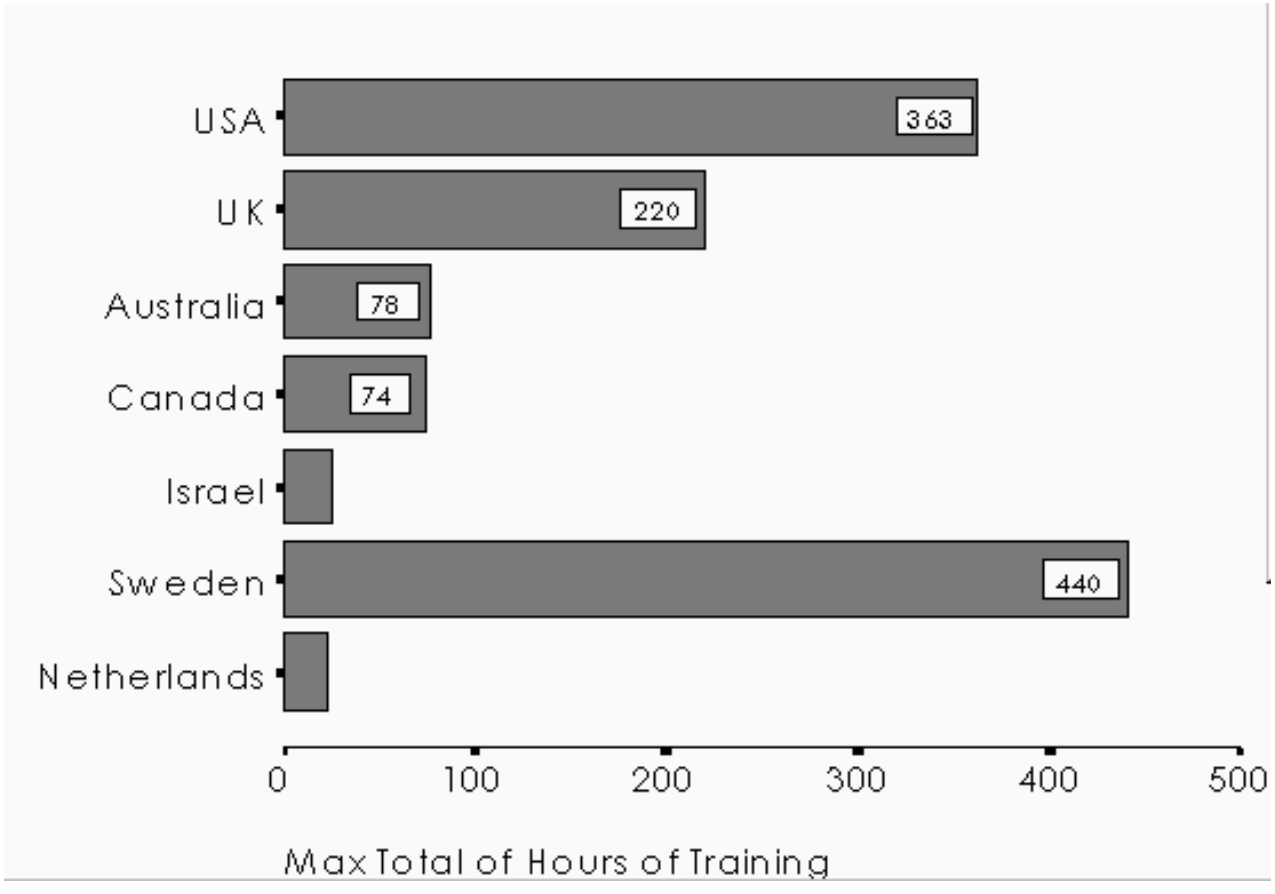


Figure 10: The Max. Distribution of the Total Hours of Training in Architectural Curriculum Across Seven Countries.

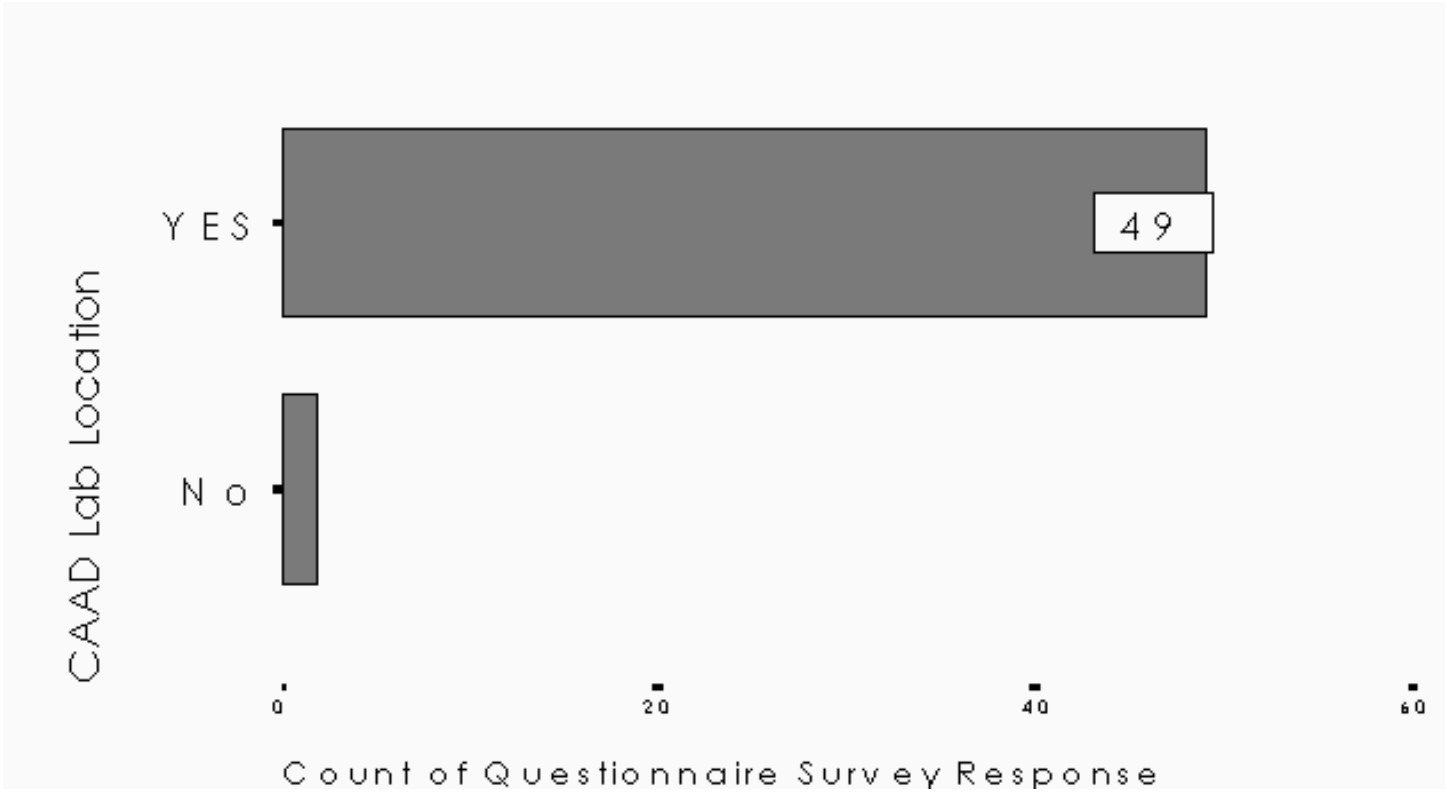


Evidently, there is a big emphasis on training in the in terms of training hours, however when the analysis of the maximum numbers of total hours was carried out, the gap decreases as more universities in the USA offer approximately as many training hours as the Sweden (Figure 10). Whereas, some of the UK universities also offer higher training hours but half of that offered by the Sweden.

12. Computing Laboratories: Hardware

Respondents were asked to indicate whether or not CAD labs are physically located in the department.

Figure 11: CAAD Labs Locations in the Department



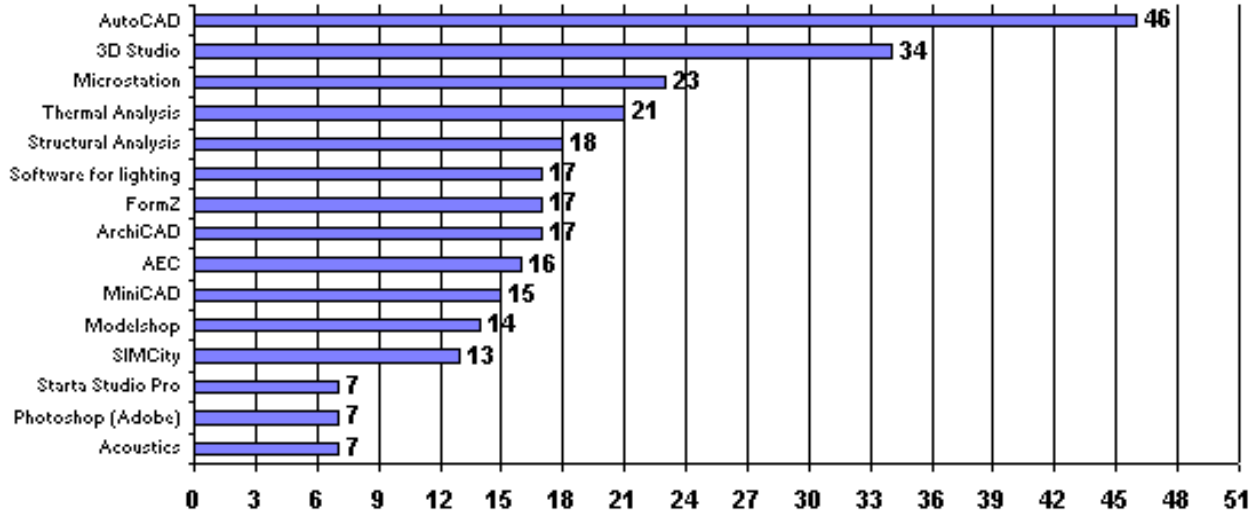
The question was designed to determine the importance of CAD labs proximity and their relationship to the department and the rest of the program. Out of the 51 universities, 49 (96%) reported to have their CAD labs in the department or school compared with only 2 (3.9 %) who did not.

The importance of CAD labs locations is recognised by the majority of the respondents of architecture schools indicating a rather clear attitude towards CAD importance as an integral part of the department. With regard to the CAD platforms in the department, 45.5% of all platforms were IBM or Compatible which mark them as the most widely used computers. Macintosh platforms with 22.7% came in second. With 14.4% Power Macintosh Platforms came in third pace and Workstations ranked fourth with 11.0%. The use of CAD platforms reflects the use of software presented in the analysis later, which suggest that IBM platforms with CAD packages are the most widely used ones. With regard to the CAD labs in the department, 41.5 % of all the computing labs were IBM or Compatible ones. Macintosh labs with 21.6% came in second. Power Macintosh Platforms came in third place with 14.2% and Workstations ranked fourth with 11.9%. It can be concluded that there was clear associations between the number of both CAD labs and CAD platforms, which indicate that there is a categorisation process of CAD labs and platforms evolving in architecture schools.

13. Computing Laboratories: Software

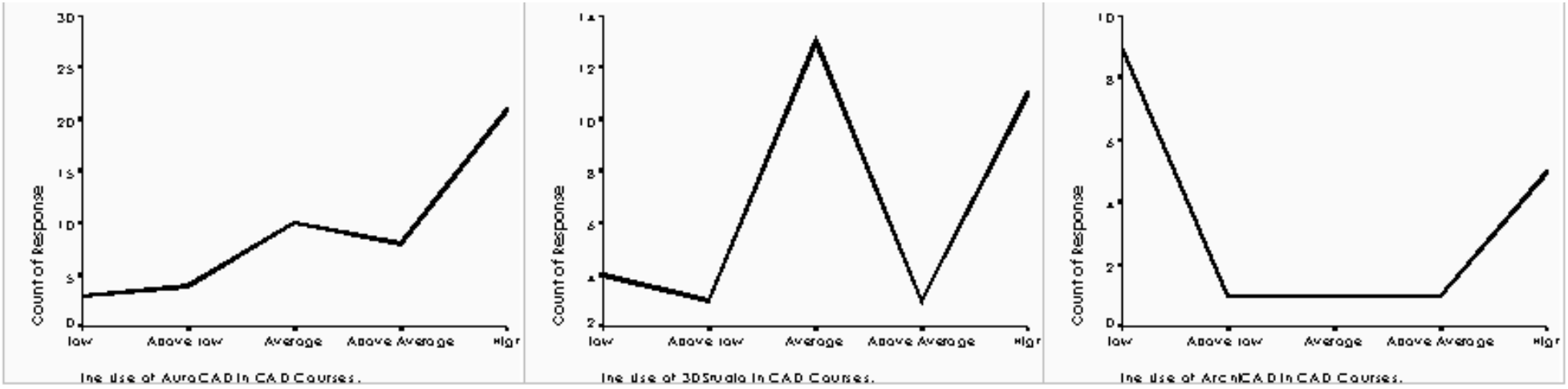
Respondents were asked to identify the importance of CAD software used in their curriculum on a 1-5 scale: 1= low use, 2= Above Low use, 3= Average use, 4= Above use, 5= High. Forty-one (41) CAD software were registered in architectural education.

Figure 12: The Highest 15 CAD Software used World-wide.



Among the 51 respondents 46 were using *AutoCAD* which puts it in the first place as the most widely used software in education (Figure 12). Other software such as *ArchiCAD* and *FormZ* have registered a high use in the curriculum but have not been implemented widely as AutoCAD. On the other hand, with regard to the overall extent of CAD software use world-wide, the use and the performance of CAD software under 'high extent' was examined, the results revealed that the highest response rate was reported in *Form Z* (58.8%), followed by *AutoCAD* (45.7%), *3DStudio* (32.4%), *AEC* (31.3%), *ArchiCAD* (29.4%) (Figure 13). Once again, *FormZ* reported the highest results under 'above average' use with a (35.3%).

Figure 13:A Comparative Analysis of a selected CAD Software According to Mean Extent.



When analysing the overall results under the average performance, dissimilar results were revealed, this time different leagues of software were being used on an overall extent, such as the Photoshop (42.9), Strata Studio Pro (42.9), again 3DStudio (38.2%) and Modelshop (35.7%).

14. Computing Staff & Technicians

There is still a strong dependency on part-time CAD tutors, e.g. the numbers of CAD tutors or instructors reported by the respondents reached a sum of 55.0% for part-time instructors and 45.0% for full-time ones (Figure 14). This indicates that most schools of architecture still rely heavily on part-time CAD tutors to teach and deliver CAD course. This also suggests a lack of proper training for CAD instructors or simply shortages in full-time CAD instructors to accommodate all CAD course in the curricula.

Figure 14: The Sum Number of CAD Instructors Labs World-wide

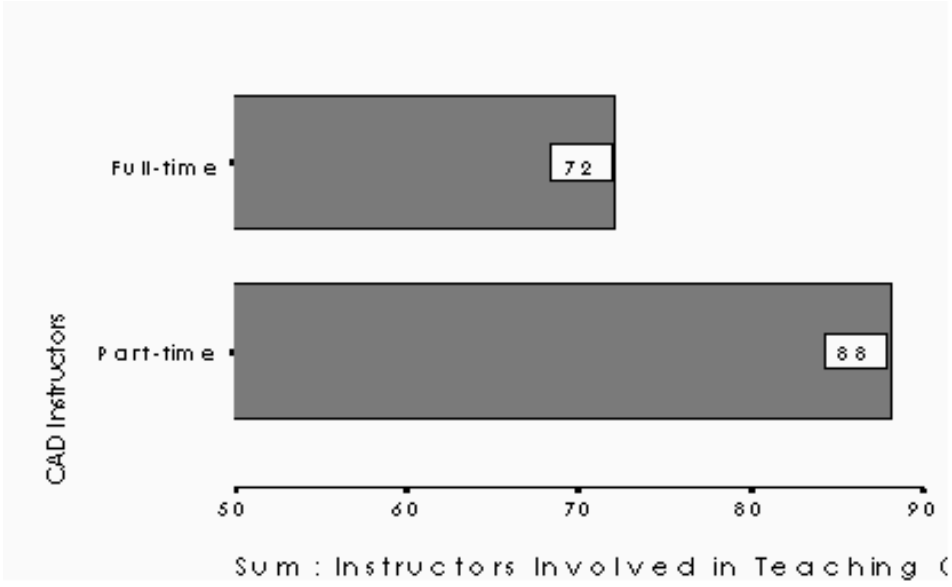
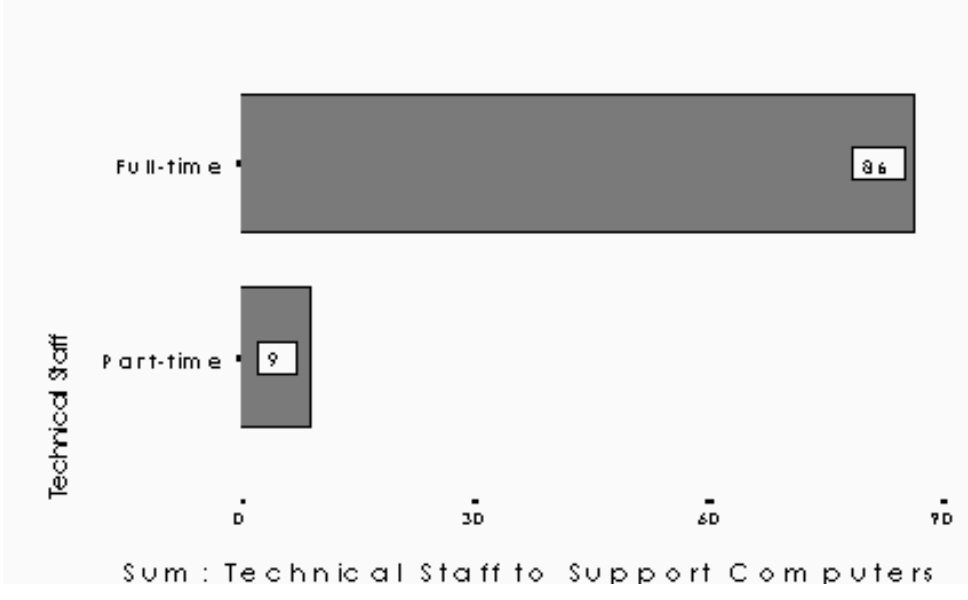
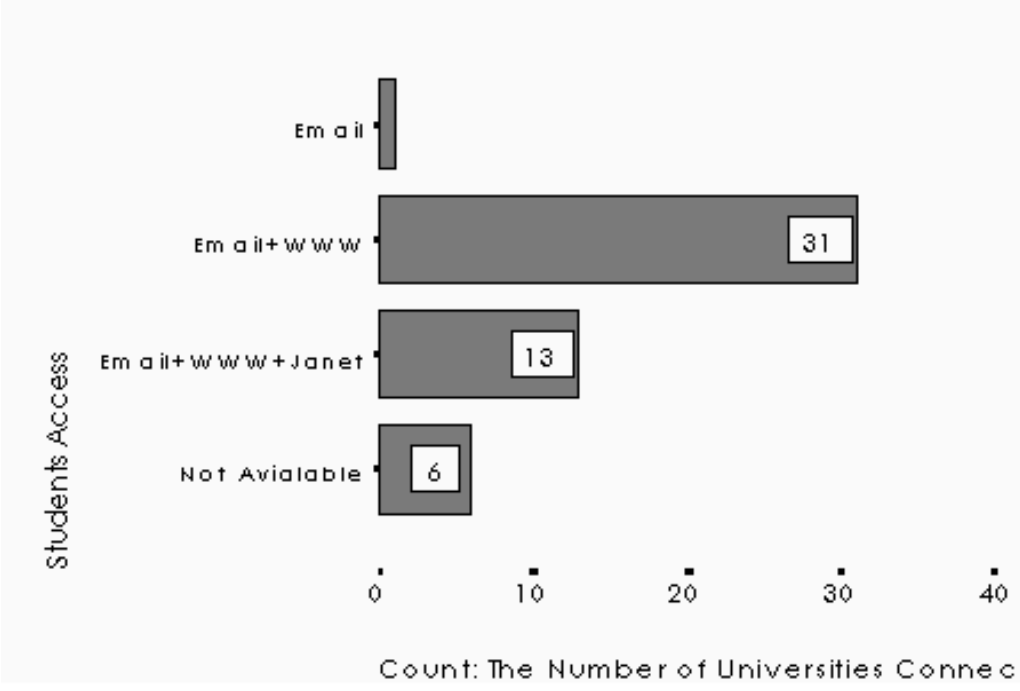


Figure 15: The Sum Number of Computing Labs Technicians World-wide



As for the technicians, most schools are heavily dependent on the full-time ones, 90.5% from the respondents reported to have full-time technicians available on computer labs, whereas only 9.5% have reported part-time technicians (Figure 15). The analysis of the mean numbers of CAD instructors across countries has revealed that Israel reported the highest mean of 6 CAD tutors compared with only 1 in USA, UK, Canada and Sweden. While the Netherlands reported a mean of 3 tutors, Australia came in third place with 2 tutors. With regard to future plans to employ more tutors, the USA universities expressed future plans to employ an average of 2 tutors.

Figure 16: The Students' Accesses to Internet.



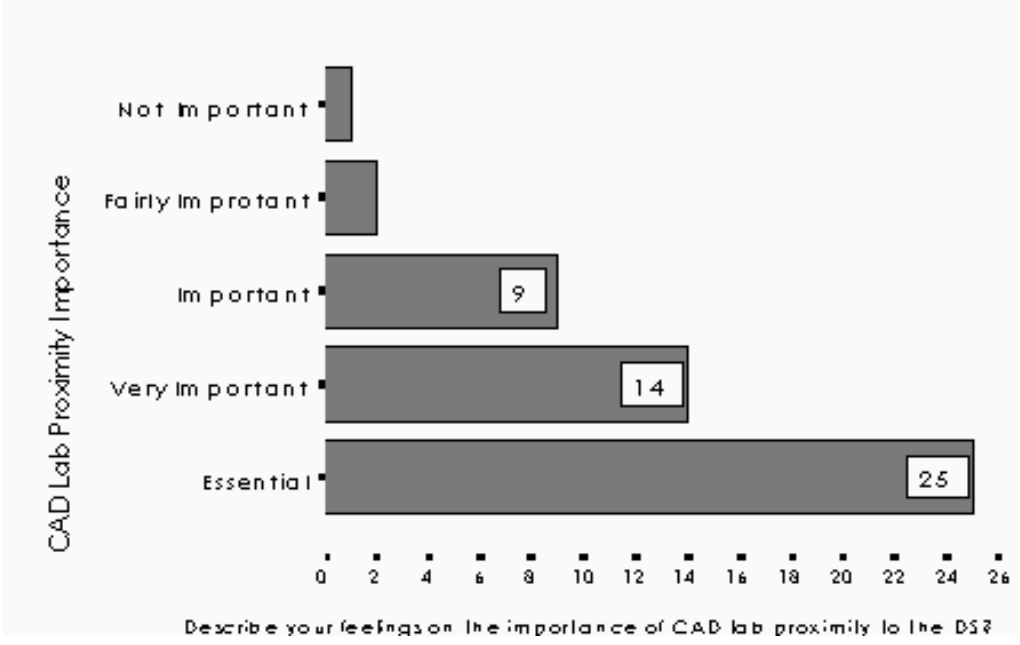
With regard to the students' access to the Internet, 50% of the respondents offer their students' access to the Email, WWW. While the 25.5% offer access to Email, WWW & Janet, only 20% offer email access. Only 18% of the respondents are not offering any access to their students.

The results indicate that there are significant changes amongst architectures schools to take advantage of this new and most powerful tool in the future of computing in architectural curriculum.

15. Department Current and Future Policies.

Fifty-one (51) respondents were asked to describe their feelings on the importance of CAD labs proximity to the design studio (Figure 20). The variable (Lab Proximity) used to define the importance of the proximity was recorded on a scale of 1=Not Important to 5 = Essential.

Figure 17: The Importance of design studio Proximity to CAD labs.

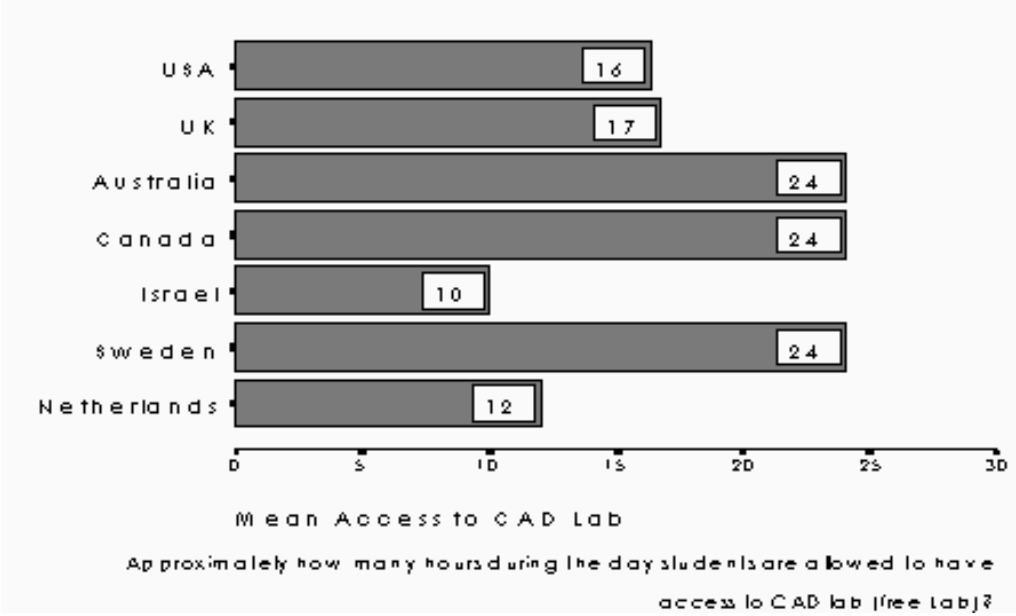


The analysis revealed that 49.0% (25 respondents) felt that CAD labs proximity location to the design studio was essential for better CAD integration. While 27.5% (14 respondents) felt that it was very important, only 2% (1 respondent) felt it was not important to have any relationship between the two. It is concluded that the design studio proximity from the CAD labs is extremely important to successfully teach CAD. A number of respondents felt strongly towards a full amalgamation of the CAD Lab and Design Studio.

This without any doubt has become a very important factor in determining the future structure of CAD in the curriculum. There are many problems that accompany the full CAD integration into design studio and the curriculum all of which may prevent to move on such a transformation (Agabani & QaQish 1995). There are many departmental and administrative issues, connected to running a computer lab, which include having separate budgets and CAD tutors and technical staff appointments, besides the maintenance and services of the computers and most importantly the issue of security, all of which seems to become an obstacle in the way of full integration between the CAD labs and the design studio (QaQish 1997). With regard to the students' access to CAD labs, Figure 20 shows the mean hours allowed to students in the computer lab within the universities of seven countries. This was a difficult data to gather since, some respondents replied with 24 hours, others have estimated percentages next to the course…etc. Australia, Canada and Sweden with 24 hours access were the only countries to offer their students this facility. Although, the USA with a mean of 16 hours access given to their student, still a small number of universities did allow 24 hours. Israel with 10 hours offered to their students was the least number of hours

among the rest of the countries.

Figure 18: The Student's Access to CAD labs.



This issue of access to computer lab may not exist in the future where CAD is fully integrated in the design studio, i.e. the University of Manchester. In fact it was the only university out of the 51 universities to have fully integrated CAD and design studio labs. Such a program is worth investigating in future research. As for the CAD literature, 86% of the overall world-wide respondents offer CAD literature to their students compared with only 18% who do not.

In the USA 76% of the universities offer CAD literature compared with higher percentages of 95% in the UK who offer the same. With regard to advanced CAD training offered to students at architectural school, 75% of the overall world-wide respondents offer advanced CAD training to their students compared with only 25% who do not (Figure 19). In the USA 80% of the universities offer CAD literature compared with 63% in the UK who offer the same. While the rest of the countries offer advanced training, Sweden do not offer any.

Figure 19: The Response Rate on Advance Training World-wide and Across Countries.

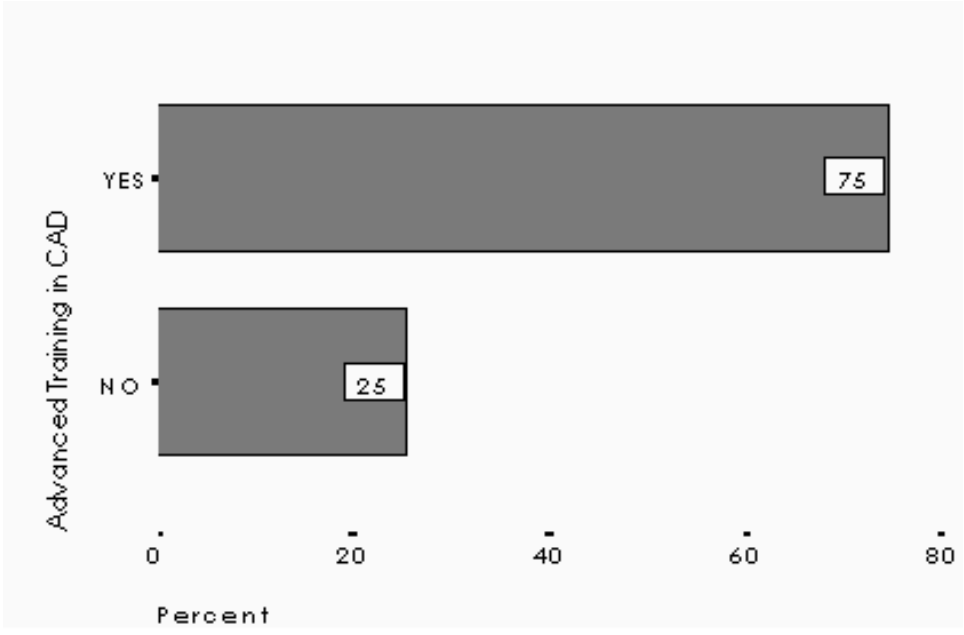
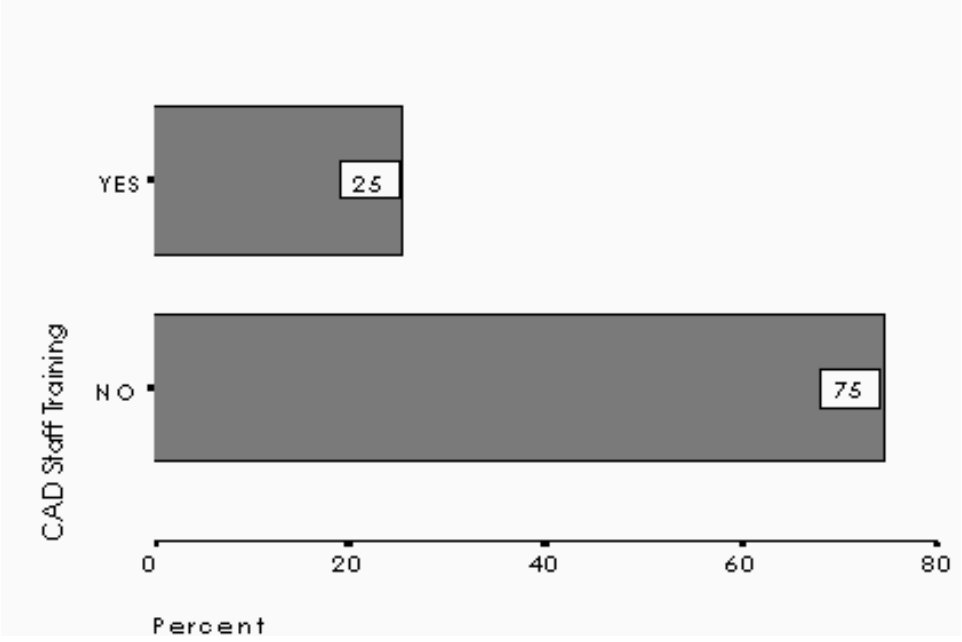


Figure 20: The Response Rate on CAD Staff Training World-wide and Across Countries.



With regard to CAD training offered to tutors on new software arrivals at architectural school, (Figure 20) only 25% of the overall world-wide respondents offer CAD staff training compared with 75% who do not. Only Israel reported to offer a full CAD staff training compared with the only 28% in the USA, 21% in the UK, 50% in Australia. Whereas Canada, Sweden and the Netherlands don't offer any training for CAD tutors.

Some of the interesting findings of this survey was concerning the comments made by CAD staff regarding the training method attained by schools of architecture. The results indicated that the *self taught* and *on demand* were reported to be the most frequently used method amongst all (Table 4). It is concluded again, that there are still many gaps and lapses in the structure of CAD in architecture schools, one of which concerns the staff training and upgrading.

Table 4: Comments on When Do CAD Staff Receive Training Across Countries:

Country	Count	Time CAD Staff Training
USA	1	**Throughout the year**
	2	**In School Training**
	1	**Evening Training**

	1	**Self Taught**
United Kingdom	1	**Through Other Universities**
	3	**On Demand**
	1	**On Staff Own Time**
	1	**In Holidays**
Australia		**None**
Canada	1	**Self Taught**
Israel	1	**On Demand**
Sweden		**None**
The Netherlands		**None**

With regard to the departmental decision making of who teaches CAD course, the study revealed that there are six categories reported by the 51 universities, namely: CAD Instructor, Director, Design Course Committee, Systems Coordinator, Design Coordinator and Computer Policy Group. In the USA, 48% reported that the director makes the decision on who teaches CAD, in the UK, 73.7% reported the CAD instructor, in Australia and the Netherlands 100% reported the CAD instructor. In Canada the decision was spelt in half between the CAD instructor and the director of the school. In some universities the decision was made by the design or CAD committees (groups), which prompt a more rational and objective approach to this problem. As for the material to teach in CAD courses, and as with other subjects' areas in the department, the instructor as a decision maker reported the highest percentages amongst the seven countries. In the USA 56% reported that CAD instructors are responsible for what to teach. A higher percentage of 78.9% was reported in the UK. In both figures (21 & 22), CAD instructors registered the highest percentages, 65% What, and 47% Who. On what to teach, with 18% response rate the design course committee registered higher than the director of the school (12% response rate). As for who teaches CAD course, the director of the school came second with a 29% response rate and the design course committee with a 18% response rate.

Figure 21: The Response Rate on the Departmental CAD Decision Makers on What CAD Courses to Teach.

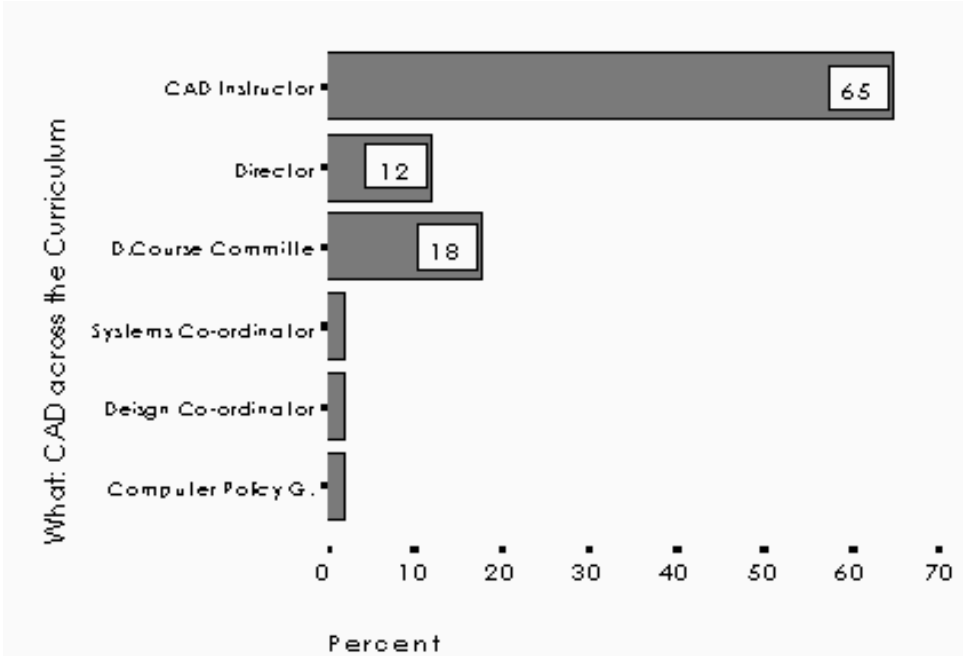
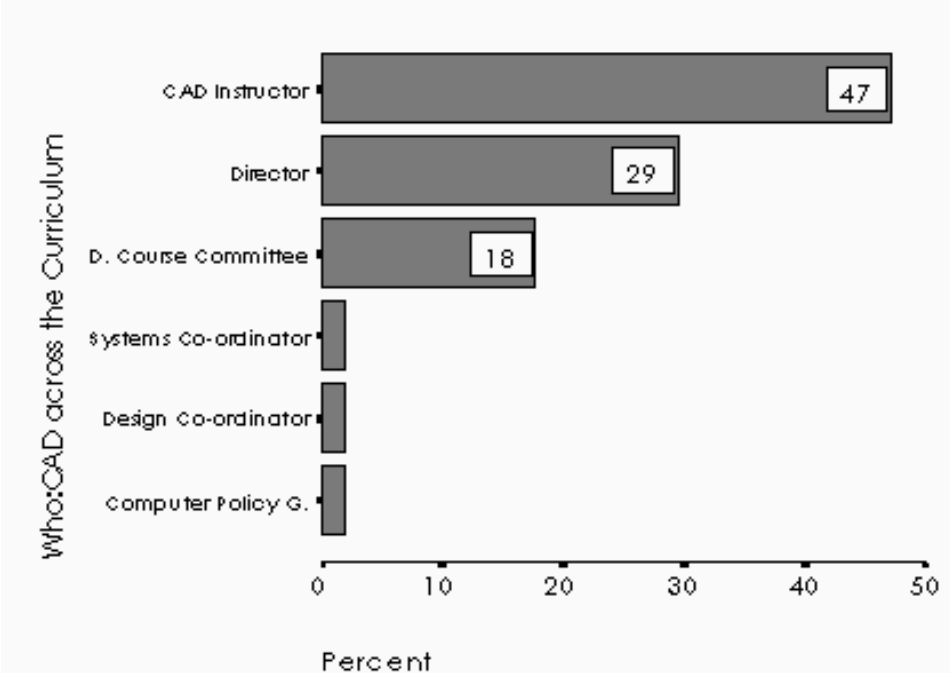


Figure 22: The Response Rate The Departmental CAD Decision Makers on Who to Teach CAD .



16. Multi-Media and Virtual Reality.

Only 31% of the respondents reported to have employed ‘Virtual-Reality’ in the curriculum, whereas 69% responded that they have not (Figure 23) . The response rate of virtual-reality employment was analysed across countries, Sweden and the Netherlands reported the highest rate of 100% of full employment, whereas the USA with only 36%, and the UK with 26% rate of employment.

Figure 23: The Response Rate on Virtual-Reality World-wide.

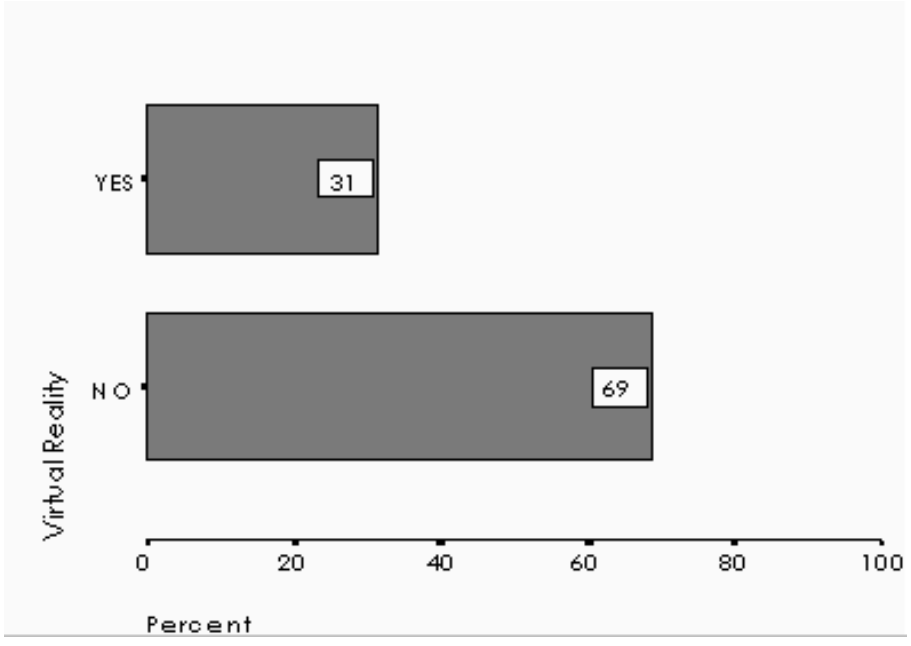
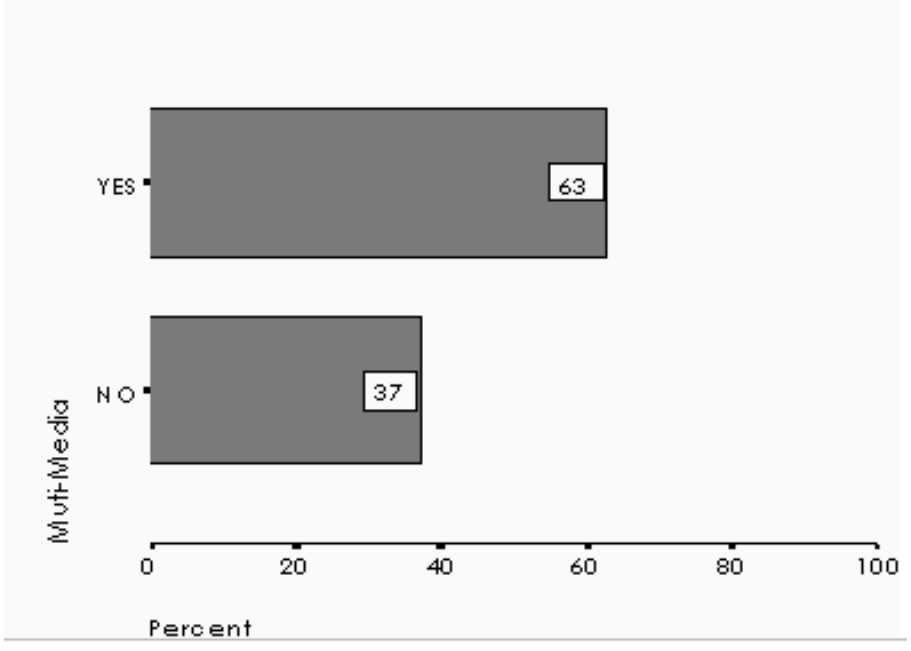


Figure 24: The Response Rate on Multi-Media World-wide.



With regard to the ‘Multi-Media’, higher employment response was reported, with 63% reported to have employed it in the curriculum, whereas only 37% responded that they have not (Figure 24). The response rate of Multi-Media employment was analysed across countries, Israel, Sweden and the Netherlands reported the highest rate of 100% of full employment, whereas the USA with 68%, and the UK with 63% rate of employment. Australia, Canada have not reported any level of employment in both MM and VR.

17. The Conclusion

The most significant findings of this study are:

1. CAD users accounted for 42.63% compared with 57.37% who are conventional method users.

2. 92.15% of the architectural schools have introduced CAD course into the curriculum, compared with only 7.9% which have not.

3. 9.8% indicated interest in introducing and improving CAD in the future compared with 3.9% who have not.

4. The Netherlands has the oldest CAD program with a mean age of 34 years compared with both the USA and Israel with 28 years of age. Sweden and Australia have the youngest CAD programs age group amongst the seven countries.

5. The age of CAD employment in the curricula of architecture schools ranges between 1 year to 34 years old.

6. Both architectural design and architectural presentation areas reported the highest mean of approximately 3.4 indicating an important role of CAD in design courses and in the presentation of projects

7. The majority of the universities has CAD program aged about 13 years, a slightly more than a decade, with only one university aged 35 years.

8. 12 respondents indicated that their students receive an average of 100 hours of training. While 14 respondents offer 59 hours of training to their student, only 5 respondents offer more that 200 hours of training.

9. With regard to the CAD platforms in the department, 45.5 % of all the platforms were IBM or Compatible which mark them as the mot widely used platforms. Second came Macintosh platforms with 22.7%. Power Mackintosh Platforms came in third pace with 14.4% and Workstations ranked fourth with 11.0%.

10. With regard to the overall extent of CAD software use world-wide, the use and performance of CAD software under high extent was examined. The results revealed that the highest response rate was reported in Form Z (58.8%), followed by AutoCAD (45.7%), 3DStudio (32.4%), AEC (31.3%), ArchiCAD (29.4%). Once gain, From Z reported high results under above average use with a 35.3%).

11. The numbers of CAD tutors or instructors reported by the respondent reached a sum of 55.% for part-time instructors and 45.0% for full-time ones

12. The analysis of the results revealed that 49.0% (25 respondents) felt that CAD labs proximity to design studio was essential for better CAD integration. While 27.5% (14 respondents) felt that it was very important only 2% (1 respondent) felt it was not important to have any relationship between the two. It is concluded that the design studio proximity from CAD labs is extremely important to successfully teach CAD.

13. With regard to ‘virtual-reality’, only 31% reported to have employed it in the curriculum, whereas 69% responded that they have not.

Principally, the survey revealed that that there is a great since of enthusiasm and hope amongst the 51 universities. In fact, the respondents implied a great level of commitment to improve CAD in architecture school. One may conclude that the future of CAD is bright, and schools of architecture may soon overcome all obstacles standing in the way of a proper innovative CAD integration.

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