

A STUDY ON ENGINEERING EDUCATION IN THE DISTANCE MODE A CASE OF THE CIVIL ENGINEERING DEPARTMENT, OPEN UNIVERSITY OF SRI LANKA.

by
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Abstract

When considering engineering education in the distance mode there are 2 fundamental questions that arise. Is it possible and is it worth it. The question of "is it possible" has been investigated by considering how successful students have been in following and passing engineering courses in the distance education mode. The question of is it worth it has been analyzed by taking in to account the average number of students being produced per staff member. The case of the Civil Engineering Department of the Open University of Sri Lanka has been considered for this study. It has been found that it is possible to give an engineering education in the distance mode but it has been extremely cost ineffective. In addition a brief SWOT analysis has been presented to identify some possible areas for improvement.

1. Introduction.

When considering engineering education in the distance mode there are two fundamental questions that arise. One, is it possible and, two, how cost effective is it. There have been many studies done by many a researchers with varying conclusions. Nevertheless, due to resource availability problems and numerous limitations many a countries took giant steps forward in making engineering education available in the distance mode. In addition with technological advancement becoming more freely available and accessible, and due to the far reach of the distance mode as well as the built in flexible nature in which it has the ability to cater to very specific needs, distance education is here to stay.

Therefore it is imperative that, engineering education in the distance mode is made to work and it must be cost effective as well.

Here an attempt has been made to analyze the present situation with respect to the above two questions by taking in to consideration the case of the Department of Civil Engineering of the Open University of Sri Lanka.

2. The data

The Civil Engineering Department of the Open University possesses at least eleven qualified senior lecturers, three engineering teaching assistants, three lab technicians, two data entry operators, and six temporary demonstrators. It conducts, programs leading to Diploma, Degree and Masters. It also conducts courses at foundation level. It conducts over 45 courses in total and possesses over 700 students.

The Department conducts most of its laboratory work in the department it self and hires outside laboratories wherever facilities are not available within. The Department has now been in existence for over 15 years and has produced Diplomates, and Degrees now for several years. Many have registered with the department to follow courses at different levels and some of them have obtained diploma's, degrees or both. The data and values are presented in section 4.

3. The methodology

An insight to the question of "is it possible" could be obtained by taking into consideration how successful students have been in course completion, i.e. following the course and passing the exams, namely success rates. The expression of desire to follow the course could be quantified by taking in to consideration the number of students that registered for the course. However, given the flexible nature of the mode of education it may be that some registered not to follow the complete course but to acquire some knowledge in some areas only and may not be to sit for exams. Therefore this indicator may

possess some built in errors but nevertheless this has been neglected in the analysis and this indicator is considered to give an appreciable insight to the above question.

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With respect to its cost effectiveness several factors such as course material costs, course administration costs etc., could be taken in to consideration. However here, just one indicator namely, the average number of students completing a program per staff member in the department has been taken into consideration as an indicator that will provide an insight to this question of cost effectiveness.

In addition a SWOT (Strengths, weakness, opportunities and strengths) analysis has been performed and action plans proposed for the development of the system.

4.“Is it possible?” - The Success Rate

The Department of Civil Engineering offers a variety of courses ranging from the foundation program up to and until the master’s programs.

Foundation Prog. —> Diploma Prog. —> Degree Prog. —> Masters Prog.

A study has been carried out to identify the extent to which two of its main programs have been successful. The two programs are, .

- Diploma in Technology
- Bachelor’s Degree in Technology

The success rates have been investigated by carrying out an analysis on the following three areas for each course in the program.

1. Percentage of students eligible to sit the exam with respect to registered number of students (Eligible/ Registered). This refers to those who have been successful in following the respective course in the relevant program.
2. Percentage of students who passed the exam with respect to those who sat (Passed/Sat). This would indicate the percentage passed out of those who sat for the particular course in the respective program. This would be a direct examination success rate.
3. Percentage of students who passed the exam with respect to those who registered (Passed/ Registered). It is an indication of the number passed as a proportion of those who registered for the course in the relevant program. This would indicate the total success rate.

These values were obtained for each course and thereafter the measures of central tendency of these values were calculated for the courses in each program.

The following sample courses are considered for the analysis.

It must be noted that CED1206 at present is not being offered, however for the years under consideration as it had been offered it has been considered for the analysis.

Diploma in Technology	Bachelors Degree in Technology
CED1201	CEU3105
CED1202	CEU3204
CED1203	CEU3302
CED1204	CEU4301
CED1205	CEU4302
CED1206	CEU4303
CED2201	CEU4304
CED2202	CEU4306
CED2203	CEU4307
CED2204	CEU4308
CED2205	CEU4309
CED2206	
CED2207	
CED2208	

4.1 The data and measures of central tendency

1997 - Diploma in Technology

Subject Code	No. Registered	No. Eligible	(Eligible/Registered) %	No. Passed	(Passed/Registered) %	No. Sat	(Passed/Sat)
CED1201	77	33	42.86%	27	35.06%	70	38.57%
CED1202	73	34	46.58%	28	38.36%	39	71.79%
CED1203	78	42	53.85%	22	28.21%	64	34.38%
CED1204	69	35	50.72%	34	49.28%	51	66.67%
CED1205	85	51	60.00%	30	35.29%	61	49.18%
CED1206	1	1	100.00%	0	0	1	0
CED2201	79	48	60.76%	29	36.71%	62	46.77%
CED2202	73	45	61.64%	21	28.77%	57	36.84%
CED2203	65	42	64.62%	32	49.23%	49	65.31%
CED2204	77	51	66.23%	39	50.65%	61	63.93%
CED2205	19	10	52.63%	7	36.84%	7	100.00%
CED2206	19	10	52.63%	14	73.68%	15	93.33%
CED2207	71	52	73.24%	32	45.07%	49	65.31%
CED2208	53	38	71.70%	13	24.53%	35	37.14%

Mean	0.61	0.38	0.55
Mean Deviation	0.10	0.11	0.20
Standard Deviation	0.14	0.17	0.26
Variance	0.02	0.03	0.07
Skewness	1.50	-0.16	-0.18
Kurtosis	3.39	2.38	0.56
Median	0.60	0.37	0.57

1998 - Diploma in Technology

Subject Code	No. Registered	No. Eligible	(Eligible/Registered) %	No. Passed	(Passed/Registered) %	No. Sat	(Passed/Sat)
CED1201	72	38	52.78%	29	40.28%	62	46.77%
CED1202	53	33	62.26%	16	30.19%	39	41.03%
CED1203	55	32	58.18%	25	45.45%	59	42.37%
CED1204	70	53	75.18%	29	41.43%	59	49.15%
CED1205	59	49	83.05%	28	47.46%	65	43.08%
CED1206	4	2	50.00%	0	0	2	0
CED2201	64	28	43.75%	14	21.88%	53	26.42%
CED2202	71	29	40.85%	23	32.39%	60	38.33%
CED2203	69	41	59.42%	12	17.39%	38	31.58%
CED2204	63	25	39.68%	27	42.86%	43	62.79%
CED2205	19	11	57.89%	11	57.89%	11	100.00%
CED2206	28	17	60.71%	14	50.00%	15	93.33%
CED2207	61	27	44.26%	15	24.59%	37	40.54%
CED2208	45	18	40.00%	10	22.22%	31	32.26%

Mean	0.55	0.34	0.46
Mean Deviation	0.10	0.13	0.17
Standard Deviation	0.13	0.16	0.26
Variance	0.02	0.02	0.07
Skewness	0.77	-0.57	0.81
Kurtosis	0.13	0.16	1.38
Median	0.55	0.36	0.42

1999 - Diploma in Technology

Subject Code	No. Registered	No. Eligible	(Eligible/Registered) %	No. Passed	(Passed/Registered) %	No. Sat	(Passed/Sat)
CED1201	68	31	45.59%	28	41.18%	57	49.12%
CED1202	57	36	63.16%	23	40.35%	47	48.94%
CED1203	62	44	70.97%	20	32.26%	67	29.85%
CED1204	56	41	73.21%	26	46.43%	49	53.06%
CED1205	59	42	71.19%	32	54.24%	54	59.26%
CED1206	2	1	50.00%	1	50.00%	3	33.33%
CED2201	59	35	59.32%	36	61.02%	66	54.55%
CED2202	69	32	46.38%	32	46.38%	56	57.14%
CED2203	68	40	58.82%	24	35.29%	54	44.44%
CED2204	74	42	56.76%	31	41.89%	50	62.00%
CED2205	13	8	61.54%	6	46.15%	6	100.00%
CED2206	15	10	66.67%	9	60.00%	10	90.00%
CED2207	66	42	63.64%	21	31.82%	48	43.75%
CED2208	37	21	56.76%	17	45.95%	31	54.84%

Mean	0.60	0.45	0.56
Mean Deviation	0.07	0.07	0.13
Standard Deviation	0.09	0.09	0.19
Variance	0.01	0.01	0.04
Skewness	-0.27	0.27	1.23
Kurtosis	-0.72	-0.46	1.67
Median	0.60	0.46	0.54

1997 - Bachelor's Degree in Technology

	No. Registered	No. Eligible	(Eligible/Registered) %	No. Passed	(Passed/Registered) %	No. Sat	(Passed/Sat)
CEU3105	29	18	62.07%	8	27.59%	27	29.63%
CEU3204	29	17	58.62%	12	41.38%	15	80.00%
CEU3302	15	12	80.00%	10	66.67%	21	47.62%
CEU4301	14	12	85.71%	15	107.14%	16	93.75%
CEU4302	2	2	100.00%	5	250.00%	8	62.50%
CEU4303	8	4	50.00%	2	25.00%	4	50.00%
CEU4304	1	1	100.00%	1	100.00%	1	100.00%
CEU4306	12	10	83.33%	5	41.67%	17	29.41%
CEU4307	5	5	100.00%	8	160.00%	10	80.00%
CEU4399	7	3	2.86%	2	28.57%	2	100.00%

Mean	0.76	0.85	0.67
Mean Deviation	0.18	0.56	0.23
Standard Deviation	0.22	0.73	0.27
Variance	0.05	0.53	0.07
Skewness	-0.31	1.51	-0.19
Kurtosis	-1.46	2.00	-1.55
Median	0.82	0.54	0.71

1998 - Bachelor's Degree in Technology

	No. Registered	No. Eligible	(Eligible/Registered) %	No. Passed	(Passed/Registered) %	No. Sat	(Passed/Sat)
CEU3105	32	29	90.63%	12	37.50%	33	36.36%
CEU3204	31	22	70.97%	5	16.13%	13	38.46%
CEU3302	10	7	70.00%	2	20.00%	17	11.76%
CEU4301	10	8	80.00%	8	180.00%	8	100.00%
CEU4302	11	9	81.82%	7	63.64%	12	63.64%
CEU4303	3	1	33.33%	1	33.33%	3	60.00%
CEU4304	1	1	100.00%	0	0.00%	0	0.00%
CEU4306	11	10	90.91%	16	145.45%	21	83.33%
CEU4307	13	12	92.31%	8	61.54%	11	57.14%
CEU4399	11	9	81.82%	1	9.09%	1	100%

Mean	0.79	0.47	0.53
Mean Deviation	0.13	0.33	0.29
Standard Deviation	0.19	0.43	0.35
Variance	0.03	0.19	0.12
Skewness	-1.77	1.38	0.01
Kurtosis	4.04	2.16	-1.09
Median	0.82	0.35	0.48

1999 - Bachelor's Degree in Technology

	No. Registered	No. Eligible	(Eligible/Registered) %	No. Passed	(Passed/Registered) %	No. Sat	(Passed/Sat)
CEU3105	21	15	71.43%	12	57.14%	32	37.50%
CEU3204	26	17	65.38%	4	15.38%	10	40.00%
CEU3302	17	11	64.71%	7	41.18%	19	36.84%
CEU4301	14	11	78.57%	11	78.57%	11	100.00%
CEU4302	7	5	71.43%	7	100.00%	11	63.64%
CEU4303	7	5	71.43%	3	42.86%	5	60.0%
CEU4304	2	1	50.00%	0	0.00%	2	0.00%
CEU4306	10	10	100.00%	10	100.00%	12	76.19%
CEU4307	10	8	80.00%	8	80.00%	14	72.73%
CEU4399	11	10	90.91%	7	63.64%	8	87.5%

Mean	0.74	0.58	0.57
Mean Deviation	0.10	0.27	0.22
Standard Deviation	0.14	0.34	0.30
Variance	0.02	0.11	0.09
Skewness	-0.27	-0.40	-0.38
Kurtosis	0.58	-0.69	0.14
Median	0.71	0.60	0.59

4.2 The analysis

It could be seen that in most cases the mean deviation and standard deviation is very low. The same could be said for skewness as well. However the Kurtosis is relatively high indicating that they are leptokurtic. Therefore considering these it could be said that the mean could be taken as a very good representative value for the set.

4.2.1 Diploma in Technology

- Eligible /Registered

In the eligible/ Registered category it is evident that the average ratio of being eligible to sit the final exam after having registered and followed the course in the year under consideration has been 0.61 (61%) in 1997, 0.55 (55%) in 1998 and 0.60 (60%) in 1999. Thus, it is evident that the probability of a student obtaining eligibility has diminished from 1997 to 1998, a small drop, and thereafter reached the same level as it was in 1997. A further calculation was performed, the mean of the means, and this gave us a single representative value for this measure of success - 0.59 (59%). This value is an indication of the possibility of a student obtaining eligibility after having followed the respective subject in that year based on the data collected over the past three years.

- Passed /Registered

Here too it is evident that the average probability of success (Passed/Registered) has had a slight decrease from 1997 to 1998, but in 1999 reached a level which exceed that of 1997. The probability of a student passing the final exam having registered in that year is 0.39 (39%) based on the data collected over the years 97, 98 and 99. Here it must be noted that the passed category contains students who did not register in the same year under consideration, i.e. Registered and obtained eligibility in a previous year but sat and passed the exam in the year under consideration. However as whole it could be assumed that if 100 register in a particular year that the number of students who would pass would be 39.

- Passed/ Sat

This measure of success also shows a similar pattern in the trend as eligible /registered. The mean of the means indicates that a student has 0.52 (52%) chance of passing the exam provided he / she sits for it.

4.2.2 Bachelor’s Degree in Technology

- Eligible /Registered

It could be said that the probability of a student being successful in following a particular course in the Degree program is 0.77 (77%) based on data collected in the past three years.

- Passed /Registered

It could be seen that the rate of success in terms of passing the exam after having sat for it has increased from 98 to 99. The probability of a student passing the final exam having registered and followed the course in the same year is 0.52 (52%) based on the data collected in 98 to 99. However as in the Diploma program in this case too the pass category contains students who did not register in the same year under consideration, i.e. Registered and obtained eligibility in a previous year but sat and passed the exam in the year under consideration. However as whole it could be assumed that if 100 register in a particular year that the number of students who would pass would be 52.

- Passed /Sat

The average rate of passing the exam having sat for the particular subject paper has decreased from 97 to 98 and there after increased to a level of 0.57 (57%) in 1999. It could be inferred that the probability of success in this context is 0.59 (59%) based on the data collected in the past three years.

4.3 Summary

The following shows the average success rate of both the Diploma and Degree program, based on the data of the past three years.

Diploma in Technology

- Eligible/Registered —> 0.59
- Passed / Registered —> 0.39
- Passed/Sat —> 0.52

Both eligibility to registered and passed to sat is more than 50% indicating reasonable success rates. The overall pass to registered is just 39%. However given the varying background of the students at entry this too could be said to be reasonable.

Bachelors Degree of Technology

- Eligible/Registered —> 0.77
- Passed / Registered —> 0.52
- Passed/Sat —> 0.59

Here the success rate is greater than the Diploma rates as by now the students are more used to the self learning methods. The eligibility to registered is high at 77% and passed to sat is also high at 59% indicating fairly high success rates. The overall pass to registered is also more than 50%. Therefore it could be said that in the Degree Program the success rates are very good. Thereby it could be inferred that it is possible to give an engineering education using the distance mode.

5. Cost effectiveness - Is it worth it?

The measure of efficiency, productivity of an organization is the input / out put ratio, and this value would indicate the effectiveness for funding sources. Generally in Education institutes the output is the number of students passing out, while the input relates to cost factors, and the greatest cost component is the staff bill. Therefore, a measure of efficiency would be the number of students being produced to the number of staff.

Taking into consideration 11 senior lecturers, 3 engineering teaching assistants, 6 demonstrators, 2 data entry operators, 3 lab technicians, the total staff in the Department could be approximated to 25. This is excluding staff members of other service Departments.

The average number of students completing the program can be assumed to be the average number passing each course. In reality the average number completing the program would be much less than the average number passing each course. However this figure has been taken as a conservative estimate.

Here it must be noted that the Degree program is an extension of the Diploma program and therefore if we are to compare the distance education mode with a conventional university comparing only the Degree program figures is sufficient.

It could be seen that the statistics give rise to extremely serious implications. A distance education institute should by its nature have large values for this indicator and it should be much larger than a conventional university. On the average a conventional university possesses figures of 10 times larger than this.

A distance education institute attempts at Broad casting by producing print material using the mass media etc., while a conventional system attempts at Narrow casting with face to face communication. However here it could be seen that this value is very small. In effect this is a situation worse than a private personal tuition class where one lecturer is responsible for one student. In effect, as the average number completing the program per staff member is a mere 0.26, this means that approximately 4 staff members are required to produce 1 student. Four staff members producing one student and this taking several years, would in effect raise very serious questions for the funding sources as this shows that it has been cost ineffective at the very extreme and more over a distance education institute.

Therefore it could be said that engineering education in the distance mode has been completely cost ineffective. For a national venture sponsored with state money this value is far beyond any acceptable limit, and suggest immediate attention / remedial action.

Therefore, as it is clear that this area needs immediate attention a separate study must be carried out in order to identify appropriate methods to improve the situation.

	Average number passing a course	Average number completing the program per staff member
Diploma Program		
1997	23.42	0.93
1998	18.07	0.72
1999	21.85	0.87
Degree Program		
1997	6.8	0.27
1998	6.0	0.24
1999	6.9	0.28

6. The SWOT analysis

6.1 Internal Scanning

(a) Weaknesses

Centralization of academic activities at the Nawala camps without enhancing support services in the regions.

Under-utilization of Regional Centers for academic activities.

Action - 1. Station at least a demonstrator level person at regional centers if possible on a permanent basis or, for example the first 7 days of the month basis.

Overloading academic staff members with additional administrative work. Overloading/under loading other staff members due to non-availability of proper job descriptions and demarcation of duties.

Action - 1. Assign 1 demonstrator to coordinate courses of 2 academics.

2. Academics to utilize other staff,

3. More efficient management of time at meetings etc. Absence of research facilities and research culture. Lack of regular contact with students leading to inability to perform advance research.

Action - 1. Allocate some time for research alone (say 30%)

2. Advocate students to perform research

Non-availability of facilities (eg. Internet access is limited due to limitation in computers or break downs, limited number of computers, No Scanners, lack of direct telephones fax, etc.)

Action - 1. Allocate funds and form plan to purchase equipment to purchase equipment by a given date. Lack of programs for professional development of academic staff members.

Action - 1. Organize regular seminars, presentation of research as well as other work. Excessive time required for the completion of Degree and Diploma programs.

Action - 1. Make as much as possible courses to stand alone by them selves. This will facilitate students study what is necessary.

Action - 2. Take steps to get rid of the compulsory credit limit ceiling and use it only as a guide line.

Lack personal assistance. - (Addressed in item 4), Assign an academic to a student. Lack of authority and accountability.

Action - 1. Regular feed back up of work being performed and associated problems.

All courses not being up to date in knowledge, techniques, examination and assessment standards

Action - 1. Curriculum revision.

Weak student support services (includes tutorial contacts, laboratories, reading facilities and counselling.)

Action - 1. Design tutorials to obtain wider knowledge
2. Addressed in item 2 Weak database and management information. Weak communication networks within and outside the University.

Action - 1. Develop a database of Civil Engineering related enterprises and increase networking. Absence of corporate sense of direction / academic policy.

Action - 1. Develop policy plan for the department with aims and objectives.

Low morale among academic and other staff members. (Addressed in item 16)

Difficulties in filling cadre posts and difficulties in obtaining cadre positions. Ineffective utilization of course Team Concept. Unattractive rates of payment for external academics .

Unattractive or no rewards for special / value addition work by internal academics. Lack of comparative recognition for the knowledge skills gained. High program development time / cost which limits introduction of new programmes.

(b) Strengths

Academic staff members generally possessing flexible times due to not having lectures during week days.

Lesson material being in written form enables easy analysis and variations.

Qualified academic staff covering wide area.

Utilization - 1. Develop wide range of programmes

Capacity to draw on a pool of academic staff members from other universities and institutions. Distance learning possessing the potential of ridding the student of "parrot type" learning . Availability of regional education services, infrastructure for students support services. Availability of audio video technology and infrastructure with the capacity to produce multimedia packages.

Facilities for flexi learning (to choose combination of courses and to study at own pace etc.) Long term Cost-effectiveness both in terms of financial and economic costs in running programs.

Capacity to provide a second chance to adult learners.
Capacity to develop inter-faculty programs. 15 years of experience in distance learning and open education. Vast outreach

Utilization - 1. Develop programmes / courses to cater to both the short term as well as long term needs of society.
2. Cater to all types of levels and needs.

6.2 External Scanning

(a) Opportunities

The job market for Civil Engineers / Diplomates continue to be stable or on the increase.

The job market changing its boundaries.

Other universities have failed to cope with the fluctuating demand for higher education.

Positive attitudes of the general public towards higher education.

Independent of UGC regulations in respect of Admissions.

Technological developments making distance education effective and relatively inexpensive.

Susceptibility to external pressure being limited. (Open University was not closed even during the 1987-90 insurrection.)

Threats

The change in perception by society towards Civil Engineering (preference of other areas)

Emergence of fee levying higher educational institutions providing tertiary education.

Perception among the public that distance education is inferior by nature and that it provides a second option to those, who cannot enter conventional universities.

New technologies that enhance access to distance education programs offered by other established international Institutes.

The accessibility to such institutes increasing.

External pressure to avoid exams etc., on public holidays.

Taking into consideration the above an action plan must be drawn to immediately redress the findings in section 5.

7. Summary and conclusion

The success rate of the Diploma and Degree programs could be said to be as follows, Diploma in Technology

- Eligible / Registered → 59%
- Passed / Registered → 39%
- Passed/Sat → 52%

Both eligibility to registered and passed to sat, is more than 50% indicating reasonable success rates. The overall pass to registered, is just 39%. However given the varying background of the students at entry as well as the beginning of self learning this could be said to be reasonable.

Bachelors Degree of Technology

- Eligible/Registered → 0.77
- Passed / Registered → 0.52
- Passed/Sat → 0.59

Here the success rate is greater than the Diploma rates as by now the students are more used to the self learning methods. The eligibility to registered, is high at 77% and passed to sat is also high at 59% indicating fairly high success rates. The overall pass to registered is also more than 50%, Therefore it could be said that in the Degree Program the success rates are very good which in turn means that it is possible to give an engineering education in the distance mode.

However, the cost effectiveness figures points out that it has been extremely cost ineffective and immediate remedial action must be taken. A distance education institute should by its nature have large values for the average number of students completing the course per staff member, and it should be much larger than a conventional university. However here it could be seen that this is very small. The average number completing the program per staff member is a mere 0.26. In effect this is a situation worse than a private personal tuition class where one lecturer is responsible for one student. Here, it means that approximately 4 staff members are required to produce 1 student.

Therefore it could be said that engineering education in the distance mode has been completely cost ineffective. For a national venture sponsored with state money this value is far beyond any acceptable limit, and suggest immediate attention / remedial action.

A SWOT analysis has been performed and a simple action plan has been proposed for the development of the Department.

Acknowledgements

The author sincerely thanks the Data Processing Unit of the Open University of Sri Lanka for providing the data that was required to perform this study.

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