Evaluation on Success of Graduating with Distinction in Higher Education using Fuzzy DEMATEL Method

Mustefa Jibril

School of Electrical and Computer Engineering, Dire Dawa Institute of Technology, Dire Dawa, Ethiopia

Abstract: The aim of this study is the evaluation of the Success of Graduating with Distinction in Higher Education (SGDHE) using the fuzzy DEMATEL method. The observation has been done using cause and effect criteria. The 11 cause and 14 effect clusters have been used in this study. The study result of this work shows that all the effects are connected to the given causes and a cause-effect graph has been generated for each connection. This proposed approach is demonstrated with the empirical case of Dire Dawa University students in Dire Dawa Ethiopia.

Corresponding Author:
Mustefa Jibril
School of Electrical and Computer Engineering, Dire Dawa Institute of Technology, Dire Dawa, Ethiopia

INTRODUCTION

Graduation with honors is a practice of recognition and awards for students. with a Grade Point Average (GPA) of 3.0 or higher[1]. A graduate with honors. To a degree, end up with a high cumulative GPA and the words "this" or "distinction" are printed on the item in the title. A Graduate with Honors. Completion means that all of the school's requirements for participation in education and in the heart of the district, concentration and earning a bachelor's degree. With the completion of the (cum laude), it means that the student has acquired the Latin distinction with honors[2].

Your parents will be shining brightly in the graduation ceremony if they are to see you walk to the front of your hard-earned regalia and prom dress. Degree awards, please refer to the performance in the sciences, in addition to meeting the basic requirements for a degree course of study[3]. Before you begin any of the schools, school administrators and teachers to evaluate the students who deserve special recognition for their outstanding achievements, leadership and other exemplary qualities. To the running of the cum laude distinction, it is a big deal because it reflects your work ethic and intelligence. An honor student can make an impression on potential employers and graduate school admissions committees to be more than your average GPA[4].

Latin honors are Latin phrases used in some colleges and universities to indicate the degree of diversity experienced by a degree. This program is widely used in the United States. It is also used in other Southeast Asian countries with a history of European colonies such as Indonesia and the Philippines, although, it is sometimes used to translate these clauses instead of Latin. Distribution of honors should not be confused with honors degrees awarded abroad or with honors degrees[5].

The system usually has three levels of recognition: cum laude, magna cum laude and summa cum laude. Usually, college or university regulations set out the

specific steps a student should take to earn a degree. For example, a student may be required to earn a certain point, submit an honors degree examination, be part of an honors program, or graduate early. Each university sets its standards[6-8]. As these levels vary, the same level of Latin honors given to different institutions can represent different levels of success. Similarly, some institutions offer equivalent (or additional) non-Latin qualifications to undergraduates. University of Wisconsin-Madison, for example has a clear English series of filters based on classroom standing.

These honors, when used, are almost always awarded to undergraduate graduates and except for law school students, it is very rare to obtain a master's or doctoral degree. Honor is often expressed in diplomas. Latin honors are often awarded to law school graduates such as Juris Doctor or JD in which case they are usually based on grade or grade level.

The honors degree has different meanings in the context of different degrees and educational programs. It is most often referred to as a bachelor's degree variation that contains a large volume of material or a high level of study, or both, rather than "standard" bachelor, "standard" or "pass".

Many universities and colleges offer bachelor's honors and non-honors. In many countries where honors degrees are awarded, they mean that the pass rate is higher than for non-honors degrees. In some countries (e.g., Australia), honors degrees may involve a longer study period than non-honors degrees[9]. Students who complete all the requirements for a bachelor's non-honors degree but do not qualify for an honors degree are usually awarded a non-honors degree (sometimes known as "pass", "general" or "general" degree), although, students who do not meet the requirements for an integrated master honors degree may receive a bachelor's honors degree[7]. In England, Northern Ireland and Wales, almost all bachelor's degrees are awarded as honors degrees; in contrast, honors degrees are rarely issued in the United States.

MATERIALS AND METHODS

Cause and effects of SGDHE criteria: In this study, 25 effective cause and effect factors had been used for evaluation on SGDHE. The factors used are listed in Table 1 and 2.

Fuzzy DEMATEL: The use of a different method of decision-making, based on a pair of comparisons is an advantage to the opinion of experts in the extraction and the structure of the system, due to the systematic use of the basic principles of graph theory and the hierarchical

Table 1: Effects of SGDHE

Code	Effect cluster
C_1	High self-confidence
C_2	Awarded by family and relatives
C_3	Finding suitable job
C_4	Upgrading education
C_5	Enrolment in higher education
C_6	Conducting researches
C_7	Upgrading practical knowledge
C_8	Getting good income
C_9	Helping parents economically
C_{10}	Good relation with employers
C_{11}	Getting job promotion
C_{12}	Good communication among employers
C_{13}	Good Ethics and culture
C_{14}	Confidence among employers

Table 2: Causes of SGDHE

Code	Cause cluster
C_{15}	Study hard
C_{16}	Attending all classes
C_{17}	Communication and collaboration with teachers
C_{18}	Giving tutor for students
C_{19}	Avoiding using substances
C_{20}	Time Management
C_{21}	Knowledge sharing
C_{22}	Participating in different programs (unions)
C_{23}	Integration of knowledge and information flow
C_{24}	Health care

Table 3: Verbal expressions of the fuzzy number

The fuzzy	Verbal phrase
(1.0000, 1.0000, 1.0000)	No effect
(4.0000, 3.0000, 2.0000)	Very low effect
(6.0000, 5.0000, 4.0000)	Low effect
(8.0000, 7.0000, 6.0000)	High effect
(9.0000, 9.0000, 8.0000)	Huge effect

structure of the agents in the system, along with the action and the influence of the relationships among the elements, it is shown that the intensity of these relationships and their significance will be given a numerical score[9-13]. The comparison of the five criteria with the words and phrases using fuzzy values are shown in Table 3.

The matrix form is $\tilde{x}_{ij} = (l_{ij}, m_{ij}, u_{ij})$ with a triangular fuzzy number $\tilde{x}_{ij} = (i = 1, 2, 3, ..., n)$ and fuzzy numbers (0, 0, 0) are considered[13].

In this study, all the experts use the arithmetic mean that is described in Eq. 1:

$$\frac{\tilde{x}^1 \oplus \tilde{x}^2 \oplus \tilde{x}^3 \oplus, ..., \oplus x^p}{p} \qquad (1)$$

In this equation, p is the number of experts and $\tilde{x}^1, \tilde{x}^2, \tilde{x}^p$ are the paired comparison matrix Expert 1, Expert 2 is a triangular fuzzy number that Certified by p.

Table 4: $\tilde{D}_i + \tilde{R}_i$ and $\tilde{D}_i - \tilde{R}_i$ values of the influential factors criteria

Influential factors	$\tilde{D}_i + \tilde{R}_i$	$\tilde{D}_i - \tilde{R}_i$
Influential factor 1	(4.1451, 7.5423, 12.2998)	(-4.5754, -0.4997, 3.5793)
Influential factor 2	(4.1137, 7.4937, 12.2517)	(-5.0202, -0.9800, 3.1178)
Influential factor 3	(4.1663, 7.5749, 12.3733)	(-4.9469, -0.8676, 3.2602)
Influential factor 4	(4.2119, 7.6455, 12.4873)	(-4.8736, -0.7459, 3.4018)
Influential factor 5	(4.1289, 7.5173, 12.2094)	(-4.9614, -0.9308, 3.1191)
Influential factor 6	(4.0516, 7.3979, 12.1642)	(-4.9383, -0.9205, 3.1742)
Influential factor 7	(4.1091, 7.4868, 12.2355)	(-4.6658, -0.6236, 3.4606)
Influential factor 8	(4.0158, 7.3424, 12.1212)	(-4.9868, -0.9739, 3.1186)
Influential factor 9	(4.1036, 7.4783, 12.2572)	(-4.5560, -0.5022, 3.5976)
Influential factor 10	(4.1097, 7.4877, 12.2621)	(-4.3083, -0.2472, 3.8441)
Influential factor 11	(4.0801, 7.4420, 12.1984)	(-4.4893, -0.4431, 3.6290)
Influential factor 12	(4.1279, 7.5159, 12.2877)	(-4.2544, -0.1941, 3.9054)
Influential factor 13	(4.0754, 7.4348, 12.1678)	(-4.2837, -0.2454, 3.8087)
Influential factor 14	(4.0535, 7.4008, 12.0986)	(-4.1688, -0.1656, 3.8763)
Influential factor 15	(4.0993, 7.4716, 12.2079)	(-3.7130, 0.3512, 4.3957)
Influential factor 16	(4.0556, 7.4043, 12.1148)	(-3.8047, 0.2114, 4.2545)
Influential factor 17	(4.1547, 7.5572, 12.2922)	(-3.6632, 0.4112, 4.4743)
Influential factor 18	(4.1172, 7.4993, 12.2079)	(-3.4295, 0.6515, 4.6612)
Influential factor 19	(4.1080, 7.4851, 12.1911)	(-3.4295, 0.6515, 4.6612)
Influential factor 20	(4.1356, 7.5276, 12.2922)	(-3.5218, 0.5594, 4.6349)
Influential factor 21	(4.1317, 7.5216, 12.2637)	(-3.4169, 0.6791, 4.7151)
Influential factor 22	(4.0879, 7.4540, 12.1278)	(-2.8043, 1.2802, 5.2356)
Influential factor 23	(4.1971, 7.6227, 12.3492)	(-3.1712, 0.9327, 4.9808)
Influential factor 24	(4.1930, 7.6162, 12.2704)	(-2.6212, 1.4850, 5.4562)
Influential factor 25	(4.2305, 7.6741, 12.3666)	(-2.7787, 1.3340, 5.3573)

$\tilde{z}$ is a triangular fuzzy number $\tilde{z}_{ij} = (l'_{ij}, m'_{ij}, u'_{ij})$. The normalized matrix obtained from Eq. 1 can be used in Eq. 2 and 3 as:

$$\hat{H}_{ij} = \frac{\tilde{z}_{ij}}{r} = \left(\frac{l'_{ij}}{r}, \frac{m'_{ij}}{r}, \frac{u'_{ij}}{r} \right) = \left(\frac{l''_{ij}}{r}, \frac{m''_{ij}}{r}, \frac{u''_{ij}}{r} \right) \qquad (2)$$

R is obtained from Eq. 3 as:

$$r = \max_{1 \leq i \leq n} \left(\sum_{j=1}^{n} u_{ij} \right) \qquad (3)$$

After obtaining the matrix, the matrix of fuzzy relations is obtained according to Eq. 4-7:

$$T = \lim_{k \to +\infty} (\tilde{H}^1 \otimes \tilde{H}^2 \oplus, ..., \otimes \tilde{H}^k) \qquad (4)$$

Each element in the fuzzy number $\tilde{t}_{ij} = (l^t_{ij}, m^t_{ij}, u^t_{ij})$ can be calculated as:

$$\left[l^t_{ij} \right] = H_l \times \left(I - H_l \right)^{-1} \qquad (5)$$

$$\left[m^t_{ij} \right] = H_m \times \left(I - H_m \right)^{-1} \qquad (6)$$

$$\left[u^t_{ij} \right] = H_u \times \left(I - H_u \right)^{-1} \qquad (7)$$

In this equations, I is a unit matrix, H_l, H_m, H_u and each n×n matrix are Elements of the lower number, the middle and high number of matrix H is created by triangular fuzzy numbers[14]. The rows and columns matrix can be obtained by using Eq. 8 and 9 to get:

$$\tilde{D} = \left(\tilde{D}_i \right)_{n \times 1} = \left[\sum_{j=1}^{n} \tilde{T}_{ij} \right] n \times 1 \qquad (8)$$

$$\tilde{R} = \left(\tilde{R}_i \right)_{n \times 1} = \left[\sum_{i=1}^{n} \tilde{T}_{ij} \right] n \times 1 \qquad (9)$$

$\tilde{R}$, $\tilde{D}$ are respectively the matrix n×1, 1×n. The indicator's $(\tilde{D}_i + \tilde{R}_i)$ importance and the relationship between the measure $(\tilde{D}_i + \tilde{R}_i)$ is specified. $\tilde{D}_i - \tilde{R}_i > 0$ if the measure is effective and if $\tilde{D}_i - \tilde{R}_i < 0$ the criterion is effective[15] (Table 4).

RESULTS AND DISCUSSION

The degree of centrality (Dx+Rx) in the DEMATEL, the impact strength are both dispatched and received. On the other hand, if the (Dx-Rx) is positive, then the evaluation criterion for x to be used to the impact of different assessment criteria for more than it receives. If (Dx-Rx) is negative, the criterion for x to get more of the other criteria, then it may receive. The values of (Dx-Rx) are shown in Table 5. We can observe a common cause-and-effect in a group of clusters. As a rule, the
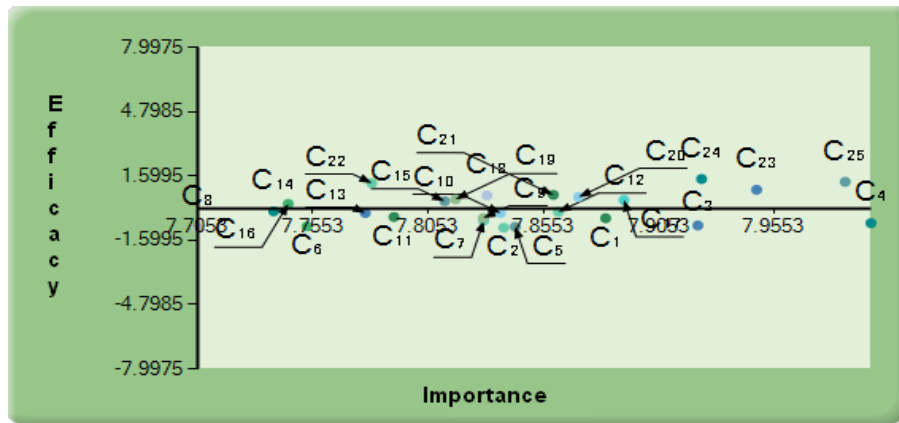
Fig. 1: The impact and influence among the criteria

Table 5: The numbers in the fuzzy Table 4

Influential factors	$(\tilde{D}_i + \tilde{R}_i)^{def}$	$(\tilde{D}_i - \tilde{R}_i)^{def}$
Influential factor 1	7.8824	-0.4989
Influential factor 2	7.8382	-0.9656
Influential factor 3	7.9224	-0.8555
Influential factor 4	7.9975	-0.7409
Influential factor 5	7.8432	-0.9260
Influential factor 6	7.7529	-0.9013
Influential factor 7	7.8295	-0.6131
Influential factor 8	7.7055	-0.9540
Influential factor 9	7.8293	-0.4907
Influential factor 10	7.8368	-0.2397
Influential factor 11	7.7906	-0.4366
Influential factor 12	7.8619	-0.1843
Influential factor 13	7.7782	-0.2415
Influential factor 14	7.7384	-0.1559
Influential factor 15	7.8126	0.3463
Influential factor 16	7.7447	0.2182
Influential factor 17	7.8903	0.4084
Influential factor 18	7.8309	0.6337
Influential factor 19	7.8173	0.4456
Influential factor 20	7.8707	0.5580
Influential factor 21	7.8597	0.6641
Influential factor 22	7.7810	1.2479
Influential factor 23	7.9479	0.9187
Influential factor 24	7.9240	1.4513
Influential factor 25	7.9863	1.3117

criteria to be included in the group of effect cluster, in particular,: 1-14 and the cause of a cluster include 15-25. The causal relations among the criteria can be proposed as a causal diagram (Fig. 1). Figure 1 shows that the Willingness to take on the position of the most effective and the strongest relationship with the other criteria. Figure 1 also shows that the significance of the impact, and the impact of each of these criteria. On the horizontal axis and the vertical axis is the measurement of the impact of the graph, it shows that the impact of each of these criteria.

Table 5 shows that all the effects are highly connected to the given cause criteria. This result proved that the cause-and-effect clusters for graduation with distinction for higher education students fulfill the criteria of this study. Figure 1 shows the interconnection between each cause to effect relation.

CONCLUSION

In this study, the evaluation on the Success of Graduating with Distinction in Higher Education (SGDHE) using the fuzzy DEMATEL method has been done successfully. The observation has been done using cause and effect criteria. The 11 cause and 14 effect clusters have been used in this study. The study result of this work shows that all the effects are connected to the given causes and a cause-effect graph has been generated for each connection. This work aims to initiate higher education students to graduate with distinction in their study program.

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