Cost-Effectiveness of Online Learning: A Case Study from Mongolia

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Abstract **- This study evaluates the cost-effectiveness of online learning at Mongolia's National University of Medical Sciences (MNUMS) by examining selected master's-level courses. The analysis was conducted at three levels: course design, instructor involvement, and student learning outcomes. Drawing on Otto Peters' theory of the industrialization of distance education and the Talent Development Association's framework for online learning design, the study undertakes a detailed process and cost analysis of both online and traditional course delivery. Student performance was compared between online and face-to-face modalities. The cost per student was estimated and the cost-effectiveness of both traditional and online learning modes was compared. The findings provide practical insights into the economic and educational viability of online learning in the higher education context of a developing country.**

Keywords **- Cost-effectiveness, online learning, higher education, Mongolia.**

DOI: 10.18421/TEM153-102
https://doi.org/10.18421/TEM153-102

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Received: 19 January 2026.
Revised: 10 April 2026.
Accepted: 07 May 2026.
Published: 27 August 2026.

1. Introduction

The human capital theory development in the sixties provided insight into the relations among education, productivity, and economic development [1]. It is as a major explanatory factor of the dramatic increase in demand for education [2]. The supply of education continuously attempts to meet this demand. A research literature on how the ICT transformed teaching and learning of all levels, and online learning is increasing [3].

To improve the quality of education in a knowledge-based economy, it is necessary to transform and modernize the formal education system, which involves the actively introducing, supporting, and developing e-learning and distance learning [4]. Online learning relates to the institutionalization of open universities and the supply of distance courses on undergraduate and postgraduate level [5]. In such applications, online learning is addressing the problems that students face in attending classroom courses due to professional, family, economic or other reasons [6].

This study investigates the cost-effectiveness (CE) of online courses compared to the equivalent courses delivered in classrooms for graduate-level students. It aims to explore the cost and effects of teaching online courses compared to the same traditional course in a classroom setting. The aim of this study is to estimate the cost of master program 2-credit hour English course and estimate Cost-Effectiveness Ratio (CER) for both online course and traditional course and compare them [7]. Cost-Effectiveness Analysis (CEA) influence resource allocation decisions help set cost-minimizing teaching modules for a higher education institution and its students [8].

The higher education industry in Mongolia is valued at over 365 billion MNT (134 million USD), with 95 higher education institutions and 157 thousand students per academic year [9], [10].

The national higher education institutions are constantly seeking additional financing. If this study demonstrates that online teaching can increase the efficiency of spending by even 2 percent, then 7.2 billion MNT would be available for other purposes, such as research, scholarship for disadvantaged students, etc. At the institutional level, such efficiency improvement would provide an additional 76 million MNT per college. However, these gains can be acquired if the costs and effects or results of appropriate measures van be estimated. This research is significant as cost analysis in Mongolia and CEA are new, and the higher education sector is growing.

This study has five limitations:

1. The absence of a time-usage study on the lecturers' and staff workload.
2. The time spent depends on the fields of science. For example, engineering, technology, medical sciences, and natural sciences courses require significant time to develop simulations and animations. Stringer and Cunningham argued that instructional costs for one discipline can be 3 times than of another discipline [11].
3. Methodological and estimation differences. Higher education institutions commonly use traditional accounting methods; however, this study uses Activity Based Costing (ABC). MNUMS uses traditional accounting whereas this study uses the ABC, especially the cost-volume approach.
4. The financial year in Mongolia overlaps with the calendar year, whereas the academic year starts in September and ends in June. From September to October, the universities generate significant income from tuition fees. They will be in the best fiscal situation in January, with an annual financial report, and the worst fiscal situation by the semiannual financial report in July, as resources diminish.
5. The realistic estimate of the tuition fee. The Government directs that the price per credit hour is not increased more than the current year's inflation rate in public universities. Hence, a tuition fee does not reflect the market price.

2. Research Methodology

CEA refers to the evaluation of alternatives according to both their choice and effects concerning producing same outcome [12], [13]. This study will examine how two different educational programs, offered online and classroom settings, with the same learning objectives, differ in college and student spending.

The assumption is a) Programs with identical goals can be compared, b) The same measure of effectiveness should be used to assess them [12], [13]. The student's score is a measure of effectiveness. The courses were selected based on the following rationale that (i) The same curriculum, content, and learning objectives to increase students' knowledge of English; (ii) Students have similar prior knowledge or same prerequisite are enrolled in the master's course; (iii) Same credit hours; (iv) Both courses are basic masters' course; (v) Common measure of effects or outcomes such as final exam test score, the drop-out rate of the courses. The Formula 1 is used to calculate the CER.

$$CER = \frac{Costs}{Effects} \quad (1)$$

First, all required inputs for the development and delivery of the courses were identified, and their monetary values were determined. Second, data on student's learning outcomes from the courses were collected. Finally, CEA was performed, and CER per online learner and per traditional student was compared.

The ingredients method was used for the calculation of the impeded costs of organizing online and traditional classroom teaching of the courses [12], [13]. The ingredients method represents a straightforward approach to estimating costs. This study aimed to identify inputs required to develop and teach online course at a given university. It interviewed faculty members, instructional designers, university administrators and accountants about how much time was spent on course development, delivery, and student assessment, and calculated direct and indirect costs.

The total cost of the online course development is estimated by the Formula 2:

$$TC = w_{lecturer} * L_{lecturer} + w_{studio\ instructional\ designer} * L_{studio\ instructional\ designer} + OEX \quad (2)$$

Where:

TC - total cost;

$w_{lecturer}$ - monthly wage of the lecturer;

$L_{lecturer}$ - median time spent by the lecturer for online course development (months);

$w_{studio\ instructional\ designer}$ - monthly wage of the studio staff;

$L_{studio\ instructional\ designer}$ - median time spent by the studio staff for online course development (months);

OEX (overhead cost) - overhead costs are all other costs such as initial investment, administrative expenses, library, security, internet by the current prices.

The ABC method, which is used to estimate the product and service prices more efficiently, was applied to estimate the L-labor or time required to design an online course [14]. In fact, the estimated work hours required for course realization were multiplied by the labor cost.

In this study, data on the lecturer's monthly salary at the university, which was 1,372,000 MNT for the 2016-2017 academic year, including the social insurance, medical insurance, and taxes, were used. To estimate the cost of the delivering the traditional course per semester, the lecturer's salary (labor cost) was calculated for the semester, along with associated overhead expenses. The process analysis results and defined activities in Table 1 and Table 2 were used in this study.

The duration of several activities varies depending on the number of students. There is a set of activities that are independent of the number of students and will be undertaken once the university decides to offer the course. From the lecturer's perspective, activities such as office hours, responding to students' e-mails, communication, marking down the assignments (activity #16), marking the exams (activity #20) depend on the number of the students. Similarly, from the instructional designer's perspective, activities such as student's counseling hours during business hours, responding to the e-mails of the students, communication (activity #17), test organization (activity #18), office hours, responding to questions, and feedback (activity #19) would depend on the number of students. If many students choose an online course, then these activities would be time-consuming and increase the total cost. It is similar to the case of the British Open University [6].

Overhead costs include facilities, equipment, instructional equipment, teaching materials, classroom furniture, computers, audiovisual equipment, books, Internet connection costs, and other supplies. It was assumed that online learning is conducted using the university's existing facilities and resources, and that its overhead costs are equivalent to those of traditional learning.

Data on the effects or learning outcomes of students who took the courses are needed to compute the CER. The independent samples t-test compares the means of two independent groups (e.g., two groups of students who took these courses) to determine whether there is statistically significant evidence that their population means differ (university, n.d.). Besides, if the sample size is greater than 30 it fulfills the requirement of the Central Limit Theorem, the t-test can be used [15].

The hypothesis is:

H_0: $\mu_1 = \mu_2$, (the two population means are equal)

H_1: $\mu_1 \neq \mu_2$, (the two population means are not equal).

where μ_1– mean of the 1st independent sample μ_2– mean of the 2nd independent sample.

When two independent samples are assumed to be drawn from populations with equal variances, Formula 3 is used to calculate the t-test statistic (university, n.d.).

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s_p\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}};$$

$$s_p = \sqrt{\frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}}, \quad (3)$$

$$df = n_1 + n_2 - 2$$

where $\bar{x}_1$– mean of the first sample, $\bar{x}_2$- mean of the second sample.

n_1- the size of the first sample, n_2- the size of the second sample;

s_1- standard deviation of the first sample;

s_2- standard deviation of the second sample, s_p- pooled standard deviation, df- degree of freedom.

When two independent samples are assumed to be drawn from populations with unequal variances, the Formula 4 is used to calculate the t-test statistic (university, n.d.).

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}}, \; df = \frac{\left(\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}\right)^2}{\frac{1}{n_1-1}\left(\frac{s_1^2}{n_1}\right)^2+\frac{1}{n_2-1}\left(\frac{s_2^2}{n_2}\right)^2} \quad (4)$$

The means scores of the online and traditional students were compared. The hypothesis using Levene's Test is:

H_0: $\sigma_1^2 - \sigma_2^2 = 0$, (the population variances of traditional and online student's scores are equal);

H_1: $\sigma_1^2 - \sigma_2^2 \neq 0$, (the population variances of traditional and online student's scores are not equal).

where σ_1- variance of the traditional student score; σ_2- variance of the online student.

If the population variances are the equal ($\sigma_1^2 = \sigma_2^2$), Formula 5, which is derived from Formula 4, is used.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s_p\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}}; \; s_p = \sqrt{\frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}} \quad (5)$$

If the variances differ ($\sigma_1^2 \neq \sigma_2^2$), Formula 6 is used to calculate t-test statistic.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}}$$

degree of freedom is calculated

$$df = \frac{\left(\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}\right)^2}{\frac{1}{n_1-1}\left(\frac{s_1^2}{n_1}\right)^2+\frac{1}{n_2-1}\left(\frac{s_2^2}{n_2}\right)^2} \quad (6)$$

In this study, the Mann-Whitney U test was selected as a non-parametric method (center, n.d.). The first group has n_x samples that are observations $\{x_1, x_2, \dots, x_n\}$ from population 1, the second group n_y sample that are observations $\{y_1, y_2, \dots, y_n\}$ from population 2. Mann-Whitney test compares observation x_i of the 1st sample to the observation y_i of the 2nd sample. Hence, the number of totals pairwise comparison is $n_x n_y$. If the samples have the same median, then each x_i has an equal chance (i.e., probability $\frac{1}{2}$) of being greater or smaller than each y_j. It tests if two independent samples have a difference (or overlaps).

Under the null hypothesis $H_0: P(x_i > y_i) = \frac{1}{2}$; and under the alternative hypothesis $H_1: H_0: P(x_i > y_i) = \frac{1}{2}$; the number of times an x_i from sample 1 is greater than a y_i from sample 2 were counted. This number is denoted by U_x. Similarly, the number of times an x_i from sample 1 is smaller than a y_i from sample 2 is denoted by U_y (center, n.d.).

If the sample size number is sufficiently large or $n_x n_y > 20$, the data can be assumed to follow a normal distribution:

$$\mu_U = \frac{n_x n_y}{2};\ \sigma_U = \sqrt{\frac{n_x n_y (N+1)}{12}} \qquad (7)$$

where $N = n_x + n_y$.

Sometimes, two or more observations can be the same. The U can still be calculated by assigning half the tied values to the X and the other half to the Y value. However, if this is the case then the normal approximation must be used with an adjustment to the standard deviation (center, n.d.). This becomes:

$$\sigma_U = \sqrt{\frac{n_x n_y}{N(N-1)} \times \left[\frac{N^3 - N}{12} - \sum_{j=1}^{g} \frac{t_j^3 - t_j}{12}\right]} \qquad (8)$$

where $N = n_x + n_y$; g- the number of groups of ties, t_j^3 - the number of tied ranks in group j.

3. Research Findings

Online course development activities, their input, output, and structural units and their roles were defined. Otto Peters considered the development of distance-learning course materials as an industrialization process [16]. The Talent Development Association's online learning development design was used in this study [17].

There are two types of higher education costing models such as cost-volume and cost accounting. The total cost is the sum of fixed and variable costs in the cost-volume economic model [6]. The main importance lies in the volume of input, cost, and generated revenue. Cost-volume analysis is used to determine whether revenue can cover the cost of a particular course in the educational sector. The total cost was estimated using cost-volume method. The current state of online course development was estimated at 30 activities lasting 138 days. George Siemens and Stephen Downes estimated that 715 to 770 hours or 89.3-96.2 days are spent to develop and deliver 12-week course on connectivism and connected knowledge [18].

In this study, the online course development costs borne by the university, the teaching, organizational and personnel costs borne by the university, and the student costs were estimated.

The cost estimate results are presented in Table 1 and Table 2.

Table 1. Learning cost estimate

№	Activities	Number	Time per unit	Labor cost (MNT)	Total (MNT)
A. Online course preparation (lecturer)					2,329,657.8
1	Prepare course description, plan (3 days)	1	3.00	62,363.6	187,090.9
2	Prepare lectures (12 lectures×6 hours)	12	6	7,795.45	561,272.7
3	Record lectures (12 lectures×1 hour record using Camtasia desktop software, edit it for 30-60 minutes)	12	1	7,795.45	93,545.45
4	Develop webinars and seminars	1	4	62,363.6	249,454.5
5	Edit record (12 lectures×1,5 hours)	12	1.5	62,363.6	1,122,545.4
6	Develop test (132 tests×10 munites)	132	10	87.69	115,748.7
B. Multimedia development, test development, consult (Instructional designer)					2,136,090.5
7	Research (10 days)	1	10	42,090.4	420,904.5
8	Develop multimedia for each unit course	1	10	42,090.4	420,904.5
9	Edit lectures (12 lectures×2 hours)	12	2	5,261.31	126,271.3
10	Locate test (132 tests×90 seconds)	132	90	87.69	1,041,738.7
11	Consult lecturer, edit		3	42,090.4	126,271.3
12	Overhead cost per unit course, MNUMS				9,831.1
C. The total cost of online learning (A+B)					4,475,579.4
	Depreciation percent (8 years, 16 semesters)		8		
D. 1-semester cost of online learning					279,723.7
E. Cost to conduct online learning course per semester					4,483,505.4
13	Schedule, contact lecturer (Instructional designer)	1	2	42,090.4	84,180.9
14	Register student (admission, graduation by Instructional designer)	50	8	5,261.31	2,104,522.7
15	Add the course to the LMS (Instructional designer)	12	3	5,261.31	189,407.0
16	Reply to student's emails (50 students×12 lectures ×5 munites by Lecturer)	600	0.08	7,795.45	389,772.7
17	Consult student over the phone during business hours, reply to their emails (Instructional designer)	50	2	5,261.31	526,130.6
18	Test (Instructional designer)	1	2	5,261.31	10,522.6
19	Consult student during business hours, respond to questions, feedback (Instructional designer)	50	3	5,261.31	789,196.0
20	Evaluate the students (50 students×1 hour, Lecturer)	50	1	7,795.45	389,772.7
Other costs					
Get permission of the rights owner (cost)		0			
F. Organization cost of conducting online course per semester (D+E)					4,763,229.1
Cost estimate of the traditional course					
G. Cost of conducting traditional 1-semester course (Lecturer)					6,183,831.0
1	Conduct course (lecturer's salary per month)	1	4.50	1,372,000	6,174,000
2	Overhead cost per unit course, MNUMS				9,831.1
Difference (G-F)					1,420,601.9

A typical lecturer and instructional designer conduct 6 types of activities for online course development. These activities have a cost in terms of labor and teaching materials. The costs were summed, and the mean value was computed (rows A and B in Table 1).

The overhead cost was estimated by dividing the total expenses by the total number of courses offered (including traditional and online courses across all educational levels).

The cost to conduct an online course per semester is 4,483,505.42 MNT (row E in Table 1).

Once the final product, an online course, is developed, it can be taught over several academic years, so it was discounted over time. The study used 8 years (16 semesters) and depreciated the current value in the estimation. Therefore, the cost of organizing online course per semester is 279,723.71 MNT (row D in Table 1).

The overhead cost per course (traditional, online for all educational levels) reported by the MNUMS is 9,831,1 MNT (row 12 in Table 1). Thus, the estimated cost of the e-course per semester is a sum of (sum of D and E in Table 1) and costs 4,763,229.14 MNT (row F in Table 1). The estimated cost of the traditional course per semester is the sum of the lecturers' salaries and overhead costs and is equal to 6,183,831.07 MNT (row G in Table 1). The traditional course is more expensive than the online course by 1,420,601.93 MNT (row G-F).

The costs of online course development vary across higher education institutions and countries, driven by different methodologies and labor costs. For example, a 3-credit-hour web-based course at the Korean Open University for 30 students costs 13,000 USD [19]. The German Rector's forum estimated that a MOOC course costs 25,000-50,000 euros [20]. In the example of the selected four American universities, the total estimated cost per MOOC ranged from 38,980 to 325,330 [18]. The cost to develop and deliver a 3-credit course over the LMS costs 35,000-50,000 USD [21].

4. The Cost Analysis of The Students' Learning

Methodology: The study attempts to estimate the cost of a student who participated in traditional or e-learning. Cost estimation can be a useful tool for comparing the cost of traditional and online learning. The traditional students' learning costs are the sum of 7 costs, including tuition fees, intercity bus service, public transport, coursebook, research, internet, and livelihood. The online students' learning costs are the sum of six costs: tuition fees, coursebooks, internet, research, and livelihood. Some costs used in the estimate, are used from official sources. This estimate has the following drawbacks. It does not reflect the student's special needs. It depends on whether the traditional student is employed.

This study has a practical advantage for students who must choose between traditional and online learning. The students' decision depends on their preference for flexibility and financial status.

Results: The cost comparison between online and traditional students is presented in Table 2. The traditional master's student's cost is 7,757,799 MNT. However, the online student's cost (estimated learning expenses for online learners) is 4,353,918 MNT. Hence, online learning is cheaper than traditional learning, 3,403,881 MNT (A-B). If the traditional student spends 352,627.2 MNT per course, the corresponding cost for online student is 197,905.4 MNT per course.

Table 2. Online and traditional student learning cost comparison, MNT

N	Activities	Unit	Unit price	Total	Note
A.Traditional master student cost					
1	Tuition fee			2,436,000	The content is 30 hours, diploma work for 10 credit hours.
2	Public Intercity bus service	4	21,750	87,000	Intercity bus service connects Ulaanbaatar and 60 regional routes with the prices that were set by the National Autotransportation center in 2018. Median distance is 508 km, median price is 21,750 MNT [22].
3	Public transport	18	25,000	450,000	The price of monthly "Unlimited" type U card, which is used in Ulaanbaatar city [23].
4	Coursebook	22	30,000	660,000	The median price of the 65 books that the library purchased in 2017 and 2018. Master's student studies 22 courses in years.
5	Internet, months	18	20,000	49,999	Monthly median price of the 5 Mbps household Internet service in Ulaanbaatar [24].
6	Research cost	1	500,000	500,000	It is a rough estimate. It varies depending on the subject, scope, nature of the research and field of the science.
7	Livelihood expenses	18	198,600	3,574,800	Monthly minimum livelihood standard per person of the Ulaanbaatar city [25]. The study is for 18 months excluding vacations.
Total				7,757,799	Traditional master student cost
Traditional master's student's study cost per course				352,627.2	Total cost is divided into total number of courses to estimate the cost per course. Master's student studies 22 courses in two years.
B.Online master student cost					
N	Activities	Unit	Unit price	Total	Note
1	Tuition fee			2,070,000	The content is 34 hours, diploma work for 6 credit hours.
2	Coursebook	22	30,000	660,000	The median price of the 65 books that the library purchased in 2017 and 2018.The master's student studies 22 courses in 2 years.
3	Internet	18	30,000	49,999	Monthly median price of the household internet service of the rural areas and Ulaanbaatar city [26].
4	Livelihood expenses	18	176,800	3,182,400	Median minimum livelihood standard per person of the 4 regions for the month [27].
5	Research cost	1	500,000	500,000	It is a rough estimate. It varies depending on the subject, scope, nature of the research and field of the science.
6	Salary (opportunity cost, months)	18	-600,907	-10,816,317	Average salary of the general practitioners and medical staff [28]. The study used the "Survey report on health workers interested in accessing rental and mortgage housing loans – 2018," conducted by the Health Development Center of Mongolia.
Total				-4,353,918	Online master student cost
Online master's student study cost of the per course				-197,905.4	Master's students study 22 courses in two years. Total cost is divided into total number of courses to estimate the cost per course.
Difference between the total costs of traditional and online master students (A-B)					3,403,881

Comparison of Student Learning Achievement: This study aimed to assess whether the learning achievements traditional and online students differ significantly. A total of 231 master's students studied English and Ethics courses (double-counted) [29]. To achieve this objective, the mean scores of these two master's courses were compared. The authors formally requested and collected information from the following sources.

Those are: Student number, LMS access number, gender, location, score, the number of accesses to the LMS, employment, and other information of the online master's students from the MNUMS's International Cyber University (ICU). Location means whether the student is from a rural area. Student number, gender, location, score, and employment of the traditional master's students from the MNUMS's Graduate School. A total of 231 students studied master's English and Ethics courses. The students' demographics are presented in Table 3. The descriptive statistics for learning achievement are presented in the Appendix.

Table 3. Students' information

Course name	Course code	Online			Traditional learning		
		Initial enrollment	Students with 70 or above scores	Attrition rate	Initial enrollment	Students with 70 or above scores	Attrition rate
Ethics	PRE-E11	44	31	13 (29.5%)	77	70	7 (9.09%)
English	RET-E11	55	37	18 (32.7%)	55	55	0 (0%)

Source: From administrative data of MNUMS, spring of 2016-2017 academic year.

The master's level student must earn at least 70 scores for passing the course. Attrition is the number of students who scored below 70 due to various reasons that led to the student's departure. The failure rate of online learning is higher than of traditional learning, rising from 20.4 to 32.7%. It is significantly higher than Korea National Open University's dropout rate of 10% [19]. Figure 1 presents a comparison between online and traditional student's mean scores.

The Kolmogorov-Smirnov test was used to determine whether students' learning achievements in online and traditional English course was normally distributed. The assumption of normal distribution was accepted, as the $p \gg 0.05$ (Table 4). The same test was applied to analyze students' learning outcomes in online and traditional Ethics courses. Based on the results, shown in Table 4, assumption of normal distribution was accepted, as the $p \gg 0.05$.

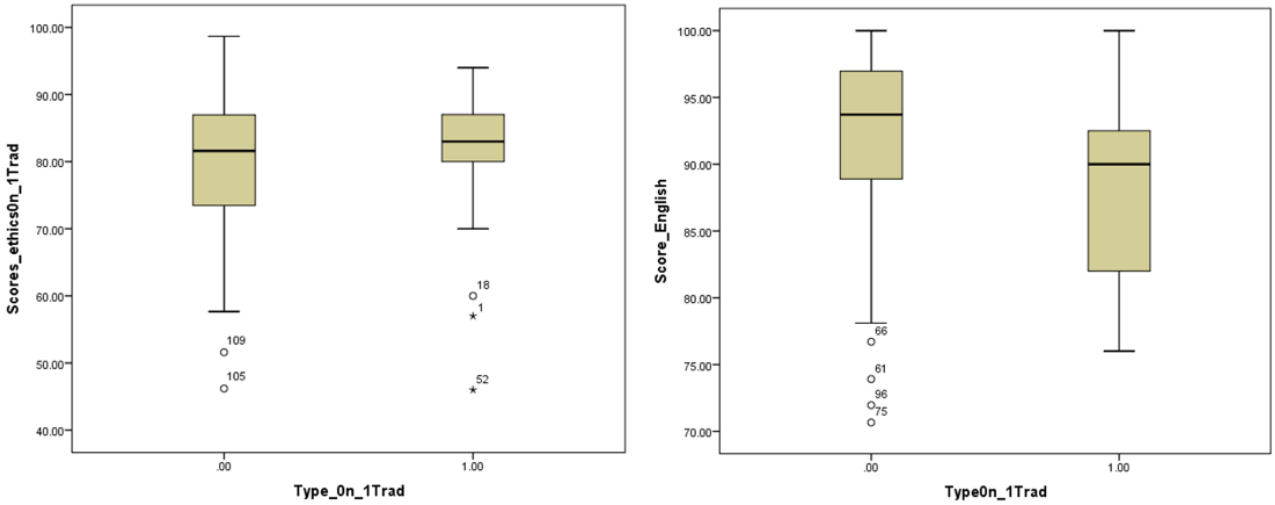

Figure 1. The comparison between online and traditional student mean scores

Table 4. Results of the Kolmogorov-Smirnov test for Normality of students' scores (English and Ethics courses)

		Eng_online	Eng_trad	Ethics_online	Ethics_trad
N		37	55	31	70
Normal Parameters[a,b]	Mean	90.7026	88.7455	82.7251	83.0143
	Std. Deviation	8.57957	88.7455	9.75392	6.03250
	Absolute	.194	.131	.107	.123
Most Extreme Differences	Positive	.139	.131	.091	.047
	Negative	-.194	-.102	-.107	-.123
Kolmogorov-Smirnov Z		1.177	.971	.597	1.029
Asymp. Sig. (2-tailed)		.125	.302	.868	.241

Note: a-Test distribution is normal; b-Calculated from data

Table 5 presents the independent samples t-test results for students' scores of the online and traditional English courses. Since p-value is greater than the significance level $\alpha = 0.05$, the null hypothesis is not rejected.

Therefore, there is no significant difference in the students' mean scores of the traditional and online learning in the English course. In summary, student performance did not differ significantly between traditional and online learning.

Table 5. Independent samples t-test results for students' scores (online and traditional English course)

	Type0n_1Trad	N	Mean	Std. Deviation	Std. Error Mean
Score_English	Traditional learning	55	88.7455	6.69222	.90238
	Online learning	37	90.7026	8.57957	1.41047

Independent Samples Test (Score_English)									
	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	2.337	.130	-1.227	90	.223	-1.95716	1.59560	-5.12710	1.21278
Equal variances not assumed			-1.169	64.318	.247	-1.95716	1.67443	-5.30190	1.38759

The results allow to draw the following conclusions:

1. There was no statistically significant difference in students' mean scores between traditional and online learning in the English course ($t_{90} = -1.227, p > 0.130$),
2. Although the observed mean difference was 1.957 scores, this difference is not statistically significant. Therefore, the average student performance in online and traditional learning can be considered comparable.

Table 6 presents the Independent Samples t-test results for students' Ethics course scores comparing online and traditional learning. Since the p-value is greater than the significance level α = 0.05, the null hypothesis is rejected. Therefore, there is no significant difference in the students' mean scores of the traditional and online learning in the Ethics course. In summary, traditional and online learning are not significantly different in terms of student performance.

Table 6. Independent samples t-test results (Ethics course, online and traditional)

	Type_0n_1Trad	N	Mean	Std. Deviation	Std. Error Mean
Scores_ethics	Online learning	31	83.0951	7.89823	1.41856
	Traditional learning	70	83.0143	6.03250	.72102

Independent samples Test (Scores_ethics0n_1Trad)									
	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	2.730	.102	.056	99	.955	.08077	1.43540	-2.76737	2.92890
Equal variances not assumed			.051	46.163	.960	.08077	1.59129	-3.12202	3.28356

Levene's test measures if the variances of two independent samples are the same, and $F = 2.73$. T test value is $t_{99} = 0.056$. Since p-value is greater than significance level α = 0.05, the null hypothesis is not rejected. Therefore, there is no significant difference in the students' mean scores of the traditional and online learning in the Ethics course (H_0: $\sigma_1^2 - \sigma_2^2 = 0$). Based on the results, the following conclusions can be drawn:

1. There was no significant difference in students' mean scores between traditional and online learning in the English course ($t_{99} = 0.056, p > .05$), and
2. The average student scores of the online and traditional learning in the English course are the same. The difference of 0.08 scores is not statistically significant. It is concluded that there is no significant difference in students' mean scores of traditional and online learning in the Ethics course.

5. Non-Parametric Method

When the Mann-Whitney U test is used for the average student score of the online and traditional learning in English and Ethics courses, $p \gg 0.05$ and there is the reason they reject the H_0 hypothesis.

The average score difference between online and traditional students is not statistically significant in the English and Ethics courses, as shown in Table 7. Thus, the learning quality for the online and traditional learning is the same for both courses.

Table 7. Mann-Whitney test results for students' average learning achievement on Ethics and English courses, comparing online and traditional learning

	Ethics course (Scores_ethics 0n_1Trad)	English course (Score_English)
Mann-Whitney U	1075.500	801.500
Wilcoxon W	3560.500	2341.500
Z	-.070	-1.722
Asymp. Sig. (2-tailed)	.944	.085
Exact Sig. (2-tailed)	.946	.086
Exact Sig. (1-tailed)	.473	.043
Point Probability	.001	.000

a. Grouping Variable: Type_0n_1Trad

Based on the results of both parametric and non-parametric analyses, it can be concluded that there is no statistically significant difference in student learning achievement between online and traditional formats in the Ethics and English courses. Furthermore, Levene's test indicated no significant difference in the variances of students' mean scores between traditional and online learning in Ethics and English courses. In the non-parametric method, the student's average scores did not differ significantly in both traditional and online learning. Attrition from online learning is higher than that of traditional learning by 20.4-32.7 percent. It can be related to the lack of the environment for Online learning based on the researcher Astin's framework "input-environment-results" [30]. In the online learning survey conducted by the authors in the 2018 academic year, 72 percent of the respondents said that environment and faculty development are the two major challenges in online learning development. More research is needed to understand student departures.

6. Online Learning Cost-Effectiveness Analysis

The advantage of the cost analysis is that it enables the researcher to compare the options and supports decision making by effective utilization of the resources [31]. The CEA was selected as the primary cost analysis method [32], [33]. The lecturer's score was chosen as an indicator of learning achievement. The study followed Levin's four step recommendations [12]. Furthermore, the study evaluated outcomes using CE technical indicators proposed by Patrick McEwan's methodology [13]. The average cost of one student was calculated using Formula 9, and the results are presented in Table 8.

$$\frac{TC_{trad}}{n_{trad.students}} = AC_{traditional}; \frac{TC_{online}}{n_{online.students}} = AC_{online} \quad (9)$$

Where:

TC_{trad}- Total cost of traditional learning;

AC_{trad}– Average cost of traditional learning per student;

$n_{trad.students}$- Total number of students enrolled in traditional learning;

TC_{online}- Total cost of online learning;

$n_{online.students}$- Total number of students enrolled in online learning;

AC_{online}– Average cost of online learning per student.

The lecturer's evaluation presents learning achievement. In doing so, the median score and average score were compared.

Table 8. Average cost per student

Activities	Total cost (TC)	Student number (n)	Average cost
Traditional learning	6183831.1	55	112433.3
Online learning	4763229.1	37	128735.9

In this study, the median scores for online and traditional learning were 90, but the average scores were differed; therefore, the average score was selected. The average score of the 55 traditional students is 88.7, and the average score of the 37 online students is 90.7. The CEA was calculated with two versions:

1. Counting only the university's learning costs,
2. Sum of the universities and student learning costs.

The effectiveness was calculated by dividing the average cost by the average score, as presented in Formula 10. In this study the university's learning average cost was assessed.

$$CE_{online} = \frac{AC_{online}}{Score_{online}}; CE_{trad} = \frac{AC_{trad}}{Score_{trad}}; \quad (10)$$

Where:

CE_{online}-Online learning effectiveness;

AC_{online}– Average cost of online learning per student;

$Score_{online}$- Average score of the total number of students enrolled in online learning;

CE_{trad}-Traditional learning effectiveness;

AC_{trad}– Average cost of traditional learning per student;

$Score_{trad}$- Average score of the total number of students enrolled in traditional learning.

According to the Table 9, the cost of the traditional learning per score is 1266 MNT, while the cost of online learning per score is 1419.36 MNT.

Using the average score as the effectiveness indicator, the results indicate that online learning is 152.51 units more cost-effective than traditional learning.

Table 9. Online and traditional learning effectiveness comparison

№	Activities	Average cost	Average score (Score)	Cost-effectiveness ratio (CER)
1	Traditional learning	112433.3	88.7	1266.8
2	Online learning	128735.9	90.7	1419.36
Effectiveness difference				152.51

The effectiveness is calculated by dividing the average cost into an average score using Formula 11. Not only was the average cost of university learning considered, but also student's learning expenses.

$$CE_{online.inc.stud} = \frac{AC_{online}+C_{online.stud.per.course}}{Score_{online.edu}};$$
$$CE_{trad.inc.stud} = \frac{AC_{trad}+C_{trad.stud.per.course}}{Score_{trad}}; \quad (11)$$

Where:

$CE_{online.inc.stud}$- Online learning effectiveness including student costs;

AC_{online}– Average cost of online learning per student;

$C_{online.stud.per.course}$ –Expenses of the student per online course;

$Score_{online}$-Average score of the total number of students enrolled in online learning;

CE_{trad}- Traditional learning effectiveness;

AC_{trad}– Average cost of traditional learning per student;

$C_{trad.stud.per.course}$ – Expenses of the student per traditional course.

$Score_{trad}$- Average score of the total number of students enrolled in traditional learning.

The average score was selected as the effectiveness indicator, and the comparison of online and traditional learning effectiveness us provided in Table 10.

Table 10. Traditional learning effectiveness

Activity cost	Average cost	
	Traditional learning	Online learning
Learning cost	112433.3	128735.9
Expenses of the master student per course	352627.2	-197905.4
Total cost	465060.5	-69169
Average score	88.7	90.7
Cost-effectiveness ratio (CER)	5240.1	-762.6

Traditional learning's CE is 5240.1 units. Similarly, online learning's CE is (-762.6) units. The negative number reflects the fact that online students can work (no lost opportunity cost). It is income rather than cost, so it has a negative number.

The student's expenses per traditional course are 5,240 units, whereas student's expenses per online course are (-762.6) units. In terms of student learning costs, online learning is cost-effective than traditional learning by 6002.7 units. There is a significant difference in CE between online and traditional learning.

Furthermore, online learning is expanding educational access, and it is effective. MNUMS's ICU is expanding educational access by enrolling students from rural areas and foreign countries. Online learning has increased the access, enabling the student to learn without space and time limitations. There is an increase in international and national students and income.

7. Conclusion

Cost analysis and CEA are important tools for research on educational economics. The purpose of the CEA is to present policymakers with a comparison of the policy alternatives. One can compare the rationale and evidence of the policy options based on CE. The research has shown that teaching and learning in traditional course are more expensive than online teaching and learning. For example, the total cost of online learning is less than traditional learning by 1,420,601.934 MNT or by. In terms of student learning cost, online learning is cheaper than traditional learning by 3,403,881 MNT.

Based on this CEA, online learning is cheaper for students than traditional learning. The study used two versions of the CEA: college spending and the sum of the college and student spending. In this study, the average score was used as the indicator of effectiveness. The estimate showed that online learning is more cost-effective than traditional learning by 152.51 units. When student learning cost are included, the estimate shows that online learning is more cost-effective than traditional learning by 6002.7 units.

The cost to increase 1 score or improve the learning quality per unit is lower for online learning than traditional learning in the English course. Furthermore, online learning expands access to education.

Then, the means of student learning achievements were compared between online and traditional learning. Independent t-tests and Mann-Whitney tests were administered to 231 masters' students studying Ethics and English. The results indicated no statistically significant difference in scores between online and traditional learners in the Ethics and English courses. It is concluded that online and traditional learning achievements are the similar, but online learning is less costly and more cost-effective. In the future, more research is needed.

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Appendix:

1. The descriptive statistics regarding learning achievement

№	Evaluation	Ethics	English
1	Attendance	10%	Homework 15%
2	Test	10%	10%
3	Assignment	20%	15%
4	Mid-term exam	30%	30%
5	Final exam	30%	30%
	Total	100%	100%

2. Descriptive statistics of the students who studied Ethics

Case Processing Summary (Scores_ethics0n_1Trad)						
Type_0n_1Trad	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
.00	36	100.0%	0	0.0%	36	100.0%
1.00	73	100.0%	0	0.0%	73	100.0%

Descriptives (Scores_ethics0n_1Trad)				
Type_0n_1Trad			Statistic	Std. Error
.00	Mean		79.6450	1.97309
	95% Confidence Interval for Mean	Lower Bound	75.6394	
		Upper Bound	83.6506	
	5% Trimmed Mean		80.3540	
	Median		81.6000	
	Variance		140.151	
	Std. Deviation		11.83855	
	Minimum		46.20	
	Maximum		98.67	
	Range		52.47	
	Interquartile Range		14.38	
	Skewness		-.930	.393
	Kurtosis		1.154	.768
1.00	Mean		81.8356	.97398
	95% Confidence Interval for Mean	Lower Bound	79.8940	
		Upper Bound	83.7772	
	5% Trimmed Mean		82.5677	
	Median		83.0000	
	Variance		69.250	
	Std. Deviation		8.32168	
	Minimum		46.00	
	Maximum		94.00	

3. Descriptive statistics of the students who studied English

	Case Processing Summary (Score_English)					
Type0n_1Trad	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
.00	37	100.0%	0	0.0%	37	100.0%
1.00	55	100.0%	0	0.0%	55	100.0%

Descriptives (Score_English)				
Type0n_1Trad			Statistic	Std. Error
.00	Mean		90.7026	1.41047
	95% Confidence Interval for Mean	Lower Bound	87.8420	
		Upper Bound	93.5632	
	5% Trimmed Mean		91.2719	
	Median		93.7100	
	Variance		73.609	
	Std. Deviation		8.57957	
	Minimum		70.66	
	Maximum		100.00	
	Range		29.34	
	Interquartile Range		11.84	
	Skewness		-1.085	.388
	Kurtosis		-.115	.759
1.00	Mean		88.7455	.90238
	95% Confidence Interval for Mean	Lower Bound	86.9363	
		Upper Bound	90.5546	
	5% Trimmed Mean		88.6869	
	Median		90.0000	
	Variance		44.786	
	Std. Deviation		6.69222	
	Minimum		76.00	
	Maximum		100.00	