Bridge to Professional Practice: Evaluating Internship Effectiveness and Coordination for Civil and Hydropower Engineering Graduates, A Study of Mid-West University of Nepal using ANN

Uttam Neupane[1*], Socrates Bhattarai Sharma[2] Subash Kumar Bhattarai[3]
[1]Assistant Professor, Graduate School of Engineering, Mid-West University, Surkhet, Nepal
[2]Research Scholar, Graduate School of Engineering, Mid-West University, Surkhet, Nepal
[3]Visiting Faculty, Graduate School of Engineering, Mid-West University, Surkhet, Nepal
[*]Corresponding Author: uttam.neupane@mu.edu.np

Abstract

The transition from academia to professional engineering practice is a pivotal and formidable challenge for graduating engineers. This research explores the effectiveness of internship programs for final semester undergraduates' students in Civil and Hydropower Engineering of Mid-West University, based on data collected from 77 intern students by evaluating the acquired knowledge and skills during internships, while also exploring the associated benefits and the level of co-ordination between university and the internship organizations. Questionnaires assessed self-evaluated knowledge and skills gained, perceived benefits of the internship, co-ordination by the university and the department, and challenges encountered. Data analysis utilized descriptive statistics and an Artificial Neural Network (ANN) model to identify factors influencing internship effectiveness. Results indicated that the effective coordination between universities and industry significantly enhances internship outcomes, impacting students' practical skill development. The study underscores the importance of collaborative efforts in fostering industry-relevant competencies among future construction engineers. These findings suggest practical implications for universities in refining internship initiatives, improving curricula, and establishing robust internship guidelines to better prepare students for professional careers in engineering disciplines.

Keywords: *ANN, Civil Engineering, Professional Practice, Internship, Hydropower Engineering, Internship Effectiveness, Sensitivity Analysis*

Introduction

For graduating engineers, the shift from college to a profession in engineering is extremely crucial and challenging (Baytiyeh & Naja, 2012). A crucial component of university education's practical training is internships, which provide students with invaluable opportunities to connect theory to practice, build their professional skills, and gain knowledge about career planning and workplace organization. Through internship the students have the opportunity to understand about real practices in their professional field. In order to enhance students' learning experiences, industry involvement activities are pedagogically essential in engineering education (Pantzos et al., 2023; Rodrigues, 2004). Collaboration between academia and industry gives students the chance to learn about their career, interact with current industry practices, and acquire the skills and competences necessary to be more productive in the classroom(Herrmann, 2013; Pantzos et al., 2023) .Collaboration between academic institutions and the professional engineering organizations make the transition of students easier (Baytiyeh & Naja, 2012). Beyond the classroom, internships offer new or improved abilities. Students clearly benefit from an engineering internship (Rolland et al., 2023).

The use of Artificial Neural Networks (ANN) has been a topic of interest in various fields. (Baashar, et al., 2022) investigated how Artificial Neural Networks (ANNs) could be utilized to forecast students' academic achievements. While the main focus of this research was predicting academic performance, utilizing ANN to assess the effectiveness of internships for engineering students may offer important insights. Using artificial neural network (ANN) techniques could enable the evaluation of internships' influence on students' educational achievements and career growth. Additionally, (Carberry & McKenna, 2014) investigated student perceptions of modeling in engineering design, emphasizing the significance of explicit modeling components in expanding student comprehension. This method could be used to evaluate how internships improve students' hands-on skills and knowledge in engineering. In general, incorporating technology, faculty assistance, and creative teaching techniques like explicit modeling modules and ANN analysis may

enhance the thorough examination of internship effectiveness for engineering students. Additional exploration in this field may offer important perspectives for enhancing internship programs and improving students' educational experiences within the engineering industry.

This article contributes to the body of knowledge regarding internship programs in engineering education through the perception of engineering interns' students. The objectives of the study are:

1. To find the current internship practices in various universities of Nepal
2. To find out the effectiveness of internship program by assessing the knowledge and skills gained during the internship and
3. To find out the benefits of internship and co-ordination by the university and the internship organization.

Current Internship Practices in Nepal

This study was fulfilled through the study of various published sources like course of structure, curriculum etc. published in formal web pages of universities and other offices of Nepal. Similarly, a short interview was done with related faculty members/personnel to confirm the available data related to the internship program.

According to University Grant Commission (UGC) of Nepal, at present there are eleven central universities, five medical academies and two provincial universities (University Grant Commission, 2024) with total 579,448 number of students. And, according to Nepal Engineering Council at present there are seven universities offering engineering education (Nepal Engineering Council, 2024). They are Tribhuvan University, Kathmandu University, Purwanchal University, Pokhara University, Mid-West University, Far-Western University and Man Mohan Technical University.

Internship Provision in Tribhuvan University

Tribhuvan University, Institute of Engineering (IOE) offers various programs in Bachelor in Engineering like Bachelor in Civil Engineering, Computer Engineering, Electronics, Communication and Information Engineering, Electrical Engineering, Mechanical Engineering, Aerospace Engineering, Chemical Engineering, Architecture, Industrial Engineering, Agricultural Engineering, Automobile Engineering and Geomatics Engineering. Recently the IOE has revised its curriculum and the provision of internship is mandatory in all the programs of Bachelor in Engineering to be effective from 2023 batch students. Before the revision of syllabus, internship was available in departments such as architecture, industry and mechanical engineering only. According to the revised curriculum 2023, civil engineering students have an internship of 12 weeks with 6 credit hour course. Similarly, the provisions for other departments are Computer Engineering-8 weeks, Electronics, Communication and Information Engineering-8 weeks, Electrical Engineering-10 weeks, Mechanical Engineering-8weeks, Aerospace Engineering-8weeks, Chemical Engineering-8 weeks, Architecture-12 weeks, Industrial Engineering-12 weeks, Agricultural Engineering-12 weeks, Automobile Engineering-8weeks and Geomatics Engineering-10 weeks.

Internship Provision in Kathmandu University

Kathmandu University has already implemented internship-based learning in various departments. There is a provision of 9 credit hours internship course in Bachelor in Architecture, 3 credit hours in Civil Engineering, 6 credit hours in chemical science and engineering, 6 credit hours in computer science and engineering, 2 credit hours in electrical and electronics engineering and 3 credit hours in geomatics engineering and 6 credit hours in mechanical engineering (Kathmandu University School of Engineering, 2024).

Internship Provision in Mid-West University

There are currently three departments in Graduate School of Engineering, Mid-West University i.e., Central Department of Civil Engineering, Central Department of Hydropower Engineering and Central Department of Computer Engineering. There is a 3-month internship provision in all the departments and internship program has been effective in all these departments from beginning of these departments (Mid West University Central Library, 2024).

Internship Provision in Man Mohan Technical University

There is a provision of work-based education of 3 credit hours with 12 hours practical and one hour lecture per week in syllabus of Man Mohan Technical University in Department of Civil Engineering and Electrical and Electronics Engineering (Man Mohan Technical University School of Engineering, 2024). Currently the students are in fifth semester so, the internship program will be effective when the students' study in eighth semester.

Internship Provision in other Universities

Other Universities like Pokhara University, Far-West University and Purwanchal University have revised their curriculum or in the process with internship provision in new curriculum. Purwanchal University is offering 10 credit hour professional training practice in Architecture (Khwopa Engineering College, 2024). Pokhara University have introduced 6 credit hour 3 months internship program and it is effective from 2022 intake students. The data of other universities could not be obtained due to ongoing revision process or due to non-availability of updated data in their websites.

From the above study regarding civil engineering, it is found that Kathmandu University and Mid-West University have successfully implemented internship-based learning in from very beginning of their establishments.

Effectiveness and Benefits of Internship program

In order to fulfil the second and the third objectives, the student-focused questionnaires were prepared after critical review of existing literature consisting of general information rating knowledge and skills gained (self-evaluation), assessing the perception of benefits of internship, effectiveness of co-ordination by the university and the department and identifying the major challenges of internship program (Bhattacharjee et al., 2013; Mengistu & Mahesh, 2019; Moore & Plugge, 2008; Naveed et al., 2017).

Methodology

Study Population and Sample Size Selection

The study population of this study were final semester undergraduate students of 2023 from civil and hydropower engineering from Graduate School of Engineering, Mid-West University. There was a total of 80 intern students from both the departments. The participant students had completed the formal internship programs at various offices/industries from July 2023 to September 2023. The civil and hydropower students were selected excluding students from the computer engineering department of Mid-West University due to different nature of these subjects.

According to (Bujang et al., 2018) sample size (ss) for the infinite population is calculated using Cochran's Formula as follows:

$$ss = \frac{Z^2 * p * (1 - p)}{e^2}$$

Where;

ss = Sample size required
Z = Z-Value for the level of confidence
For a 90% confidence level, Z = 1.645
For a 95% confidence level, Z = 1.96
For a 99% confidence level, Z = 2.576
p = Percentage of chances that the questionnaire depicts the issues of implementation in different phases, Expressed as a minimum of 50% or 0.5
q = 1-p
e = Margin of error, Expressed as $\pm 5\%$ or 0.05
The sample size for the finite population is calculated using the correction as follows:

$$New\ ss = \frac{ss * N}{N + ss - 1}$$

Where;

New ss = Sample size for finite/known population
ss = Previous sample size
N = Population size

Table 1: Sample Size Calculation

Parameter	**Respondent**
Population Size (N)	80
Degree of Confidence	95%
Z-Value for level of confidence (Z)	1.96
Population Proportion (p)	0.5
Margin of Error (e)	5%
Sample Size for Infinite Population (ss)	384.16
Sample Size for Finite Population (New ss)	67
Required Sample Size	**67**

Hence 77 samples were taken for the study which is more than required sample size.

Data Analysis

The data collected from the questionnaires survey was analyzed by descriptive and ANN method. Data was analyzed, interpreted and presented using statistical techniques, to provide the information needed. For the easier interpretation of data, they are expressed in percentages and the findings are expressed in the form of charts and tables. In this research, to determine the skills gained by students during the entire internship period and to determine whether the timing of the internship program was appropriate or not, ordinal scales were used for rating.

Table 2: Ordinal Scale for Skills Gained by Students and Timing of the Internship Program

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Scale	1	2	3	4	5

The Relative Importance Index method (RII) was used to determine the skills gained by students during the entire internship period and to determine whether the timing of the internship program was appropriate or not.

$$\text{Relative Importance Index (RII)} = \frac{1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5}{5 * N}$$

Where;

N = the total number of respondents
n_1 = number of respondents who answered "Strongly Disagree"
n_2 = number of respondents who answered "Disagree"
n_3= number of respondents who answered "Neutral"
n_4 = number of respondents who answered "Agree"
n_5 = number of respondents who answered "Strongly Agree"

Artificial Neural Network (ANN) model was used to determine the main factor of internship effectiveness in which the causes were grouped into main 3 factors (Benefits of Internship (BI), Coordination by Industry (CI), and Coordination by University (CU) and was selected as the input

variable for the model and the Internship Effectiveness (IE) which is calculated from the mean response analysis of those main 3 factors was selected as the output of the model.

For the model development, 77 sets of data were collected from 80 intern students of Civil and Hydropower Departments of Mid-West University, Surkhet, Nepal using google from (39 samples) and hard copy questionnaire (38 samples) for determining importance of input variables using Artificial Neural Networks (ANNs). In this research, IBM SPSS version 26 software was selected to develop ANN with multilayer perception model as it is more accurate, powerful and flexible as well as easy to use. As per the requirement of multilayer perception model, among 77 data sets available, 70% of the data which is 54 set is used for training phase and 30 % of the data which is 23 is used for testing purpose. The model was developed using 1 hidden layer. Independent variable importance analysis was selected in Output tab with other setting remaining same. To avoid the possibility of over fitting, a ten-fold cross-validating procedure was done and the sum of square error (SSE) was obtained from which root mean square of errors (RMSE) was calculated (Ooi & Tan, 2016). To measure the strengths of the predictive power of each of the input neurons, sensitivity analysis was conducted to obtain the normalized importance of these neurons by dividing its relative importance to the maximum importance and present it in the form of percentage (Karaca et al., 2019).

Reliability of Data

The questionnaire set was prepared and used for this research and was tested for Reliability Test. The questionnaire consisted of demographic questions with 40 questions based on Likert Scale and some open-ended questions to find the effective way to improve internship program. To measure internal consistency of the questionnaire, the questionnaire was subjected to Cronbach's alpha test. Cronbach's alpha (α) developed by Lee Cronbach in 1951, measure's reliability of multiple questions to see if multiple surveys are reliable. The formula for the standardized Cronbach's alpha is given by,

$$\alpha = \frac{N * \bar{c}}{\bar{v} + (N-1) * \bar{c}}$$

Where N is equal to the number of items, c-bar is the average inter-item covariance among the items and v-bar equals the average variance.

Table 3: Cronbach's Alpha level of reliability

Cronbach's Alpha	**Internal Consistency**
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

Source: (Bujang et al., 2018)

Cronbach's alpha test was carried out in SPSS, for the purpose of analysis; responses from questionnaire sets were fed in SPSS. There were 40 items in the questionnaire of which the reliability of its measurements needs to be measured. The Cronbach's alpha test was run, and overall alpha value found to be 0.919. As per prescribed values and range illustrated by the rule of thumb prescribed in table 3, the consistency of questions within the questionnaire was found to be excellent.

Results and Discussion

Demographic Features

Most of the students were from Karnali Province (71.6%) followed by Lumbini (14.8%) Sudurpaschim 4.9%, Madhesh 3.7 %, Gandaki 2.4% and Bagmati 2.4 % of Nepal. Demographic

features show that 89% were male and 11 % female. 84.6 % were between 20-25 years age and 15.4 % above 25 years age. 53.4 % respondents were placed at different offices for internship by the university and remaining was self-placed. Regarding the nature of the internship 43.6 % were site based, 43.6 % were site and office based both and remaining 12.8 % were only office based.

Skills Gained by Students during Internship

The RII was calculated for the skills gained by students during their internship. The respondents' view towards the skills gained during internship has been tabulated in table 4.

Table 4: Relative Importance Index for the Skills Gained by Students during Internship

Skills Gained	**RII**	**Rank**
Occupational Safety Health and Environment Management	0.706	1
Project Proposal Writing and Appraisal	0.642	2
Communication and Reporting	0.626	3
Procurement/Bidding	0.592	4
Planning and Scheduling	0.574	5
Use of software for Design and Drawing	0.564	6
Construction Methods and Technology	0.561	7
Progress Report Writing	0.556	8
Surveying and Layout	0.538	9
Monitoring and Supervision	0.470	10
Estimation	0.444	11
Construction Billing Procedures	0.416	12

Table 4 shows the results of the relative importance index that were conducted for the skills gained by students during internship. The result shows that the skill gained during internship in Occupational Safety Health and Environment Management was ranked number 1 followed by Project Proposal Writing & Appraisal, and Communication & Reporting respectively. Other skills like Construction Billing Procedures, Estimation and Monitoring & Supervision are considered as the skills not gained as their relative importance index is below 0.5.

Timing of the Internship Program

RII was calculated to determine whether the timing of the internship program was appropriate or not. The RII value and its corresponding rank given by the respondents have been presented in the table below.

Table 5: Relative Importance Index for the Timing of the Internship Program

Timing of Internship Program	**RII**	**Rank**
Daily working hours are appropriate	0.738	1
The period of three months is sufficient	0.618	2
The time for implementation of the internship was suitable	0.478	3

Table 5 shows the results of the relative importance index that were conducted for timing of the internship program. The result shows that daily working hours are appropriate and the period of three

months is sufficient for the internship. But the time for implementation of the internship was found not suitable as their relative importance index is below 0.5.

Benefits of Internship (BI)

The questionnaire included 9 benefits of internship program which are: My internship provides me with an opportunity to gain real-world knowledge of my profession (BI1), Internships reinforced my classroom learning (BI2), I gained a deeper understanding of the profession through my participation in an internship program (BI3), It assisted me in choosing a career path as a graduate in the specializations of my profession (i.e., I was able to determine my area of interest) (BI4), I gained industry experience through my internship (i.e., my network broadened) (BI5), The internship experience will improve my chances of getting a job after graduation (BI6), Through my internship, I felt I was able to contribute the knowledge I gained in my classes to my company's goals (BI7), My internship experience helped me perform better in my classes (BI8), and A professional experience was gained through this internship, which met my expectations (BI9). Sensitivity analysis using ANN for each of the 9 benefits of internship program was determined and the benefits were ranked accordingly.

Table 6: Sensitivity Analysis for Benefits of Internship

Neural Network (NN)	**BI1**	**BI2**	**BI3**	**BI4**	**BI5**	**BI6**	**BI7**	**BI8**	**BI9**
NN (i)	0.46	0.88	0.57	0.91	0.94	1.00	0.92	0.87	0.95
NN (ii)	0.64	0.89	0.84	1.00	0.81	0.85	0.73	0.83	0.95
NN (iii)	0.48	0.66	0.64	0.74	0.74	0.84	0.60	1.00	0.67
NN (iv)	0.42	0.90	0.82	0.90	0.69	0.96	0.87	1.00	0.94
NN (v)	0.74	0.85	0.87	0.94	0.86	0.92	0.86	1.00	0.95
NN (vi)	0.73	0.90	0.68	0.96	0.96	1.00	0.70	0.75	0.93
NN (vii)	0.56	0.81	0.73	0.79	0.87	0.98	0.77	1.00	0.77
NN (viii)	0.60	0.62	0.37	0.66	0.76	1.00	0.68	0.69	0.82
NN (ix)	0.69	0.86	0.78	1.00	0.92	0.90	0.83	0.99	0.83
NN (x)	0.35	0.69	0.65	0.74	0.63	1.00	0.62	0.94	0.75
Average Importance	0.57	0.80	0.69	0.86	0.82	0.94	0.76	0.91	0.86
Normalized Importance	60%	85%	73%	92%	87%	100%	80%	96%	91%
Rank	9	6	8	3	5	1	7	2	4

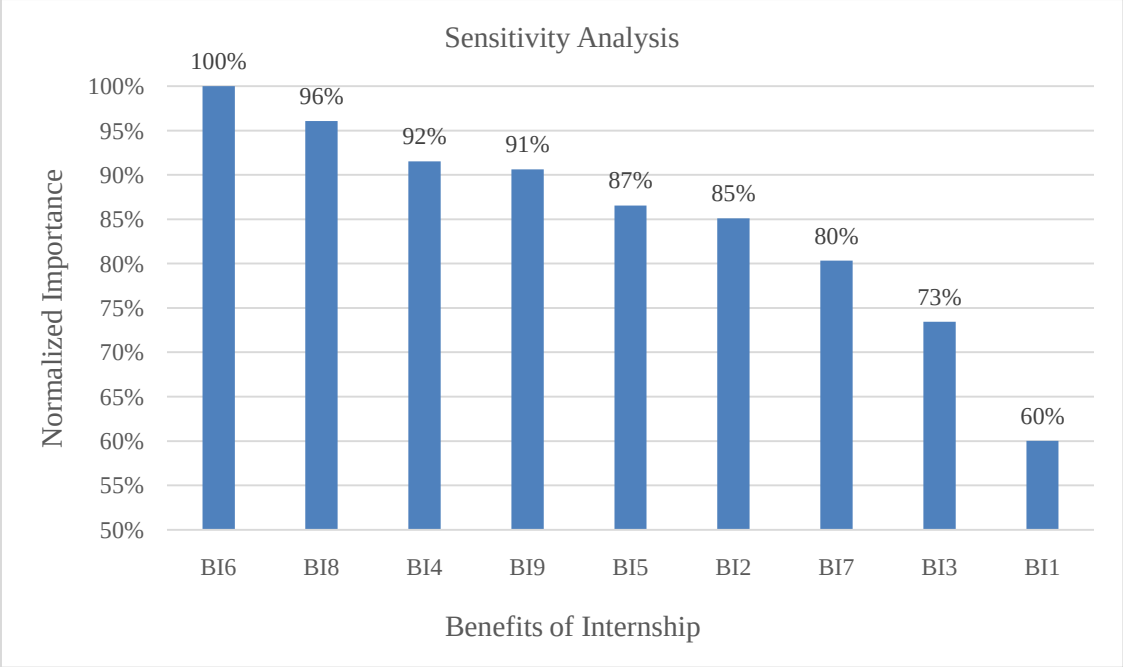

Figure 1: Sensitivity Analysis for Benefits of Internship

Table 6 and Figure 1 shows that the internship experience will improve the chances of getting a job after graduation (BI6), internship experience helped to perform better in the classes (BI8), Internship assisted students in choosing a career path as a graduate in the specializations of the profession (i.e., Students were able to determine the area of interest) (BI4), and a professional experience was gained through the internship, which met the student's expectations (BI9) respectively were the most ranked benefits that students gained from internship. Similarly, internship provides an opportunity to gain real-world knowledge of the profession (BI1), and deeper understanding of the profession through participation in an internship program (BI3) was the least ranked benefits that students gained from internship.

Coordination by Industry (CI)

The questionnaire included 11 factors of Coordination by Industry (CI) which are: The organizations provide orientation on the complete workplace, organizational rules, and processes (CI1), The organizations assign supervisors to students (CI2), The staff at the organization I was staying at provided me with in-depth answers to all of my inquiries throughout my internship (CI3), The organization provided the opportunity to work in all relevant departments of the organization (CI4), I was assigned to work independently (CI5), Evaluations by supervisors from the hosting company are conducted responsibly (CI6), Organizations are willing to take intern students (they don't consider intern students as a burden) (CI7), Organizations understand that they are responsible for producing qualified manpower (CI8), The site was suitable for my study/career goals (CI9), The site supervisor was well-prepared to cover specific areas of the workload (CI10), and I would recommend this site supervisor for future internships (CI11). Sensitivity analysis using ANN for each of the 11 factors of coordination by industry was determined and the factors were ranked accordingly.

Table 7: Sensitivity Analysis for Coordination by Industry

Neural Network (NN)	**CI1**	**CI2**	**CI3**	**CI4**	**CI5**	**CI6**	**CI7**	**CI8**	**CI9**	**CI10**	**CI11**
NN (i)	0.79	1.00	0.77	0.84	0.63	0.77	0.63	0.50	0.72	0.80	0.67
NN (ii)	0.87	0.95	0.87	0.96	0.99	0.81	0.94	0.58	0.82	1.00	0.80
NN (iii)	0.87	1.00	0.87	0.91	0.78	0.69	0.92	0.58	0.85	0.60	0.86
NN (iv)	0.88	0.84	0.83	0.59	1.00	0.86	0.85	0.56	0.89	0.94	0.87
NN (v)	0.96	0.93	0.87	0.99	0.91	0.73	0.83	0.68	1.00	0.77	0.90
NN (vi)	0.60	0.71	0.30	1.00	0.26	0.55	0.77	0.62	0.54	0.69	0.55
NN (vii)	0.71	0.91	0.76	0.95	0.51	0.53	0.66	0.57	1.00	0.54	0.96
NN (viii)	0.52	0.56	0.99	0.82	0.54	1.00	0.59	0.51	0.54	0.82	0.49
NN (ix)	0.52	1.00	0.78	0.57	0.60	0.52	0.59	0.43	0.36	0.72	0.86
NN (x)	0.61	0.80	0.96	0.91	0.71	0.49	0.83	0.59	0.84	1.00	0.92
Average Importance	0.73	0.87	0.80	0.85	0.69	0.70	0.76	0.56	0.76	0.79	0.79
Normalized Importance	84%	100 %	92%	98 %	80 %	80 %	87 %	65 %	87 %	91%	90%
Rank	8	1	3	2	10	9	6	11	7	4	5

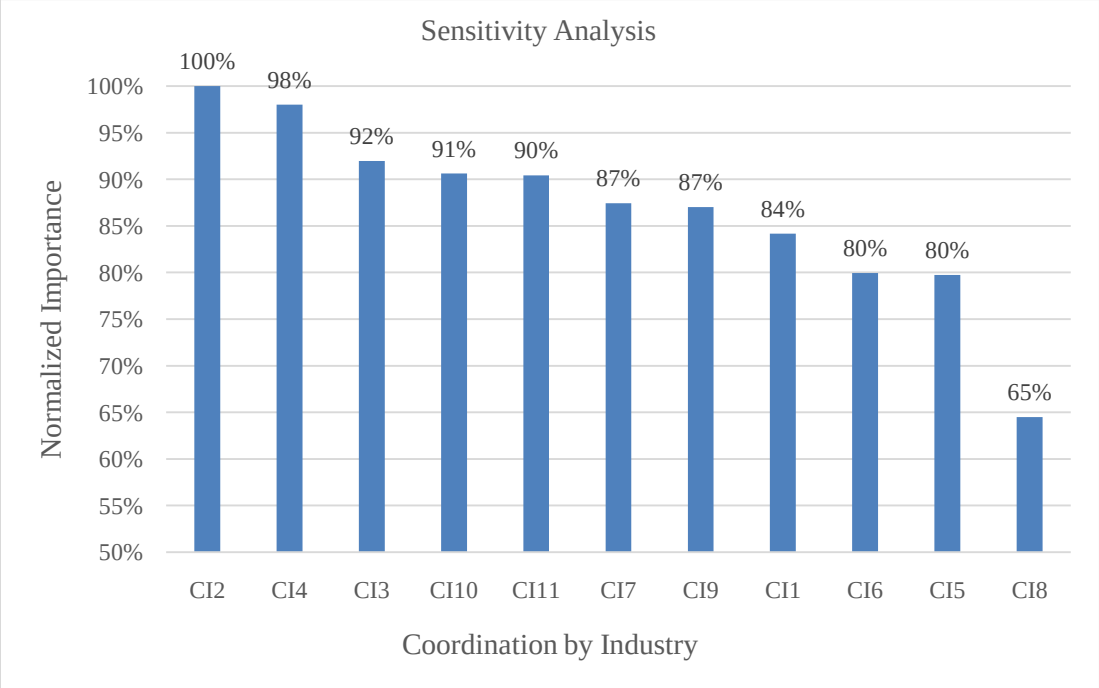

Figure 2: Sensitivity Analysis for Coordination by Industry

Table 7 and Figure 2 shows that the organizations assign supervisors to students (CI2), the organization provided the opportunity to work in all relevant departments of the organization (CI4), the staff at the organization provided in-depth answers to all of the inquiries of students throughout their internship (CI3), the site supervisor was well-prepared to cover specific areas of the workload (CI10), and students recommend their site supervisor for future internships (CI11) respectively were the most ranked coordination factor that students gained from internship office. Similarly,

organizations understand that they are responsible for producing qualified manpower (CI8) was the least ranked coordination factor that students gained from internship office.

Coordination by University (CU)

The questionnaire included 5 factors of Coordination by University (CU) which are: The department offers students the chance to join organizations where they can gain useful experience (CU1), The assigned supervisor from the department visits the students regularly (CU2), The supervisor from the department motivates students to identify real-world issues for their final-year project or thesis (CU3), The department receives feedback from students to improve the internship program (CU4), and Report evaluation is done responsibly (i.e., it reflects the actual performance of the students) (CU5). Sensitivity analysis using ANN for each of the 5 factors of coordination by university was determined and the factors were ranked accordingly.

Table 8: Sensitivity Analysis for Coordination by University

Neural Network (NN)	**CU1**	**CU2**	**CU3**	**CU4**	**CU5**
NN (i)	0.95	1.00	0.75	0.94	0.81
NN (ii)	0.97	1.00	0.94	0.95	0.71
NN (iii)	1.00	0.98	0.98	1.00	0.73
NN (iv)	0.96	1.00	0.97	0.98	0.70
NN (v)	0.98	0.97	0.97	1.00	0.74
NN (vi)	0.99	0.99	0.97	1.00	0.73
NN (vii)	0.95	0.93	0.96	1.00	0.73
NN (viii)	0.81	1.00	0.70	0.69	0.76
NN (ix)	0.99	0.95	0.98	1.00	0.75
NN (x)	0.75	0.98	1.00	1.00	0.74
Average Importance	0.93	0.98	0.92	0.96	0.74
Normalized Importance	95%	100%	94%	97%	75%
Rank	3	1	4	2	5

Table 8 and Figure 3 show that the assigned supervisor from the department visits the students regularly (CU2), the department receives feedback from students to improve the internship program (CU4), the department offers students the chance to join organizations where they can gain useful experience (CU1), and the supervisor from the department motivates students to identify real-world issues for their final-year project or thesis (CU3) respectively were the most ranked coordination factor that students gained from university. Similarly, report evaluation is done responsibly (i.e., it reflects the actual performance of the students) (CU5) was the least ranked coordination factor that students gained from university.

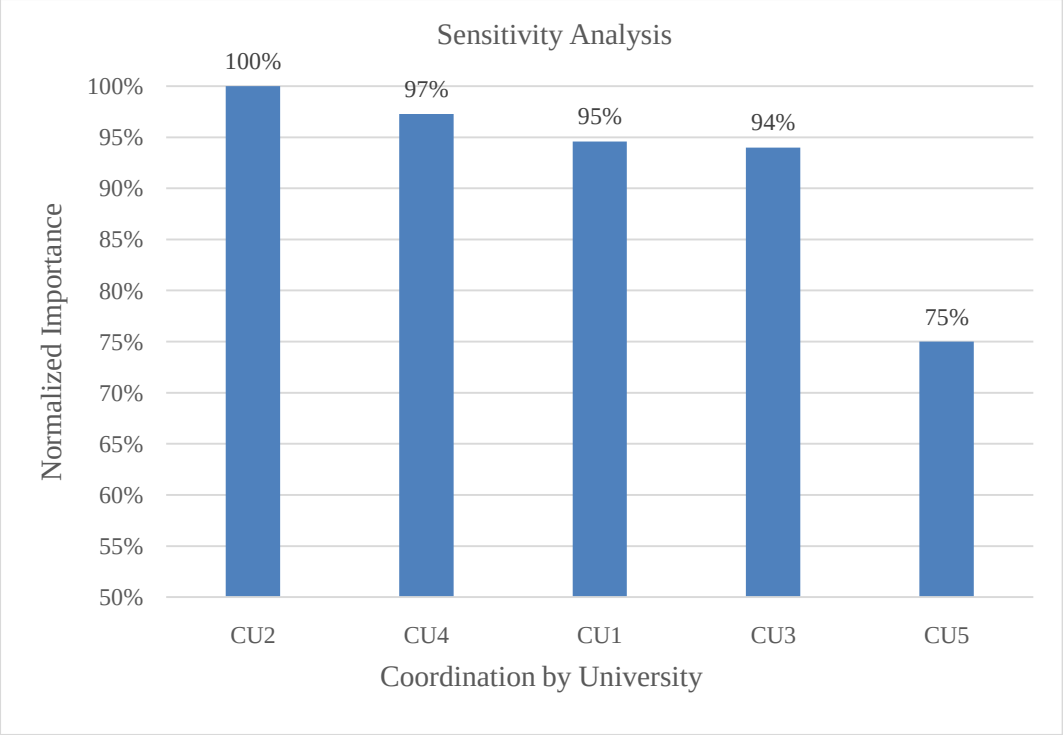

Figure 3: Sensitivity Analysis for Coordination by University

Artificial Neural Network (ANN) Analysis for Internship Effectiveness

The ANN analysis was implemented using IBM SPSS neural network module. To analyze the internship effectiveness the input variables were dived into BI, CI and CU as shown in table 10. 70 % of the samples for the training procedure and the remaining 30% of the samples were used for the testing procedure. A single hidden layer was used in model development and all other parameters remained the same.

Table 9: Case Processing Summary

		N	Percent
Sample	Training	60	77.9%
	Testing	17	22.1%
Valid		77	100.0%
Excluded		0	
Total		77	

Table 10: Network Information

Input Layer	Covariates	1	BI (Benefits of Internship)
		2	CI (Coordination by Industry)
		3	CU (Coordination by University)
	Number of Units[a]		3
	Rescaling Method for Covariates		Standardized
Hidden Layer(s)	Number of Hidden Layers		1

	Number of Units in Hidden Layer 1[a]		1
	Activation Function		Hyperbolic tangent
Output Layer	Dependent Variables	1	Internship Effectiveness
	Number of Units		1
	Rescaling Method for Scale Dependents		Standardized
	Activation Function		Identity
	Error Function		Sum of Squares
a. Excluding the bias unit			

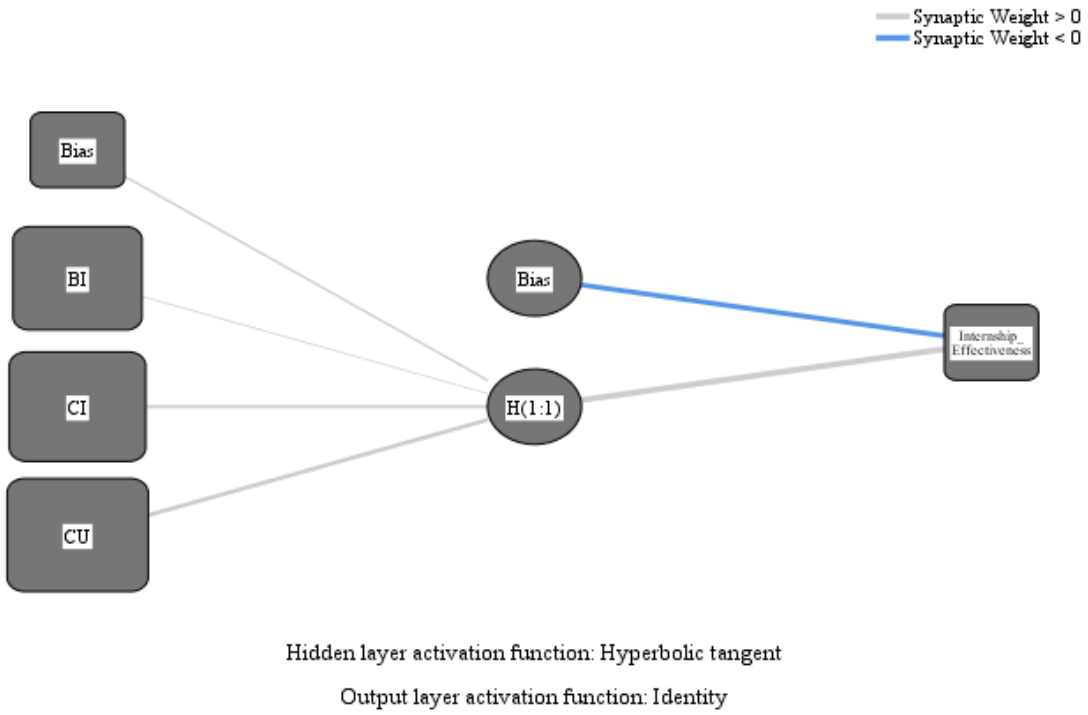

Figure 4: Artificial Neural Network Diagram

Root Mean Square Error (RMSE) Values

To avoid the possibility of over fitting, a ten-fold cross-validating procedure was done and the sum of square error (SSE) was obtained from which root mean square of errors (RMSE) was calculated. Table 28 shows that the average RMSE values of the training and testing procedures are relatively small at 0.028 and 0.031, respectively. Therefore, we confirm that there is an excellent model fit.

Table 11: Root Mean Square Error (RMSE) Values

Training			Testing			
N	SSE	RMSE	N	SSE	RMSE	Total Samples
60	0.029	0.022	17	0.010	0.024	77
49	0.050	0.032	28	0.021	0.027	77

58	0.040	0.026	19	0.008	0.021	77
55	0.035	0.025	22	0.003	0.012	77
57	0.131	0.048	20	0.040	0.045	77
47	0.036	0.028	30	0.075	0.050	77
48	0.029	0.025	29	0.015	0.023	77
55	0.035	0.025	22	0.010	0.021	77
50	0.029	0.024	27	0.137	0.071	77
52	0.032	0.025	25	0.008	0.018	77
Mean	0.045	0.028	Mean	0.033	0.031	
Standard Deviation	0.031	0.007	Standard Deviation	0.043	0.018	

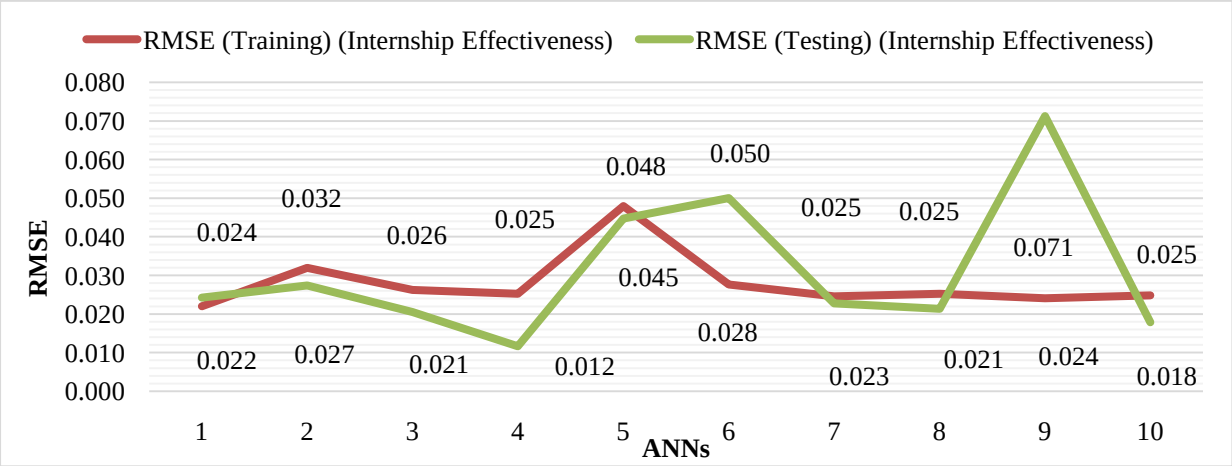

Figure 5: RMSE (Training) Vs RMSE (Testing)

Sensitivity Analysis

The IBM SPSS's Neural Networks analysis provides a useful tool to identify sensitive input variables. The sensitivity analysis was done by calculating the normalized importance of each batch testing on the bilateral perception model after fixing the training model as 70% and testing model as 30%. The network output was computed for 10 times repeating each input same. Finally, a report summarizing the variation of output with respect to the variation of each input was generated.

Table 12: Sensitivity Analysis for Internship Effectiveness

Neural Network (NN)	**Benefit of Internship (BI)**	**Coordination by Industry (CI)**	**Coordination by University (CU)**
NN (i)	0.871	0.951	1.000
NN (ii)	0.871	0.812	1.000
NN (iii)	0.875	0.958	1.000
NN (iv)	0.868	0.936	1.000
NN (v)	0.817	1.000	0.881
NN (vi)	0.836	1.000	0.832

NN (vii)	0.877	0.957	1.000
NN (viii)	0.874	1.000	0.994
NN (ix)	0.854	0.948	1.000
NN (x)	0.864	0.793	1.000
Average Importance	0.861	0.936	0.971
Normalized Importance	89%	96%	100%
Rank	3	2	1

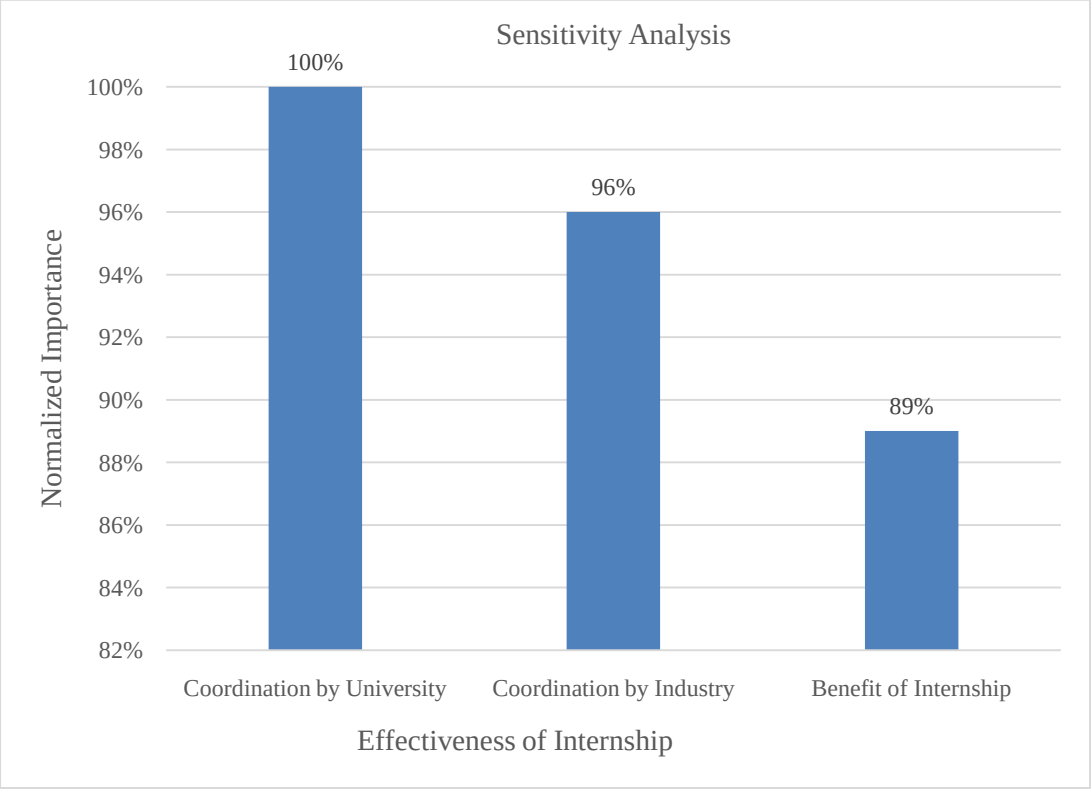

Figure 6: Sensitivity Analysis for Internship Effectiveness

Table 12 and Figure 6 shows that Coordination by University (CU) has the most influence on internship effectiveness followed by Coordination by Industry (CI). Similarly, Benefits of Internship (BI) have the least influence on internship effectiveness.

Enhancements deemed necessary to optimize the effectiveness of the internship program

Students were presented with an open-ended question aimed at enhancing the effectiveness of the internship program. Feedback revealed that the timing of the internship was unsuitable due to the absence of ongoing construction activities, particularly during Nepal's monsoon season and the commencement of the fiscal year. Enhancing coordination between the university and industry stakeholders is imperative to address this issue. Students expressed a desire for greater autonomy in selecting industries aligned with their interests. They also emphasized the importance of regular mentorship visits from university staff during the internship period. Orientation programs and training sessions prior to placement were deemed essential for optimal preparedness. Furthermore, continuous inspection and monitoring by both university and industry representatives were highlighted as crucial elements for enhancing internship effectiveness.

Conclusion

This study aims to find the effectiveness of internship program in teaching learning activities for undergraduate students in Graduate School of Engineering, Mid-West University. At first, current internship provision in various universities of Nepal was studied through the curriculum of those universities. The study found that most of the universities of Nepal have revised their curriculum and some are in the process of revision. This signifies that the universities have realized the importance of internship and learning by doing in teaching learning activities.

Effective coordination between universities and industry holds the potential to bolster labor market-driven initiatives within the construction engineering sector. Such collaboration can bridge the gap in acquiring practical knowledge and skills essential for enhancing the construction industry. The findings of this study offer valuable insights for universities to refine internship programs, informing curriculum revisions and the development of comprehensive internship implementation guidelines.

Acknowledgement

Authors would like to acknowledge all the respondents who took part in this data collection. Also, authors would like to thank all the faculty members from Mid-West University and other universities and all friends who directly and indirectly supported during the research.

Declaration of Interest Statement

The authors would like to declare that there are no conflicts of interest in this study.

References

Baashar, Y., Alkawsi, G., Mustafa, A., Alkahtani, A. A., Alsariera, Y. A., Ali, A. Q., Hashim, W., & Tiong, S. K. (2022). Toward predicting student's academic performance using artificial neural networks (ANNs). *Applied Sciences*, 12(3), 1289. https://doi.org/10.3390/app12031289

Baytiyeh, H., & Naja, M. (2012). Identifying the challenging factors in the transition from colleges of engineering to employment. *European Journal of Engineering Education*, 37(1), 3–14. https://doi.org/10.1080/03043797.2011.644761

Bhattacharjee, S., Ghosh, S., Young-Corbett, D. E., & Fiori, C. M. (2013). Comparison of industry expectations and student perceptions of knowledge and skills required for construction career success. *International Journal of Construction Education and Research*, 9(1), 19–38. https://doi.org/10.1080/15578771.2011.647248

Bujang, M. A., Omar, E. D., & Baharum, N. A. (2018). A review on sample size determination for Cronbach's alpha test: A simple guide for researchers. *Malaysian Journal of Medical Sciences*, 25(6), 85–99. https://doi.org/10.21315/mjms2018.25.6.9

Carberry, A. R., & McKenna, A. F. (2014). Exploring student conceptions of modeling and modeling uses in engineering design. *Journal of Engineering Education*, 103(1), 77–91. https://doi.org/10.1002/jee.20033

Herrmann, K. J. (2013). The impact of cooperative learning on student engagement: Results from an intervention. *Active Learning in Higher Education*, 14(3), 175–187. https://doi.org/10.1177/1469787413498035

Institute of Engineering Tribhuvan University. (2024). Retrieved from https://ioe.tu.edu.np/pages/undergraduate-be-124

Karaca, Y., Moonis, M., Zhang, Y.-D., & Gezgez, C. (2019). Mobile cloud computing-based stroke healthcare system. *International Journal of Information Management*, 45, 250–261. https://doi.org/10.1016/j.ijinfomgt.2018.09.012

Kathmandu University School of Engineering. (2024). Retrieved from https://soe.ku.edu.np/departments-list

Khwopa Engineering College. (2024). Retrieved from https://www.khec.edu.np/: https://www.khec.edu.np/course/view/?dept_id=1.html

Man Mohan Technical University School of Engineering. (2024). Retrieved from https://soe.mtu.edu.np/: https://soe.mtu.edu.np/program_detail/bachelor-in-civil-engineering

Mengistu, D. G., & Mahesh, G. (2019). Construction education in Ethiopia: Knowledge and skills level attained and effectiveness of internship program. *Higher Education, Skills and Work-Based Learning*, 9(3), 510–524. https://doi.org/10.1108/HESWBL-06-2018-0062

Mid-West University Central Library. (2024). Retrieved from http://64.227.160.137:8080/handle/123456789/130

Moore, J. D., & Plugge, P. W. (2008). Perceptions and expectations: Implications for construction management internships. *International Journal of Construction Education and Research*, 4(2), 82–96. https://doi.org/10.1080/15578770802229433

Naveed, M. H., Thaheem, M. J., Khurshid, M. B., & Farooqui, R. U. H. (2017). Performance assessment of construction engineering and management (CEM) degree program in developing countries: Case of Pakistan. *International Journal of Construction Education and Research*, 13(1), 3–23. https://doi.org/10.1080/15578771.2016.1183732

Nepal Engineering Council. (2024). Retrieved from https://nec.gov.np/university/country_detail

Ooi, K.B., & Tan, G. W.H. (2016). Mobile technology acceptance model: An investigation using mobile users to explore smartphone credit card. *Expert Systems with Applications*, 59, 33–46. https://doi.org/10.1016/j.eswa.2016.04.015

Pantzos, P., Gumaelius, L., Buckley, J., & Pears, A. (2023). Engineering students' perceptions of the role of work industry-related activities on their motivation for studying and learning in higher education. *European Journal of Engineering Education*, 48(1), 91–109. https://doi.org/10.1080/03043797.2022.2093167

Rodrigues, C. A. (2004). The importance level of ten teaching/learning techniques as rated by university business students and instructors. *Journal of Management Development*, 23(2), 169–182. https://doi.org/10.1108/02621710410517256

Rolland, S. A., Jones, J. W., & Bunting, G. (2023). The impact of a year in industry on academic outcomes in higher education (engineering). *European Journal of Engineering Education*, 48(4), 747–760. https://doi.org/10.1080/03043797.2023.2194244

University Grant Commission Nepal. (2024). Retrieved from https://www.ugcnepal.edu.np/