Civil Engineering Students' Perception on the Use of Mathematics in the Job

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Students' Feelings towards Application of Mathematics

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Abstract

Use of Mathematics is common in civil Engineering job. The use of mathematics in civil engineering are influenced by different factors like attitude of learners and teachers, learning environment, and realization of mathematics as a part of the job. It is the need to identify how Civil Engineering students feel importance of mathematics in the job. Thus, the objective of the study was to investigate the perception of Civil Engineering students on the use of mathematics in Civil Engineering job taking into consideration of realization of mathematics, mathematical background and engineering as a career, attitude of students and teacher, and learning environment as input (independent). The sample for the study consists of 228 students of civil engineering purposefully selected from the colleges in Pokhara valley. A six –point Likert –scale survey instrument having 29 structured questions was used and administered. The result of the study was obtained by analyzing the data through descriptive tools of statistics, CV, correlation, and regression analysis. Descriptive, ANOVA, CV and correlation revealed that most of the students were strongly agree with the statement that mathematics is the foundation of engineering. It also found that the use of mathematics

in civil engineering job is significantly correlated with attitude of learners and teachers, learning condition, realization of mathematics, and background of mathematics and engineers as a career. Though the study was focused on the students of civil engineering at Pokhara valley, such study should be expanded in other places to validate and generalize these results.

Keywords: *civil engineering, students, perception, application, mathematics*

Introduction

Civil engineering is one of the pivotal parts of engineering. Civil engineering is applied in buildings, creating industrial plants, and transportation infrastructure like roads, bridges, etc. It applies mathematical principles and physical science to design and develop new infrastructure. Various types of forces such as wind force, seismic force, and fluid force etc. are used to design multistory buildings, bridges and roads (Saini, 2022). The real world –problems using the application of mathematics related with trigonometry, geometry, linear algebra, differential equations, calculus are studied in civil engineering. Engineers related to civil apply trigonometric concepts to calculate elevation and angles while constructing a bridge, structure and to deal with land elevation as well as sides and angles of construction. The analysis of different types of shapes and the relationship among them are studied in geometry. Civil engineers could design, develop, and assemble the different appearance to build buildings, bridges, tunnels, dams, and highway systems etc. with the help of geometry. Calculus is applicable to compute heat loss or heat gain in buildings, forces in complex structural configuration, and structural analysis in seismic design. The construction and the design solutions in architecture were mathematically justified. Civil Engineers had to know the theoretical fundamentals of calculation to solve applied problems using the method of mathematical measurements and to build mathematical models (Sergeeva, 2020) Therefore, strong foundations of mathematics are required for engineering work. Mathematics is the basic need of civil engineering activities.

The civil engineering student's feeling on the application of mathematics for effective engineers job can be one of the important parts of obtaining engineering education successfully. The positive thinking of the students could support the

Engineers to make their job reliable and effective. On the other way, Application of Mathematics and mathematical tools are common in the career of Civil Engineering. However, there is debate among the Civil Engineering students toward the need and use of mathematics in making the Engineering job effective. Thus, there is a need to investigate on how the students of Civil Engineering perceive the use of mathematics in real work life situation of the engineering job. For this, the study aims to analyze students' perception about the importance of mathematics in Engineering job and the factors associated with this. Specifically, the objective of the study was to explore the perception of Civil Engineering students towards the use of Mathematics in making the Civil Engineering job effective.

Literature Review

The mathematics skill of trigonometry, calculus, algebra, and geometry was applied to analyze fluid mechanics, rigid mechanics, and solid mechanics. Structure analysis and particle study in different substances needs mathematical tools to analyze and calculate different problems. Mathematics is the foundation of civil engineering (Jain, 2017). Mathematics is the foundation of different engineering branches. The knowledge of mathematics supported the design thinking to solve the engineering design work. Mathematics was the baseline to design behavior in engineering task (Tolbert & Cardella, 2017). Mathematical concept and knowledge required to design different engineering work such as like buildings, bridges, canals, dams, sewerage systems, pipelines, airports and railways of different sector of civil engineering. The curriculum of mathematics of engineering had to be redesigned for effective teaching and learning activities to attract the learners by enhancing their motivation and confidence level of mathematics. Course content of mathematics should support the applied disciplines and engineering work. Most of the respondents provided positive response towards mathematic motivated STEAM education for quality and applicable education (Kim, et al., 2019). Mathematical mind learners could achieve quality education in technical and non-technical education.

The immediate feedback system was required for guidance during learner's activities and their evaluation to make them high –quality learning in mathematics. The faculty members have to select appropriate context and knowledge tool to emphasis the learners. Further an affective favorable classroom. Environment and dealing students problem individually were needed for mathematical improvement

(Koskinen & Pitkäniemi, 2022). Immediate feedback system on students' activities and their evaluation, suitable learning tools and context for subject matters, individual students' dealing system, and an effective favorable learning atmosphere are required for quality education. The qualifications in skills and knowledge of engineering learners are related to the attitude of students towards their study. The attitude of learners played vital role for quality education in higher-level. The student –centered learning activities of engineering students encourage the learners' attitude and motivation factors towards their study but gender factor does not play any role achieve active participation and effective learning (Mohamad et al.,2020). The students centered learning activities made the students positive attitude towards study and supported them to meet the objective of curriculum.

Learning self-efficacy, learning realization of learners was significantly correlated with the teacher's emotional support. The learning development was affected by learners' approach. Learners of different disciplines in Chinese Universities have required mathematical knowledge for their dynamic improvement. Mathematical analysis is required for different research activities in all subjects. The project-based learning supported the students for their bottomless learning methods and their understanding of cooperation in their teamwork (Du et al., 2019). The project-based learning (PBL) encouraged the learners to be positive for their learning.

The perception of students of first semester of engineering in a Chilean University had a more preferable perception of mathematics and physics than the awareness of third semester learners. The significance of mathematics was more than the application of physics in engineering (Zavala & Dominguez, 2016). The applied mathematical skills play a vital role for different engineering work and different courses of engineering. The concept of mathematics in engineering courses was a central problem. It was a fundamental concern in practice and design for new engineering students (Harris et al. 2015). Mathematical knowledge was a basic need for newcomers of engineering students. The behaviors of teachers could influence learners to learn mathematics (Ukobizaba. et al., 2020). If teachers motivated, guided, encouraged, and inspired more to their students they could achieve good marks in mathematics.

The curriculum of Engineering Mathematics had to redesign the course content to raise learners' confidence and motivation for effective teaching learning activities (Giannoulas & Stampoltzis, 2021). The content of each course of

mathematics should be applied in engineering work. Science, Technology, Engineering, Art and Mathematics (STEAM) are demanded education at present. Math –concentrated STEAM education is required for learners. Teachers realized that convergence in STEAM education should be in integrated approach, convergent approach, and further to new courses. They showed positive vibes towards math– oriented STEAM education for effective teaching learning activities of students. Teachers could not teach mathematical application in other disciplines due to deficiency of teacher skill and scarcity of time (Asli,et.al, 2021).Most of the teachers could not connect mathematical problems in the civil engineering course. Mathematics teachers have to be interested to learn applied parts of mathematics in different engineering programs. They should be updated and exposed in different applied fields in different declines.

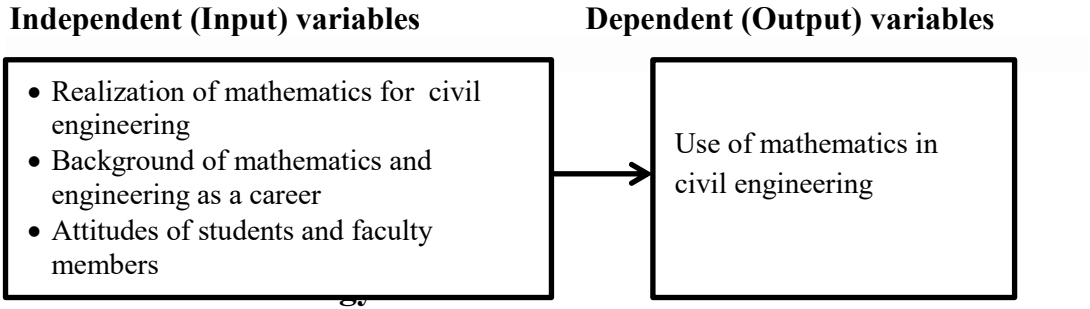
Civil engineers in the kingdom of Bahrain in Filipino were demanded in the market on their profile on the basis of years of experience, taking part in seminars or training, and educational achievement (Nebrida,2021). The findings of this study were contradictory statements that most respondents of civil engineering partially agreed that engineers were demanded in the market with good salary. In the context of Nepal, engineers were not updated timely to increase their profile on the basis of their outcome preformation and the government could not treat engineers fairly so this happened. It demotivates the students of civil engineering toward their education for being effective engineers in future. This study also concluded that most learners partially agreed that new learners are interested in enrolling in an engineering program.

The literature review of articles implies that realization of mathematics, mathematical background and engineering as careers, attitude of learners and tutors, and learning atmosphere influence the use of mathematics in civil engineering for effective engineering. The relation and impact of realization of mathematics, attitude of students and teachers, learning surrounding and engineering as a careers and background of mathematics with application of mathematics in civil engineering for effective engineering has not been done at Pokhara valley and Nepal also. The researcher is interested in carrying out the relation of each variable and influence of dependent variables on the basis of independent variables. It is the research gap of this study.

Conceptual Framework

The conceptual framework of relationship of independent and independent variables has been the Figure 1.

Figure 1
Conceptual Framework



This study applied positivism as a quantitative research method with descriptive and analytical research design. This study was carried out to identify the relationship between the independent (input) variables and output (dependent) variable exhibited in the Figure 1 to achieve the objective of exploring Civil Engineering students' perception on the application of Mathematics in the job. In this regard, a structured survey questionnaire consisting of 8 questions related to respondents' demographic variables and 29 questions about the independent and dependent variables was developed and administered to the sample respondent. Out of 29 questions, five were related to realization of mathematics for civil engineering, 6 for background mathematics and engineering as a career, 5 for the attitude of students and faculty members, 6 for learning environment, and 7 for use of mathematics in civil engineering. The researcher prepared questionnaires in English languages by using 6- point Likert scales such as, strongly disagree-1, disagree-2, partially disagree-3, partially agree-4, agree-5 and strongly agree-6.

The target population of 228 sample respondents who were selected purposefully was the students of Civil Engineering and civil and rural Engineering of sixth, seventh, and eighth semester studying in the Bachelor level of three colleges located in Pokhara valley. The colleges were School of Engineering (SOE) at Khudi- a constituent campus of Pokhara University, Western Region Campus (WRC) at Lamachaur - a constituent Campus of Tribhuvan University and Pokhara

Engineering College (PEC) at Shreejana Chok-an affiliated college of Pokhara University.

Among the sample respondents 93(43 students of Eight Semester and 36 of six semester of Civil Engineering and 14 students of eight semester of Civil and Rural Engineering program), 78(seven Semester students of Civil Engineering), and 57(students of Eight Semester of Civil Engineering) respondents were from the respective colleges. For the collection of data, a prior permission was obtained from the administration of the concerned college. The researcher distributed 240 structured questionnaires among them 235 submitted their responses but the responses of seven respondents was rejected due to irrational response. Altogether, 182 boys and 46 girls had constituted the active respondents for the study. Mean score, standard deviation, coefficient of variation, correlation, and regression analysis, and regression analysis were used to analyze the data with the help of SPSS version 20

Result and Discussion

The survey data were examined to confirm their legitimacy and credibility. Internal consistency of the input variables and output variable of the learners' perceptions shown in the Table 1 confirms the reliability of the data collection instrument (questionnaire) adopted in the study.

Table 1
Reliability Analysis

S. N	Constructs	No. of items	α-value
1	Realization of mathematics for civil engineering	5	0.770
2	Mathematical background and engineering as a career	6	0.745
3	Attitude of students and faculty members	5	0.733
4	Learning Environment	6	0.745
5	Use of mathematics in civil engineering	7	0.813
	Total items	29	

Table 1 displays that the trustworthiness of the constructs is the uppermost at 0.813 and the lowermost at 0. 733. The α-value of each construct is more than 0.7. Therefore, the paradigms of the learning are highly consistent. The reliability of the total construct is 0.895.

Demographic Variables

Table 2
Demographic Variable

Demographic	Variables	Frequency	Percentage
Sex	Male	182	79.8
	Female	46	20.2
Address	Village	36	15.8
	Municipality	78	34.2
	Sub Metropolitan	13	5.7
	Metropolitan	101	44.3
Associated University	Tribhuvan University	78	34.2
	Pokhara University	150	65.8
Programs	Civil Engineering	214	93.9
	Civil and Rural Engineering	14	6.1
Campus	SOE, Pokhara-30	94	41.2
	WRC, Pokhara 16	78	34.2
	PEC, Pokhara 08	56	24.6
Semester	Eighth	114	50.0
	Seventh	78	34.2
	Sixth	36	15.8
Occupation of parent's	Agriculture	51	22.4
	Business	37	16.2
	Teacher	48	21.1
	job holder	31	13.6
	Aboard	21	9.2
	Others	40	17.5
Need extra support for mathematics	Yes	148	64.9
	No	80	35.1

n=228

Among the 228 students of civil engineering involved study, 182 students were male and 46 females. The number of male respondents was early four times more than the number of females. The respondents coming from village were 36 and 78 belonged to municipality, 13 in sub-metropolitan, and 101 in metropolitan. Out of the total respondents, 150 students' area of study was civil engineering in

Pokhara University and 78 in Tribhuvan University. Based on parental occupation, 51 involved in agriculture,37 in business,48 in teaching, 31 in job holders, 21 in abroad and 40 in others area. One hundred forty-eight (64.5%) students realized the need of extra support for mathematics to make their study of civil engineering better.

Results and Discussion

For the testing of the position of the feeling of civil engineering students on the construct and relationship between dependent and independent variables and influence of independent to dependent variables, mean, correlation, Coefficient of Variance, regression analysis was applied. As we have used six-point Likert, the mean 1 to 1.833 specifies strongly disagree, 1.834 to 2.663 gives disagree, 2.664 to 3.493 provides partially disagree, ,3.494 to 4.324 provides partially agree, 4.325 to 5.153 means agree and 5.154 to 6 means strongly agree Pimentel,2010).

Table 3

Realization of Mathematics for Effective Civil Engineering

	Mean	S.D
I think that mathematics is the foundation of engineering.	5.26	0.734
I think that knowledge of mathematics supports engineers to enhance their efficiency, competency, and skill development in engineering work.	5.09	0.728
I think that knowledge of mathematics supports engineers to become innovators.	4.74	0.818
I think that mathematical tools and their application model make engineering work comfortable.	5.00	0.796
I think that knowledge of mathematics plays a vital role in design/development, maintenance, production, management, and project management.	4.79	0.822

n=228

Table 3 indicated that the height mean was 5.26, which were greater than 5.156. Hence the most of respondents strongly agree that mathematics was the foundation of engineering. The most of the participants provided the consistency response on first statements with coefficient of variance of 13.95 percentage. The lowest mean was 4.74 with coefficient of variance 18.29 percentage. It cleared that the respondents were more vary on the statement third. Thus, mathematics could not support them properly to become innovators. The other statements were more variable than the first statement based on coefficient of variance.

Table 4

Mathematical Background and Engineering as A Career

		S.D
I had good mathematical knowledge up to class ten.	5.26	0.738
I had sufficient knowledge of mathematics in classes 11 and 12.	5.09	0.728
I was interested in applying mathematical knowledge in real life in school.	4.79	0.869
I had sufficient knowledge of mathematics which was used in physics.	4.68	0.769
I have a fixed aim to be an engineer in the future from school.	4.56	1.162
I always understand the mathematical problem that the teacher teaches in class.	4.58	0.918

n=228

Table 4 explained that the highest mean of the first statements was 5.32. It explained that the majority of students of civil engineering strongly agreed that they had good mathematical knowledge up to class ten. They gave more uniformity response on the first statements with coefficient of variance 13.53 percentage. They were good at mathematics at school level. The means of statements second, third, fourth, and fifth were 4.92.4.79, 4.68 4.56 and 4.58 respectively. The participants agreed on these statements. The least mean was 4.56 of statement fourth with coefficient of variance 25.63 percentage. They provided less uniform response on statements fourth. Some of the students of civil engineering had no fixed aim to be engineers in future from school life. The second lowest mean of fifth statements was 4.58 with CV 20.04 percentage. It assessed that some of the learners of civil

engineering could not understand the mathematical problem that the teacher taught in class.

Table 5
The Attitude of Students and Faculty Members

	Mean	S.D
I am attentive in learning mathematics and I like mathematic.	4.81	0.894
I have sufficient knowledge of mathematics to apply to engineering courses.	4.63	0.821
Mathematics is normally counted among my best 3 subjects.	4.86	0.997
I feel that most of the faculty members of the engineering department have a positive perception of mathematics.	4.50	0.883
My mathematics teacher cannot connect most topics of mathematics in practical engineering works.	4.65	0.768

n=228

The mean of first, second, third, fourth and fifth statements were 4.81, 4.63, 4.86, 4.50, and 4.65 respectively in the Table 5. These all were less than 5.153 which explained that most of the respondents could not strongly agree with any of these five statements. Majority of the respondents agreed with these statements .The second lowest mean of statement fifth was 4.65 with the smallest coefficient of variance 16.51 percentages. Majority of the participants were provided with the most uniform response on the mathematics teachers could not connect the topic of mathematics in engineering work.

Table 6
Learning Environment

	Mean	S.D
I feel that most Universities in the world have given more priority to engineering courses.	4.68	0.810
I feel that most people have a positive perception of mathematics for engineering careers.	4.62	0.767
I think that engineers are demanded in the market with good salaries.	3.92	1.108
I feel that most of the new generations are interested in enrolling in engineering programs	4.21	0.900
I feel that most parents motivate and encourage their children to study mathematics for their engineering careers.	4.45	0.872
I feel that engineering students get the support of mathematics from teachers, friends, and online.	4.66	0.789

Table 6 revealed that 4.68, 4.62, 3.92, 4.21, 4.45, and 4.66 are the respective mean of first, second, third, fourth, fifth, and sixth statements. The lowest mean of this above table was 3.92 with CV 28.26 percentage. Majority of learners partially agreed that the engineers were demanded in the market with good salaries. They provided less consistent response on statement third. Most of the respondents were partially agreed fourth statements and agreed with other statements.

Table 7
Application of Mathematics in Civil Engineering

	Mean	S. D
I think that algebra is used for symbols, numbers, letters, and quantities used to solve the equation.	4.85	0.773
I think that calculus is used as a mathematical study of change with respect to time in heat, vibration, wave, and electrical current.	4.85	0.837
I feel that trigonometry is applied for surveying land of elevation, angles, sides, and their relation.	5.14	0.763
I think that geometry is used to design and assemble the shape of construction of buildings, damps, highways, bridges, and tunnels.	5.10	0.714
I feel that mathematical equations are used to study the chemistry of materials to judge the strength of the material.	4.68	0.843
I feel that mathematics is used for the cost estimation of the projects.	5.00	0.735
I feel that mathematics is used for planning phase of the projects and budgets		

The Table 7 showed that the mean of third and sixth statements were 5.14 with their CV 14.84 percentage and 14.29 percentage respectively. It meant that most of the respondents agreed with the above statements. They responded that statement sixth was more consistent than third. Majority of them realized that mathematics was used for the cost estimation of the projects. The mean of fourth and seven statements were 5.10 and 5.00 with their CV 14% and 14.66% respectively. Most of the learners agreed on statements fourth and sixth. The difference of CV of statements third, four, sixth and seventh statements with each other were in decimal numbers. They provided a more consistent response on fourth statements. The mean of first and second statements were 4.85 with CV 15.93% and 17.25% respectively. These two statements were agreed by most of

the respondents however response on first was more uniform than second statements. The mean and coefficient of variance of fifth statements was 4.68 and 18.01 percentages. Most of the respondents agreed with the fifth statement but they gave more variable responses compared to other statements.

Table 8
The Correlation among the Paradigms Variables

	The realized of math for civil engineers	Mathematical background and engineering as a career	Attitude of students and teachers	Learning Environment	Use of Math in civil engineering.
Realized of math for civil Engineers	1	0.339**	0.362**	0.283**	0.412**
Math background and engineering as a career		1	0.666**	0.467**	0.437**
Attitude of students and teachers			1	0.433**	0.521**
Learning environment				1	0.411**
Use of mathmatics in civil engineering					1

**significant

The correlation coefficient between realized mathematics for civil engineers and mathematical background and engineering as a career was 0.339. It interpreted

that these two constructs were significantly positively correlated. If one of the constructs increased positively then the other should positively increase. The value of correlation between the first construct and third construct was 0.362 which explained that these two constructs were positively correlated. The degree of increase or decrease would follow same direction of these two constructs. The correlation coefficient of first construct and four constructs was 0.284 which was less than before two relations. It revealed that mathematics for civil engineering was significantly positively correlated with the learning environment. The relation between first and fourth construct was weaker than the relation between first and second, and first and third. The correlation coefficient between realized math for civil engineering and application of mathematics for civil engineering was 0.412 which was greater than the previous three results. It concluded that realization of math and uses of math in civil engineering was the most correlated than other previous relation. Mathematical background and engineering as a career were strongly positively correlated with the attitude of students and teachers having the correlation coefficient 0.666.

The Karl Pearson's correlation coefficients between second and fourth, and second and fifth constructs were 0.467 and 0.437 respectively. It meant that mathematical background and engineering as a career was significantly positively correlated with learning environment and application of mathematics. The attitude of students and teachers was strongly positively correlated with the application of mathematics in civil engineering having correlation coefficient 0.521. Third construct was positively associated with the learning environment with correlation coefficient 0.433. The correlation coefficient between learning environment and application of mathematics was 0.411 which explained that they possessed a positive relation with each other. All correlation coefficients among different constructs were positive. Thus, these constructs were positively correlated with each other.

Table 9
Regression Analysis Displaying Effect of Independent Variables on The Depended Variable

Model	β	T-value	Sig.	VIF
(Constant)	11.075	5.010	0.000	
Realized of mathematics for civil Engineers	0.295	3.806	0.000	1.193
Background of math and engineers as a career	0.071	0.887	0.376	1.952
Attitude of students and teacher	0.397	4.278	0.000	1.920
Learning environment	0.190	2.878	0.004	1.343

The variance inflation factor (VIF) among the construct that indicate multi-co-linearity was below than 5 of each construct. That means, there was no multi-co-linearity in any paradigms of the learning. The P value of mathematics for civil engineers, feeling of instructor and students, and learning environment were 0.000, 0.000, and 0.004 respectively, which were less than 0.05. Thus, the attitude of teachers and students, learning environment and realization of mathematics for civil engineering significantly impacted on the uses of mathematics for civil engineering. The p values of mathematical background and engineering as a career was 0.376, which was greater than 0.05. Thus, it revealed that background of mathematics and engineering as a career was no significantly impacting factor on the uses of mathematics for civil engineering. The beta coefficient of realized mathematics in civil engineering with dependent variables in a regression model was 0.295, which meant that if one unit of realized mathematics was increased then application of mathematics would be expected to increase 0.295 parts. The coefficient of β values between attitude of students and teachers and dependent variables in a linear regression model was 0.397.

It explained that if one unit of attitude of students and teacher was increased then dependent variable could be expected to increase 0.397. The regression coefficient value of β between learning environment and dependent variable was 0.190 which assessed that if one unit of learning environment was raised then uses

of mathematics in civil engineering could be increased 0.190 portions. The attitude of students and teachers was highly impacted by the application of mathematics than other independent two remaining variables. The value of the R-square is 0.361 Based on the coefficient of determination (R^2), it can be decided that 36.10 percent of variations in the output variables are influenced by input variables.

Learning environment, attitude of teachers, and realization of mathematics played a vital role to influence the uses of mathematics in civil engineering job. The Beta value (0.397) which is greater than others proves that the attitude of teachers influences learners for the uses of mathematics in their job, career aspirations of learners and their attitude were significantly correlated with each other (Oracion, et al, 2021). This study gave similar findings on mathematical background and engineering as a career was strongly correlated with the attitude of learners and teachers. Attitude of teachers and students played a significant role in making a strong mathematical background and engineering as a career. The application of mathematics in civil engineering was positively correlated with realization of mathematics in civil engineering, attitude of teachers and students, mathematical background and engineering as a career, and learning environment. The uses of mathematics in civil engineering were strongly correlated with the realization of mathematics in civil engineering

Conclusion and Implication

This study revealed that most learners, nearly 80% male studied civil engineering programs. Most of the learners lived in Municipality and Metropolitan. It was clear that most of the people who lived in Metropolitan and Municipality were interested in enrolling their children in the engineering field. Parents of most of the students were teachers, job holders, and farmers. Few parents were businessmen. It assessed that teachers, job holders, and farmers were more aware than businessmen for their children's engineering education.

Any design and construction of civil engineering has to be justified mathematically. Theoretical foundation of mathematics, making processes of mathematical models, solution of applied problems on the uses of mathematical statistics were required for civil engineers (Sergeeva, 2020). This study revealed a similar finding that most respondents strongly agreed that mathematics was the foundation of engineering courses. Nepal governments, universities, faculty members, and learners had to provide more priority for mathematical courses. Civil

engineers could provide different ideas and skills for national development. This study explored that the majority of learners were good in mathematics up to class ten then their mathematical quality had been decreasing from that level. Faculty of mathematics and university has to identify the major problem to reduce the quality of mathematics in plus two levels and higher levels. This study found that some of the students were involved in engineering courses however their child aim was not to be engineers in future. They need motivation for this course.

This study revealed that most respondents agreed that mathematics was counted among their best three subjects. It cleared that some of them faced difficulties in mathematical problems and engineering courses. They required extra support on mathematics knowledge. Majority of learners agreed that mathematics teachers could not connect the topic of mathematics in engineering work.

This study concluded that the majority of learners strongly agreed that mathematics was the foundation of civil engineering; most of the learners were good in mathematics up to class ten. The most respondent partially agreed that engineering was demanded in the market with good salaries and new learners are interested to enroll in engineering programs. The majority of learners agreed that faculty members of mathematics could not connect the mathematics problems in real engineering work. It also concluded that most learners accepted that part of trigonometry; geometry, mathematical equation, and planning phase of project and budget were highly applied in civil engineering courses near about mean 0.515 means nearly strongly agreed. This study was done only in the Pokhara valley about the above mentioned dependent and independent variables. It was unknown about the financial position of learners, friends' influence, and household influence. Further study should be done including financial position of learners, friends influence and family encouragement including Pokhara Valley and excluding Pokhara Valley on the respondent of learners of civil engineers to validate and generalize this result.

Implications

Some implications based on the major finding of this study of the perception of learners of civil engineering on the application of mathematics for effective engineers are listed below:

- The scope of mathematics for engineering programs should be explained and demonstrated to the students of school level organized by different programs.
- Major problems of mathematics in 11 and 12 and higher levels of students should be identified by doing research to enhance their mathematical capacity to apply in different fields and to motivate them to study mathematics.
- Capacity building programs of faculty members of mathematics about the application of mathematics in different disciplines should be organized frequently.
- Different skill development programs of civil engineering for learners, job holders and faculty members should be implemented on the research basis to increase the market value of engineers and to motivate the new learners to enroll in engineering programs.
- The feeling of learners and teachers, learning situation and realization of calculation for civil engineering should be improved for application of mathematics for effective engineers.

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