

STRATEGIES FOR TRANSFER OF PRACTICAL ENGINEERING SOFT SKILLS IN ENGINEERING EDUCATION IN NIGERIA USING CONCURRENT TRIANGULATION MODEL.

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ABSTRACT

*It has become imperative that engineering education should include soft skills into technical/hard skill training for a holistic education. In this study, **team work skills** was identified, accessed and analyzed as a soft skill that will transfer practical engineering skills. From the three selected soft skills; negotiation skills, inter-personal skills and team work skills, the impact of teamwork skills was explained at 96.2% coefficient of determination, R^2 as the practical skills needed for development in engineering education followed by 91.5% for negotiation skills and 89.6% for inter-personal relationship skills. The F- statistics of teamwork skills, negotiation skills and interpersonal skills with values of 21.300, 17.054 and 7.255 respectively at prob (sig) = 0.000^b conducted at 5% level of significance in the regression results, showed there is a statistical significance and linear relationship between teamwork skills, negotiation skills and inter-personal skills. From the Durbin Watson statistics value of 1.954, 1.935 and 1.928 respectively, there is absence of serial auto correlation in the regression analysis showing that results compiled from the model, can be relied upon in implementing strategies for development and transfer of practical engineering skills in engineering education.*

KEYWORDS:

Concurrent triangulation model, Practical Engineering skills, Team work skills, Negotiation skills, Interpersonal relationship skills.

1. INTRODUCTION

Practical engineering soft skills are possessed by practical engineers who implement the research outcome of academic engineers with unending training in order to keep up with latest technologies in engineering development and produce industry ready students. Engineering training involves real world experiences and can only be implemented by TEAM WORK using team work skills as engineers cannot work in isolation but work effectively with teams, normally comprising of six to eight members. Engineers work with teams to achieve information ordering, reasoning out induced ideas, having a robust knowledge of experiments, having independent thinking, determination, investigations for facts, manage inventory and being commercially aware of industry latest (Chandra and Chugh, 2014). Acquiring practical engineering skills in

Nigeria, beyond classroom knowledge as it pertains to engineering education in Nigerian universities, is significantly on the increase, hence, strategies for transferring practical engineering skills in engineering practice have been spelt out to be: identifying, assessing and analyzing the selected soft skills. The selected soft skills in this study are team work skills, negotiation skills and inter-personal relationship skills. These skills will help to transfer practical engineering skills into our curriculum in other to make lectures attractive for engineering students, increase success of interns and boost innovations. In analyzing, two steps were taken: 1. learning by doing (LBD) where soft skills for engineers are learnt by action. These soft skills are acted and engineers in turn learn these soft skills by doing. 2. Curriculum restructure where seminars should be embedded into curriculum to interact, learn and ask questions where in doubt (Bernd Schulz, 2008). Empathy, active listening, honesty, responsibility, commercial awareness, charisma, resilience, boldness, collaboration and problem solving skills should be learnt (Bernd Schulz, 2008). The use of soft skills by employees in the tourism industry will help to encourage diverse background with cross cultural links (Prasad,2020).Having adjustments in social and emotional areas of business,will hold to make a head way in the present decision hiring today's employees (Vijayalakshmi, 2011).

1.1 TEAM WORK SKILLS

Some engineers are rich in team skills naturally while others are poor in team skills. Our team skills ability will only be effective if we develop it and practice it. Team work skills are skills needed to develop teamwork, manage team members, and tactically carry out team task and stay focused on the purpose of the team. The four groups of teams needed to carry out team task are: special purpose team, e.g. covid-19 team, multi-purpose team e.g. multidisciplinary research team, self-directed team, management team e.g. Nigerian Society of Engineers/(NSE) executive members made up of president of NSE, vice president, secretary, technical secretary etc. and Executive team.

After a team is established, the goals of the team are listed. As the team sets to work, developing action plan, evaluation plans, reporting of outcome and communication is critically executed. To do this, members of a team are assigned duties (Ulabar Ehimen et al, 2020). For team task to be easy, team roles and clarities of these roles are mapped out (Uddin et al, 2015). Some of the types of team members are: Team plants, team shapers, team completers, team workers, team evaluators, team experts and team stabilizers (Meredith Belbin, 2020). Team stabilizers are members of a team that are strategically noted for spurring the team to succeed by providing monetary support, material support and emotional support. Some of the team work skills needed for teams to succeed are: Conflict resolution, Decision making, Reliability, Planning skills, Respectfulness , Tolerance, Creative thinking, Language skills, Motivation, Problem solving, Listening skills , Building rapport, Persuasion and influencing, Community building , Collaboration , Critical thinking and Mediation. A sound team leader should be one with wisdom and integrity (Steve,2017). Engineers need to have Team Culture that will help to stop Team members from becoming cynical, which can cause a big problem

in the team and may disorganize the entire team, thereby creating a desperate need for a team culture. Team culture is that which pulls a team together, spurs the team to work, promote trust, autonomy and enhance efficiency of the team (Sanyal,2018).

1.2 INTERPERSONAL SKILLS

This is close association amongst individuals' right from the initial meet. Interpersonal skills are skills that one possesses and is able to establish deep relationship based on due of meet, regular meet, social meet, love and solidity (Tbhidi. 2011). Some of the skills for interpersonal relationship are: flexibility, empathy, patience, motivation, dependability, and understanding, communication skills. Engineers with interpersonal relationships skills will be able to build innate personality traits (Phina, 2018).

1.3 NEGOTIATION SKILLS

Negotiation skills allow one to pay attention to verbal language, non-verbal language and listening with the eyes and using body gestures. Facial expressions are decoded and engineer with negotiation skills is able to: adapt, is resourceful, committed, honest, and confident, result oriented (Ghulam, 2019). Figure 1 explains the relationship between engineering skills, the three skills 1. Negotiation skills 2. Team skills and 3. Interpersonal relationship and their prospects.

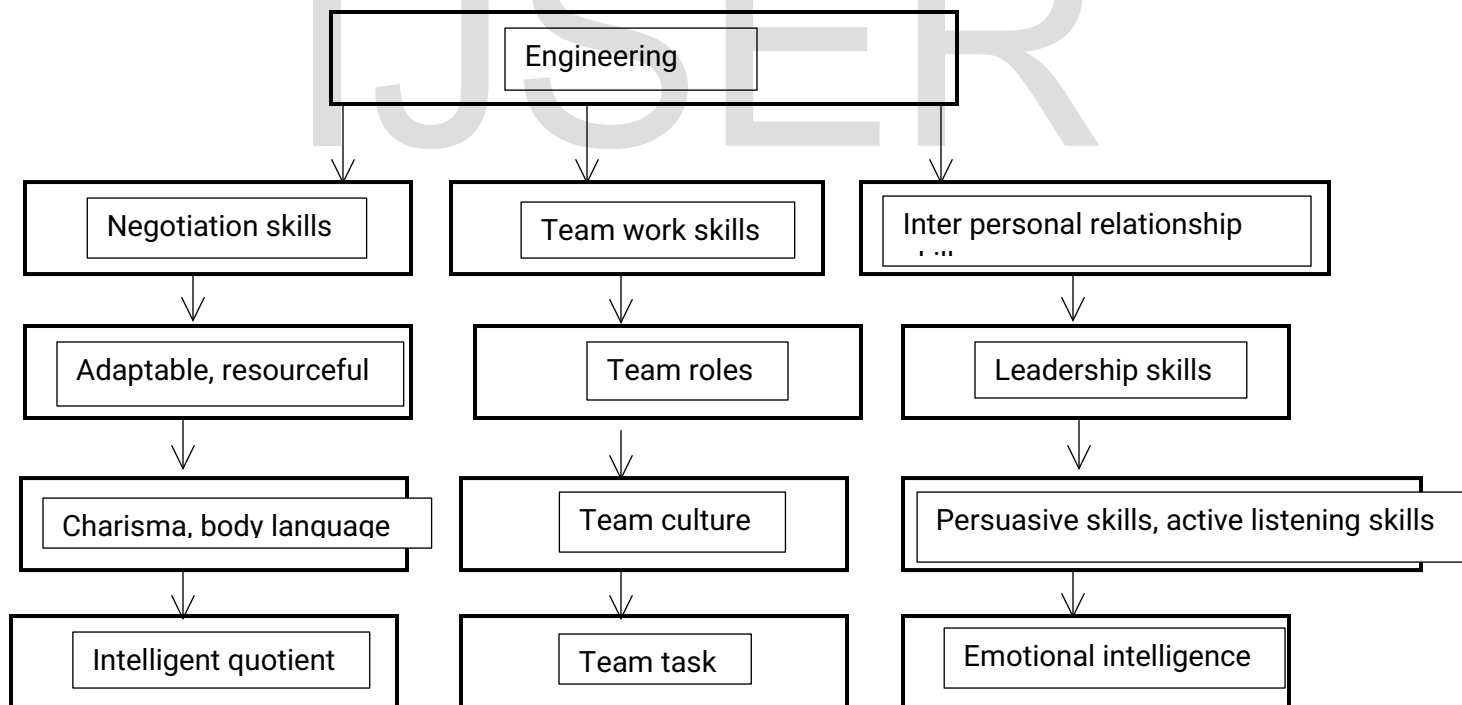


Figure 1; Engineering skills and prospects.

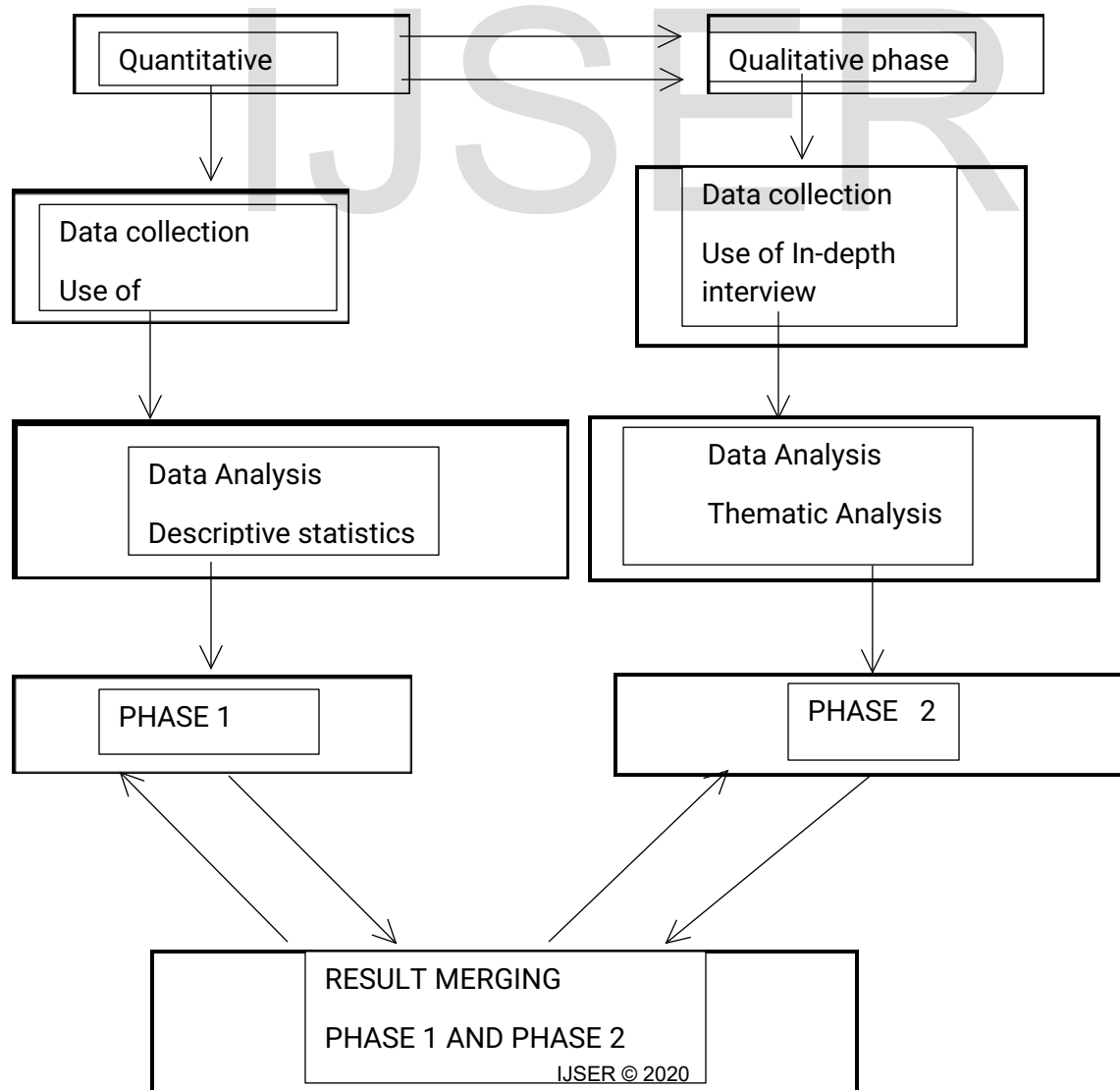
2. GAPS OF PRESENT RESEARCH

Academic programs in our tertiary institutions are devoid of acquisition of soft skills training. Hence, improving teaching methodologies by embedding soft skills training into the teaching curriculum of hard skills, will take engineering education beyond academic knowledge to acquiring special skills to sharpen graduates for the future and getting them to be industry ready.

To bridge the gap, engineering students should get involved in power point presentation in every lecture groups discussions and making all topics in engineering interesting using re-thinking, re-planning and re-structuring with soft skills sets such teamwork, negotiation skills and interpersonal relationship skills.

3. METHODOLOGY

The concurrent triangulation model was used in this study to collect data, analyses the date collected and merged results are recorded. This model is in two phases. Phase1 collects data and analyses data using descriptive statistics. Data is collected using close ended questions questionnaires and phase1 is the Quantitative phase. The Qualitative phase, the phase 2 deals with collections of data using in-depth interview with data being analyzed using the thematic analysis. The final result is collected and recorded. Figure 2 shows the concurrent triangulation design showing the two phases.



. Figure 2 : Concurrent triangulation model

3.1 RESEARCH QUESTIONS

This research answers the following research questions:

1. Is there any significant relationship between practical engineering skills and team skills?
2. Is there any significant relationship between negotiation skills and practical engineering skills?
3. Is there any significant relationship between interpersonal skills and practical engineering skills? The main objective of the study is to empirically examine the relationship between team work skills, negotiation skills and interpersonal skills.

3.2 HYPOTHESIS TESTING

Hypothesis formulated using the results formulated from the regression analysis, were carried out in a Null form. The Decision rule: P-values greater than 0.05 (5%) level of significance, we accept the null hypothesis (H_0): and reject the alternate (H_A) : , if the P-value is less than 0.05 (5%) level of significance, we accept the alternate hypothesis (H_A) and reject the null hypothesis (H_0). from Table 8 results.

1. HYPOTHESIS ONE

H_1 : There is no significant relationship between practical engineering skills and team work skills in engineering practices.

The P-value for team work skills in the regression result is 0.00 which is less than 0.05. Following the decision rule, we reject the null hypothesis (H_0) and accept the alternate hypothesis (H_A), that there is significant relationship between team work skills and practical engineering skills in engineering practices.

2. HYPOTHESIS TWO:

H_2 : There is no significant relationship between practical engineering skills and negotiation skills.

The P-value for negotiation skills in the regression result it is 0.000. The P-value is less than 0.005. Following the decision rule, we reject the null hypothesis (H_0) and accept the alternate hypothesis (H_A), that there is significant relationship between negotiation skills and practical engineering skills in engineering practices.

3. HYPOTHESIS THREE:

H₂: There is no significant relationship between inter-personal skills and practical engineering skills in engineering practices.

The P-value for inter-personal skills in the regression results is 0.000. The P-value is less than 0.005. Following the decision rule, we reject the null hypothesis (H₀) and accept the alternate hypothesis (H_A), that there is significant relationship between inter-personal skills and practical engineering skills in engineering practices.

4. RESULTS AND DISCUSSION

Table 1: Questionnaire survey collected, analyzed and recorded (Phase1)

S/N	Questionnaires (closed ended questions)		
	Engineering skills	Frequency	Percentage (%)
1	Team skills	81	43.5
2	Negotiation skills	45	24.2
3	Interpersonal skills	60	32.3
	Total	186	100

From Table 1, team work skills responses were recorded at 81 responses with 43.5% indicating that from the 186 respondents, a high response was recorded from team work skills showing that respondents were of the opinion that practical skills engineering will be achieved if team work skills are transferred and incorporated into engineering practices. The least response was recorded with negotiation skills. 45 responses at 24.2% was recorded. 60 responses were recorded for negotiation skills at 32.3% showing that respondents were of the opinion that engineers with negotiation skills will function better in practical engineering skills for the development of engineering education.

Table 2: Table of in-depth interview responses (phase 2)

S/N	In-depth interview responses		
	Engineering skills	Frequency	Percentage (%)
1	Team skills	103	55.4

2	Negotiation skills	32	17.2
3	Interpersonal skills	51	27.4
	Total	186	100

From Table 2, team work skills had highest response at 103 response with 55.4%, followed by interpersonal relationship skills of 51 responses at 27.4%. The least responses was negotiation skills with 32 responses at 17.2%. From the questionnaire survey and in-depth interview records, team work skills had the highest responses showing that team work skill impacts more on engineering skills and will help put a value to real world experiences. Practicing team work skills will produce skills sets for task, help evaluate plans, stay focus on engineering task to produce positive results.

Table 3: Merged results of phase 1 and phase 2

S/N	Engineering skills	Questionnaires	In - depth interview	Merged results		Optimum values
		Frequency	Frequency	Total Frequency	Total percentage	percentage
1	Team work skills	81	103	184	98.9	49.45
2	Negotiation skills	45	32	77	41.4	20.70
3	Interpersonal Relationship skills	60	51	111	59.7	29.85
		186	186			100

From Table 3, it can be seen that team work skills recorded the highest response with an optimum value of 49.5%. Indicating that almost half of the total responses were of the view the team work skill is a skill set that if when practiced, will transfer practical engineering skills in engineering practices for national development.

Table 4: Table of Model Summary

Model	R	R square	Adjusted R square	Standard Error estimate						
					R-square change	F change	df 1	df 2	Sig F change	Durban Watson
1	0.195*	0.038	0.033	0.96576	0.038	7.255	1	184		1.928

- a. Predictor: Team work skills
- b. Engineering education.

Table 5: Table of ANOVA for Regression residual

Model	Sum of squares	df	Mean square	F value	significance
Regression	6.766	1	6.766	7.255	0.008
Residual	171.614	184	0.933	-	
Total	176.380	185	-	-	

Table 6: Table of Coefficients

Model	Unstandardized Coefficient	Standardized coefficient	T	Significance
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Team work skills	B	Std errors	Beta		
	2.737 0.297	0.428 0.110	-0.1950	6.396 -2.693	0.000 0.000

Table 7: Table of Residual Statistics

	Minimum	Maximum	Mean	Standard deviation	N
Predicted values	2.7373	4.8317	3.8740	1.19124	186
Residual	-2.7372	7.48771	0.000	0.96314	186
Standard predicted value	-5.9440	5.0070	0.000	1.0000	186
Standard residual	-2.8340	7.7530	0.000	0.9970	186

A summary of regression analysis of team work skills, negotiation skills and interpersonal skills.

Table 8: Summary of regression analysis

S/N	Engineering skills	R Square	Adjusted R square	Coefficient.	F statistics	F sig	P value T t- statistics	Durban Watson
1	Team work skills	0.1040	0.0990	-0.3460	21.300	0.000	0.000	1.954
2	Negotiation skills	0.0850	0.0800	-0.3410	17.054	0.000	0.000	1.935

3	Interpersonal relationship skills	0.0380	0.0330	-0.2970	7.255	0.000	0.000	1.928
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A simple regression analysis was used to estimate the relationship between team work skills, negotiation skills and interpersonal skills. The regression analysis was conducted at 5% level of significance and used to test for the formation formulated hypothesis.

The impact of team work skills in engineering education for engineering skills was explained at 10.4% of increase in engineering skills while 89.6% is the cause for reasons for the need for team skills in engineering education at a coefficient of determination of 0.104. The coefficient of determination (adjusted R-square) value was recorded at 0.099. This implies 9.9% for team work skills, 8.0% for negotiation skills and 3.3% for interpersonal skills after adjustment to the degree of freedom. The F-statistics test of 21.300, 17.054 and 7.255 for team work skills, negotiation skills and interpersonal skills respectively showed there exist statistically significant linear relationship between team work skills, negotiation skills and interpersonal skills as it relates to engineering skills. For the R-square coefficient of determination for skills, 8.6% explains the decreases in negotiation skills while 91.5% explains the need for negotiation skills in engineering skills to boost engineering education 3.8% explains the decrease in interpersonal skills while 96.2% are reasons for boost in soft skills in engineering education. In summary for team work skills 89.6% will cause change in engineering skills if implemented in engineering education, 91.5% for negotiation skills will cause changes in engineering skills of implement in engineering education and 96.2% will cause changes in engineering education, build up engineering skills and enhance engineering education. All these finding collated the Durbin Watson statistics of 1.954, 1.935 and 1.928, implying that there is absence of serial auto correlation in the regression analysis. This shows that results complied from the model, can be relied upon in implementing engineering skills in our tertiary institutions.

The F-statistics test of 7.255, 17.052 and 21.300 at prob (sig)= 0.000^b conducted at 5% level of significance showed in the regression results showed, there is a statistically significant linear relationship between Team work skills, Negotiation skills and Interpersonal skills. The result further agreed with the t-statistics of 0.00 showing that there is a significant relationship between team work skills, negotiation skills and interpersonal relationship skills.

5. FINDINGS

There is a significant relationship between team work skills, negotiation skills and interpersonal skills in transfer of practical engineering soft skills.

This study provides empirical evidence on the strategies for development and transfer

of practical engineering soft skills.

Academic programs in our tertiary institutions will be enhanced with the acquisition of soft skills training

Acquiring special soft skills like team work skills ,will help to sharpen graduates for the future and get them ready for Nigerian industries.

The gap in skills sets will be bridged, as engineering students getting involved in power point presentation in every lecture group's discussions will make all topics in engineering interesting.

using Re-thinking, re-planning and re-structuring of engineering curriculum, soft skills sets such teamwork skills, negotiation skills and interpersonal relationship skills should be introduced in order to have a holistic Engineering education.

6. ACKNOWLEDGEMENT

None declared

7. CONFLICT OF INTEREST

The author confirms that this article content has no conflict of interest.

CONCLUSIONS:

From the findings of this study, it can be concluded that team work skills, negotiation skills and interpersonal skills are skills that can be transferred and incorporated into practical engineering skills for development of engineering education in Nigeria.

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