The Effect of Work-Based Learning on the Acquisition of Technical Skills amongst Mechanical Engineering Students in National Polytechnics in Western Kenya Region

*Migiro Wycliffe Lumumba, Kitainge Kisilu and Dimo Herbert
Department of Technology Education, School of Education, University of Eldoret,
P.O. Box 1125, Eldoret, Kenya

***Corresponding author's email address:** wycliffelumumba16@gmail.com

Abstract

The right approach to teaching and evaluation of practical subjects in technical colleges is crucial in imparting practical skills and adequate creative power to students in order to meet the requisite human resource skills needed in achieving Sustainable Development Goals (SDGs 2016-2030), through Technical and Vocational Education and Training (TVET). Teaching methods can affect acquisition of technical skills by mechanical engineering students in national polytechnics. The study determined the effect of work-based learning on acquisition for mechanical engineering students in national polytechnics in Western Kenya Region. An explanatory research design was used and random samples was used to sample mechanical engineering trainees (248) and trainers (66) in 3 (Kisii, Kisumu, Sigalagala) national polytechnics in western Kenyan region. Data was collected using structured questionnaires which were self-administered. Data was analyzed by use of both inferential and descriptive statistics using SPSS version 25.0. Results of multiple regressions revealed that work-based learning affected acquisition of technical skills in mechanical engineering in national polytechnics. There was a positive significant effect of 67.1% in acquisition of technical skills with a beta value of 0.178 for work-based learning. The findings imply that national polytechnics should embrace a worked based learning methods complemented by other approaches such as virtual learning and computer aided learning and proactively formulate policies and resources which support the teaching methods above in order to improve acquisition of technical skills among mechanical engineering students.

Keywords: Work based learning, technical skills, methods, mechanical engineering, Western Kenya

INTRODUCTION

World over, the interest of vocational education is to enable trainees to do things according to standards and best practices as set by experts in the occupation into which they are progressing. In this regard, higher education must be reviewed critically especially the instructional practices as well as teaching methodologies that lead to improvement of learners' vital abilities (Mohsen, WahnZah and Mariah, 2013). This is in consonance with the aspiration of Technical Vocational Education and Training (TVET), which is to prepare trainees for the labour market, due to the fact it is an ability-orientated field whose main focus is inculcating vocational abilities /aptitudes to its recipients (Ayonmike & Okeke, 2016). Thus, the technical skills emphasis is the ultimate goal of training Mechanical Engineering in technical and vocational education and training (TVET) institutions. The actual answers to enhancing productivity from vocational training lies in understanding the many decisions trainers take as they interact with students during the learning process as said by Lucas, Spencer & Claxton, (2012). Therefore, instructors in TVET institutions should use appropriate teaching methodologies in order to allow the students/learners to acquire hands-on experiences that meet market demand for employability and entrepreneurship by the end of their training course.

The success of teaching and learning depends on didactics used in any field of study as well as the pedagogy i.e., the strategies or methods of instruction applied in the classes, laboratories, workshops or any place where learning takes place (Harman & Bich, 2010). It can therefore be inferred that the degree of knowledge retention depends on the pedagogy involved although not in an exclusive manner. This implies that the best way to improve acquisition of technical skills is to upgrade the teaching methods. This is justified by teaching and learning involves a broad scope of all such actions and processes that are required learners in order to develop cognitive and psychomotor skills (Faye, 2011).

Approriate teaching methods for technical skill acquisition is underscored by the essence of equipping trainees with the specialized and expert capacity needed for any country to succeed both financially and economically (Ansah & Kissi, 2013). The utilization of inappropriate teaching and learning methods especially at technical institutions frequently brings about learners who lack hands-on skills, low creativity, and who eventually cannot be employed easily (Udofia, Ekpo, & Akpan, 2012). Obwoge et al.,(2013) accentuate that compared to the developed countries, linkages and collaborations between TVET institutions and industries are still far below expectation. This situation has often left many of the technical graduates unemployed (Adam, 2011). Instructional methods should be carefully selected in order to cater for different categories of learners especially those who need hands-on skills, specific competencies in many exceptional contexts (UNESCO and UNEVOC, 2014).

In Africa owing to incessant challenges, the tradition in TVET is inclined towards obtaining hands-on skills that are required for the development of a skilled workforce (Maame, 2018). In South Africa, Arfo (2015) analyzed comparatively TVET policies in selected African countries. The countries included Nigeria, Ghana and South Africa in order to identify similarities and differences in the system. From this analysis, it was clear that TVET policies execution was poor all the countries under study. All the countries were not able to produce the relevant skill needed in industry. It was evidently clear that in Ghana for example technical institute graduates did not have the requisite skills needed in the employment market. It is for this reason that many graduates from the institutes could not secure employment (Adam, 2011).

The main reason for which Technical and Vocational Education and Training (TVET) exists in a country is to give people the much needed technical and professional skills required for social, economic and industrial development, (Ansah and Kissi, 2013). There exists a correlation between teaching methods and learners' technical skill uptake (Udofia., Ekpo, Nsa, & Akpan, 2012). The real solutions of improving benefits from technical and vocational education depend on understanding decisions teachers make as they interact with their students during learning a learning process (Lucas et al., 2012). The application of improper teaching and evaluation method especially in practical subjects can produce learners who lack hands-on experience, inadequate innovation and creativity as well as a redundant work force that cannot find employment (Udofia et al., 2012; Lumumba et al., 2020). Further, the problem is exacerbated by poor linkages and collaboration between TVET institutions and industries resulting in gaps between training and labour market needs in Kenya (Obwoge et al., 2013). Ngure (2013); Ferej et al. (2012) & Nyerere (2009) has indicated that there are potential problems in teaching methodologies currently in use. As a result, there is need for an assessment of the work-based teaching methods used in TTIs / TVET institutions in Kenya to help unearth associated problems with the aim of helping improve or suggest alternative methods that can help fill in identified gaps. Therefore, an evaluation of the effect of work-based teaching methods on acquisition of technical skills amongst mechanical engineering trainees in national polytechnics in Western Kenya Region was conducted.

THEORETICAL FRAMEWORK

Constructivism and Cognitive learning theories were adopted in finding the effects work-based learning as an instructional method to the acquisition of technical competencies.

Constructivism Theory

This theory says that learners build or construct knowledge by being active as opposed to being passive. Dewey (1929) Bruner (1961), Vygotsky (1962), and Piaget (1980), (Sarita, Constructivism: A new paradigm in teaching and learning, 2017) were the proponents of the constructivism theory which says that knowledge exists in the brain of a human being and it doesn't compare with any real-world reality. This theory can develop knowledge through real world experience, their own representations are developed from pre-existing information. This theory explains how people acquire knowledge and learn. In constructivism theory the learner is considered as being active in the process of obtaining knowledge. Through experience learners make their own understanding and representations as they reflect on pre-existing knowledge (Bada and Olusegun, 2015).

Cognitive learning theory

Cognitive Learning Theory (CLT) was improved by Albert Bandura in 1986 as an expansion of his social learning theory (McCullough Chavis, 2011) . The CLT explains that when a person studies a model performing a behavior and the results of that behaviour, they recall the chronological occurrences and use this information develop successive behaviors. The CLT, gives a way of learning, predicting and diverting human character (Carrington, Neville, & Whitwell, 2010). In respect to character, other researchers like Betz, (2007), concurred with Bandura's preliminary assumptions of CLT, that behavior is pointed or directed towards specific objectives. Behavior is eventually self-controlled. Mental processes that are involved in learning are crucial; research also indicates that reinforcement as well as punishment present indirect consequences on learning. (Nabavi, 2012). Cognitive learning theorists insist on obtaining knowledge and skills, development of mental structures, processing of information and beliefs (Schunk, Social cognitive theory., 2012). To cognitivists, learning is an internal mental phenomenon derived from what people do and say. Cognivists believe that learning is better when one is fully involved. (Ausubel, 2012).

Conceptual framework

This study conceptualized that acquisition of technical skills is mainly by work-based learning methods that have a direct impact on learners' capabilities; Cognitive (mental skills and knowledge), affective (growth in feelings or emotional areas and attitude or self), psychomotor (manual or physical skills).

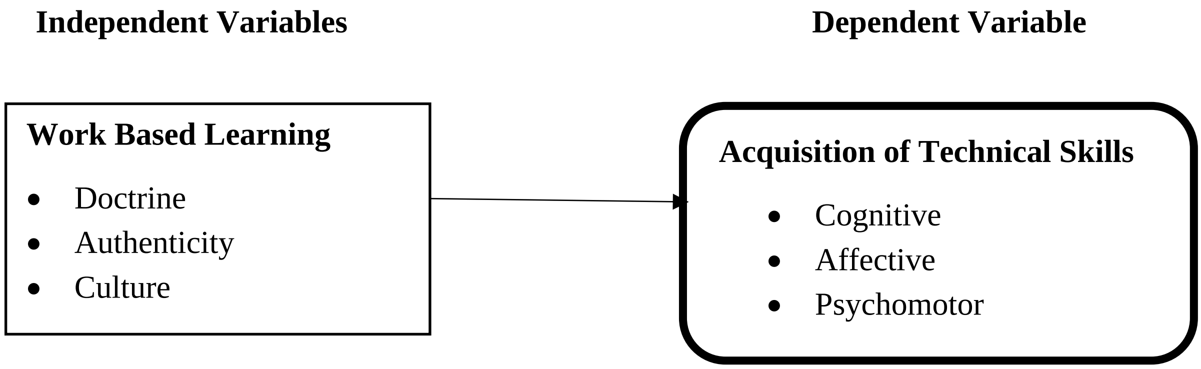

Figure 1: Conceptual Framework

Source (Author 2020)

METHODOLOGY

This research adopted an explanatory research design. Research was conducted in Western Kenya zones which houses Kenya Association of Technical Training Institutes-Western region. Western Kenya region includes Kisii National Polytechnic, Kisumu National Polytechnic and Sigalagala National Polytechnic. This study focused mainly on the National Polytechnics that offer The Kenya National Examinations Council (KNEC) Technician Diplomas in Mechanical Engineering. In this research the accessible population was 674 trainees and 80 trainers. Krejcie & Morgan (1970) tables were used to estimate the sample size which comprised of 66 trainers and 248 trainees. Cluster random sampling method was applied in the selection of the national polytechnics. The respondents were selected using simple random sampling procedure. The main data collecting tool were questionnaires. In this study, the questions were based on the construct of work-based learning and knowledge acquisition. Piloting was done to minimize ambiguities, remove repeated questions as well as simplifying questions and establishing the time required to complete the questionnaire items. Measurement and operationalization of independent and dependent variables was also done at this period. The pilot testing was done at The Eldoret National Polytechnic in Uasin Gishu County. Also, Face validity and Content validity were determined. Cronbach's Alpha coefficient was established; a value of 0.7 and above was considered high reliability whereas below 0.5 and below was taken as low reliability (Taber, The use of Cronbach's alpha when developing and reporting research instruments in science education, 2018).

Descriptive statistics were used in an attempt to answer the research questions. For example, a mean greater than 3.5 meant that there was high level of agreement whereas a mean below 3.0 was considered moderate agreement and means below 3.0 implied that there existed disagreement among the respondents, this is according to (Alexandra, 2014).

The researcher performed inferential statistics using a linear multiple linear regression model which is illustrated below:

$y = \beta 0 + \beta_1 X_1 + \varepsilon$

Where y represented acquisition of technical skills and the dependent variables $x_{1,}$ represented teaching methods, β_1 is the standardized regression coefficients

β_0 Represented the y intercept

X_1 Represents work-based learning

$\boldsymbol{\varepsilon}$ Represents error term

This study also used correlation and regression analysis. Prior undertaking regression analysis, diagnostic test was done to confirm normality, multi-collinearity, auto-correlation and homoscedasticity. Ethical considerations were made in this research so that the research was free of manipulation, creation or falsifying of data and therefore this promoted openness and truth which was the main objective of this research.

RESULTS FINDINGS AND DISCUSSION

Reliability Test Results

Cronbach's alpha was used to measure the level of internal consistency of the questionnaire items. The coefficient of reliability of the two sets of questionnaires was tabulated on table 1.

Table 1: Reliability of instruments

Construct	Trainers Reliability co-efficient	No of items	Trainees Reliability co-efficient	No of items
Work-based learning	0.705	6	0.745	6
Acquisition of technical skills	0.737	6	0.743	6

All the items in the questionnaires had an alpha value that was higher than the minimum acceptable value of alpha which should be at least 0.70 or above (Taber, The use of Cronbach's alpha when developing and reporting research instruments in science education, 2018). Therefore, the response items were considered reliable.

DESCRIPTIVE RESULTS OF WORK BASED LEARNING

Trainers' Perspective on Work Based Learning

The study evaluated the work-based learning in 3 National Polytechnics. The results were tabulated in table 2 below.

Table 2: Work based learning

Statement	VSE f(%)	SE f(%)	ME f(%)	GE f(%)	VGE f(%)	M	SD
The projects and assignments required in work-based learning are challenging for students.	0.0	0.0	7(16.7)	18(42.9)	17(40.5)	4.24	.726
Keeping academic and occupational circulars up-to-date through regular integration between school and industry	0.0	1(2.4)	5(11.9)	20(47.6)	16(38.1)	4.21	.750
Work-based learning prepares the student to locate permanent job opportunities	0.0	1(2.4)	8(19.0)	16(38.1)	17(40.5)	4.17	.824
Work-based learning provides the student with authentic experiences	0.0	1(2.4)	7(16.7)	19(45.2)	15(35.7)	4.14	.783
Work-based learning method enhances learning quality	0.0	2(4.8)	6(14.3)	19(45.2)	15(35.7)	4.12	.832
Enable students to be acquitted to work terminology, workplace conditions and industry protocols.	0.0	6(14.3)	13(31.0)	13(31.0)	10(23.0)	3.64	1.008

Key: f represents frequency; **Likert Scale weights represents**: **5 =** Very Great Extent (VGE); **4** = Great Extent (GE); **3** = Moderate Extent (ME); **2** = Small Extent (SE) and 1 = Very Small Extent (VSE)

Results presented in Table 2 revealed that a total of 93.4 % of the respondents agree to a very great extent and great extent that projects and assignments required in work-based learning are challenging for them while 0.0 % to a small extent and 16.7 % to a moderate extent (M=4.24 SD=.726). 2.4 % agree to a small extent and very small extent that keeping academic and occupational circular up-to-date through regular integration between school and industry while majority at 85.7 % agree to a very great extent and great extent and 11.9 % agree to a moderate extent (M=4.21 SD=.750). 2.4 % agree to a small extent and very small extent that work-based learning prepares the student to locate permanent job opportunities at 78.6 % agree to a very great extent and great extent and 19.0 % agree to a moderate extent (M=4.17 SD=.824). 80.9 % of the respondents agree to a very great extent and great extent that work-based learning provides the student with authentic experiences while 2.4 % to a small extent and 16.4 % to a moderate extent (M=4.14 SD=.783). 80.9 % of the respondents agree to a very great extent and great extent that work-based learning provides the student with authentic experiences while 4.8 % percent to a small extent and 14.3 % to a moderate extent (M=4.12 SD=.832). 14.3 % agree to a small extent and very small extent that work-based learning enables students to be acquitted to work terminology, workplace conditions and industry protocols at 54.0 % agree to a very great extent and great extent and 31.0 % agree to a moderate extent (M=3.64 SD=1.008).

Trainees Perspective on Work Based Learning

The results were tabulated in table 3 below.

Table 3: Work Based Learning from the perspective of trainees

Statement	VSE f(%)	SE f(%)	ME f(%)	GE f(%)	VGE f(%)	M	SD
The projects and assignments undertaken during work-based learning are challenging.	0.0	7(4.2)	33(19.8)	77(46.1)	50(29.9)	4.02	.818
Industry and School activities integration are up-to-date	1(0.6)	24(14.4)	20(12.0)	76(45.5)	46(27.5)	3.85	1.004
Work-based learning prepares the student to locate permanent job opportunities	0.0	13(7.8)	27(16.2)	53(31.7)	74(44.3)	4.13	.952
Work-based learning provides the student with authentic experiences	0.0	15(9.0)	17(10.2)	76(45.5)	59(45.3)	4.07	.902
Quality of learning is enhanced by work-based learning	0.0	10(6.0)	18(10.8)	85(50.9)	54(32.3)	4.10	.816
Exposes students to terminology of work environment and business and industry protocol.	15(9.0)	23(13.8)	12(7.2)	65(38.9)	52(31.1)	3.69	1.288

Key: f represents frequency; **Likert Scale weights represents**: **5 =** Very Great Extent (VGE); **4** = Great Extent (GE); **3** = Moderate Extent (ME); 2 = Small Extent (SE) and 1 = Very Small Extent (VSE)

The analyzed results revealed that 76 % of the respondents agreed to a very great extent and great extent that the projects and assignments undertaken during work-based learning are challenging while 4.2 % percent agreed to a small extent. 19.8 % agreed to a moderate extent (M=4.02 SD=.818). 15 % percent agreed to a small extent and very small extent that school and industry activities integration were up-to-date while the majority of 73 % agreed to a very great extent and great extent and 12.0 % agreed to a moderate extent (M=3.85 SD=1.004). Only 7.8 % agreed to a small extent and very small extent that Work-based learning prepared the student to locate permanent job opportunities at 76 percent agree to a very great extent and great extent and 16.2 % agree to a moderate extent (M=4.13 SD=.952). 90.8 % of the respondents agreed to a very great extent and great extent that work-based learning provides them with authentic experiences while 9.0 % to a small extent and 10.2 % to a moderate extent (M=4.07 SD=.902). 83.2 % of the respondents agree to a very great extent and great extent that quality of learning is enhanced by work-based learning while 6.0% percent to a small extent and 10.8 % to a moderate extent (M=4.10 SD=.816). 22.8 % agreed to a small extent and very small extent that exposes students to terminology of work environment and business and industry protocol at 70.0 % agree to a very great extent and great extent and 7.2 percent agree to a moderate extent (M=3.69 SD=1.288).

Effects of Work-Based Learning on Acquisition of Technical Skills Amongst Mechanical Engineering Students

The model summary presented in table 6 involves work-based learning as the only independent variable.

Table 6: Model Summary for Work Based Learning Regression

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.557[a]	.311	.307	.346	1.879

a. Predictors: (Constant), Work Based Learning

b. Dependent Variable: Acquisition of Technical skills

The coefficient of determination (R squared) of 0.311 indicated that the model explained only 31.1 % of the total variation in the dependent variable with the remainder of 68.9 % explained by other factors other than work-based learning. Adjustment of the R square did not change the results substantially, having reduced the explanatory behavior of the predictor to 30.7%. ANOVA output was examined to check whether the proposed model was viable as depicted in table 7.

Table 7: Regression Model Goodness of Fit test results for Work Based Learning

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.142	1	11.142	93.330	.000[b]
	Residual	24.712	207	.119		
	Total	35.854	208			

a. Dependent Variable: Acquisition of Technical Skills

b. Predictors: (Constant), Work Based Learning

Results shown in Table 7 revealed that the F-statistic was highly significant (F= 93.330 $p<0.01$), this showed that the model was valid. The model significantly improved the ability to predict acquisition of technical skills in mechanical engineering. Thus, the model was fit.

Regression Coefficients of Work based Learning

Results of the regression coefficients presented in Table 8 shows that the estimates of β values and gives the work-based learning contribution to the model.

Table 8: Regression Coefficient of Work Based Learning

Model	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	T	Sig.	Tolerance	VIF
1 (Constant)	2.476	.154		16.043	.000		
Work Based Learning	.368	.038	.557	9.661	.000	1.000	1.000

a. Dependent Variable: Acquisition of technical skills

The β value tells us about the relationship between acquisition of technical skills in mechanical engineering with the predictor, work-based learning. The positive β value indicates a positive relationship between the work-based learning and acquisition of technical skills in mechanical engineering. The unstandardized coefficient for acquisition of technical skills in mechanical engineering (.368) was positive. The positive β value indicates the direction of relationship between the predictor and outcome. From the results in Table 8 the model was then specified as: -

$y= \beta_0 + \beta_1 X_1 + \varepsilon$

Acquisition of technical skills = 2.476+ 0.368 Work Based Learning

The coefficient of the variable indicates the amount of change one could expect in acquisition of technical skills given a one-unit change in work-based learning basing on the unstandardized coefficients. Result reveal unstandardized regression coefficient for work-based learning ($\beta=0.368$), implies that an increase of 1 unit in work-based learning is likely to result in 0.368 units increase in acquisition of technical skills in mechanical engineering. T-test was used to identify whether the predictor was making a significant contribution to the model.

Based on the research question;

What is the effect of work-based learning on acquisition of technical skills amongst mechanical engineering students in national polytechnics in Western Kenya Region?

When the t-test associated with β value is significant then the predictor is making a significant contribution to the model. The results showed that work-based learning is ($t =9.661$, $P<.01$). In this regard the findings explain that work-based learning significantly affects the acquisition of technical skills in mechanical engineering amongst students in national polytechnics. These findings are supported by the findings of Ondieki, Kimani and Tanui (2018); Haruna, Kamin and Buntat (2019); European Training Foundation(ETF)., (2013). In these regard workplace learning is increasingly being used as a learning place for youths and adults in occupational training and educational programs.

These findings are premised on Constructivist theory which considers the learner as an active agent in the process of knowledge acquisition. This theory underscores that learning should be structured around events that facilitate the development of knowledge and skills. Therefore, work-based learning should be structured around activities that enhance acquisition of technical skills in mechanical engineering. Thus, national polytechnics and other TVET institutions should consider incorporating work-based learning as part of their response to need for acquisition of technical skills inclined towards the employability agenda. Work-based learning is therefore a recipe for education relevance to the Job requirement and transition from school to work.

Work based learning was found to have a positive and significant influence on acquisition of technical skills of mechanical engineering students ($F= 93.330$; $p<0.01$). The coefficient of determination (R squared) was 0.311 representing 31.1 % of the total variation in acquisition of technical skills for mechanical engineering students. The unstandardized regression coefficient for work-based learning ($\beta=0.368$) implies that work-based learning increases acquisition of technical skills in mechanical engineering students.

Conclusion and Recommendations

Work-based Teaching methods are key in enhancing acquisition of technical skills in mechanical engineering in national polytechnics. Therefore, the study recommends that the TVET institutions should utilize work-based learning in order to secure maximal acquisition of technical skills in mechanical engineering and also in order to exploit the acquisition of practical skills for marketability and employability of the students at the end of the completion of their program. Because of the exponential growth in TVET, modern learning techniques arise from current educational theories. For this reason, there, is need for a paradigm change from the classical methods of instruction to the current constructivist approaches which put emphasis on the student being an active participant. For further studies, the study recommends that there is also need to explore some of the challenges that hamper use of other methods of active learning including the influence of policy on curriculum and its implementation in TVETs across the country.

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