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Investigation into the Effects of Education, Training And Business Location on Product Quality

***C.M.M. Ondieki, Bisanda, and W.O.Ogola**

The Case Study of Arc Welding in Small Scale Metalworking Enterprises in Kenya

Abstract

The quality of products from the micro and small enterprise sector is affected by both the entrepreneur's and enterprise's attributes. This paper presents and discusses findings of a study that was designed to investigate experimentally the relationship between the quality of arc welding in the Small Scale Metalwork sub-sector and the artisan's education and training levels and business location. Four pairs of groups with a total of 36 with secondary education and 36 with primary education consisting of formally and informally trained artisans from urban and rural areas participated in the evaluation. A mild steel product was fabricated by each participating artisan, assessed and scores awarded based on the quality of arc welding. The data collected was analyzed using the Statistical Analysis System (SAS) and excel spreadsheet. The analysis of variance (ANOVA) was used to show any variation in the quality of arc welding; comparisons of means using the Least Significant Difference (LSD) at the alpha level of 5% were done to determine which pairs of artisans affected quality significantly. The study found out that informally trained artisans with secondary education working in urban areas exhibited the highest quality of arc welding. The informally trained artisans with primary education working in rural areas exhibited the lowest quality of arc welding. Generally the product quality from artisans with secondary education was higher than that from artisans with primary education. Formal training can improve the quality of products from rural artisans. Business location does only affect the quality of welding from informally trained artisans at any education level.It is recommended that the quality of products from artisans with lower education and especially those working in rural areas can be improved by raising their standard of education and/or by formal training.

Key words: Modes of Training, Product Quality, MSE, Metalworking sub-sector, Arc welding

1.0 Introduction

The quality of products from the MSE sector is affected by both the artisan's attributes- age, gender, educational level, mode of training, work experienceand membership to business support and business's attributes - its age, location, ownership structure, and formal status and business activity. All these attributes determine the performance and productivity of the enterprise (Kimuyu, 2001).

This paper discusses the findings of a study that was designed to investigate experimentally the relationships between the quality of arc welding in the Small Scale Metalwork sub-sector and the artisan's education level and mode of training,and business location. The understanding and validation of these relationships is important for the effective marketing of the MSE products.

While it is accepted that higher education and training is necessary for faster individual development, the same may not necessarily be true for product quality. There is, therefore, a need to find out how the artisan's education level, mode of training, business location and other attributes influence the quality of products.Most of the studies on MSE activities have been carried out mainly in urban areas using either qualitative or survey methods. The researchers obtained their data through the use of one or more of the following instruments: questionnaires, desk reviews, observations, interviews, focus group discussions, and content analysis. This study was mainly experimental (with a bit of qualitative using observation as far as the use of welding equipment and welding techniques are concerned to find out which groups – secondary/primary or urban/rural or trained/untrained - were proficient or understood the welding process).

In arc welding processes the most common defects are either surface defects (cracks, distortion, overlaps and rolls, undercuts, excessive spatter, and bad weld surface appearance) or subsurface weld defects. These defects come as a result of improper selection of processes, incorrect current setting, prior defects (laminations or impurities), undesirable inclusion (e.g. Hydrogen), poor profile, incorrect joint preparations and poor fit-up, stray arcing, tool marks, undercuts, etc. (Parmar, 1997).

1.1 Objectives of the Study

1.1.1 Overall objective

The main objective of this study was to investigate the factors affecting the quality of arc welding in small scale Metalworking sub-sector in Kenya.

1.1.2 Specific Objectives

To assess the relationship between the quality of arc welding and:

- Education level;
- Modes of Training; and
- Business location.

1.2 Hypotheses

To achieve the objectives of this research study the following hypotheses were postulated:

- There is no significant difference between the quality of arc welding from trained artisans with **primary education** and that from trained artisans with **secondary education**.
- There is no significant difference between the quality of arc welding from **formally trained** artisans and the quality of arc welding from artisans that are **trained-on-the-jobs**.
- There is no significant difference between the quality of arc welding from artisans working in the **rural areas** and the quality of arc welding from artisans working in the **urban areas**.

The independent variables of the study are the artisan's attributes (education level and mode of training) and the business characteristics (business location), while the dependent variable are the scores awarded to indicate the quality of the product fabricated by the artisan by using arc welding processes.

2. Material and Methods

2.1 Sampling

The target population of the study consisted of experienced artisans who had completed class eight of the Kenyan primary education and experienced artisans who had completed form four of the Kenyan secondary education. The artisans were selected both from rural and urban areas with two modes of training (on-the-job training and formal technical training).

The Kenyan MSE sector engages about 8.33 million operators (Government of Kenya, 2010). Out of this the *Jua Kali* sector (the MSEs that are engaged in technical work) is about 18% according to the National MSE baseline Survey conducted in 1999. The most widely used welding method is arc welding for mild steel products, and according to the survey the number of artisans engaged in welding and fabrication is about 37,485 (Government of Kenya, 1999). About 60% and 40% of this number comprise primary education class eight graduates and secondary education form four graduates respectively (Government of Kenya, 2004).

Based on these figures the total population for primary class eight artisans was taken to be 22,491 and for secondary form four was taken to be 14,994. A total of 36 artisans with primary education class eight and a total of 36 artisans with secondary education form four were selected for assessment. The sample size determination was based on the relation:

$$n = \frac{Nc^2}{c^2 + (N-1)e^2}$$; where n = sample size, N = population size,

c = coefficient of variation (≤ 30%), and e = error margin (≤ 5%).

This formula enabled the researchers to minimize the error and enhance stability of the estimates (Nassiuma, 2000). In this study *c* was taken to be 30% and *e* to be 5% (using the maximum percentage in each case). Table 1 show the number and category of artisans who participated in this study.

Table 1: Number and category of artisans who participated

Education Level	Attributes	Urban Area	Rural Area	Total
Secondary Education	Formally trained	5	14	**19**
	Informally trained	10	7	**17**
	Total	***15***	***21***	***36***
Primary Education	Formally trained	6	10	**16**
	Informally trained	8	12	**20**
	Total	***14***	***22***	***36***
Total		**29**	**43**	**72**

The Directorate of Industrial Training (DIT) testing centers were used for this research. This was meant to minimize the effect on the quality of the fabricated products due to the condition of the

welding equipment; (the welding equipments used in all DIT testing centers are more else of the same working condition).

The selected DIT testing centers were those with high concentrations of welders, and easily accessible by the researchers. A total of ten (10) DIT testing centers were used as shown in Table 2. Work started at the same time in all testing centers. Research assistants (who had been selected from among the DIT trained examiners) were used to supervise the participating artisans.

2.2 Evaluation

a) The effect of **education level** was evaluated by comparing the mean scores of the following groups:

- Formally trained artisans with secondary education and those with primaryeducation working in urban areas.
- Formally trained artisans with secondary education and those with primaryeducation working in rural areas.
- Informally trained artisans with secondaryeducation and those with primaryeducation working in urban areas.
- Informally trained artisans with secondaryeducation and those with primary education working in rural areas.

Besides the above primary groups the effect of **education level** was also evaluated by comparing the mean scores of the following combined groups of artisans with different other attributes:

- Formally trained artisans with secondary education and those with primaryeducation.
- Informally trained artisans with secondaryeducation and those with primaryeducation.
- Artisans with secondaryeducation and those with primaryeducation working in urban areas.
- Artisans with secondaryeducation and those with primaryeducation working in rural areas.
- Artisans with secondaryeducation and those with primary education.

b) The effect of **mode of training** was evaluated by comparing the mean scores of the following groups:

- Formally and informally trained artisans with secondaryeducation in urban areas.
- Formally and informally trained artisans with secondaryeducation in rural areas.
- Formally and informally trained artisans with primary education in urban areas.
- Formally and informally trained artisans with primary education in rural areas.

Besides the above primary groups, the effect of **mode of training** was also evaluated by comparing the mean scores of the following combined groups of artisans with different other attributes:

- Formally and informally trained artisans with secondaryeducation.
- Formally and informally trained artisans with primaryeducation.
- Formally and informally trained artisans working in urban areas.
- Formally and informally trained artisans working in rural areas.
- Formally and informally trained artisans.

c) The effect of **business location** was evaluated by comparing the mean scores of the following groups:

- Trained artisans with secondary education working in urban areas with those in rural areas.
- Artisans that are trained-on-the-job with secondary education working in urban areas with those in rural areas.
- Trained artisans with primary education working in urban areas with those in rural areas.
- Artisans that are trained-on-the-job with primary education working in urban areas with those in rural areas.

Besides the above primary groups, the effect of **business location** was also evaluated by comparing the mean scores of the following combined groups composed of artisans with different other attributes:

- Artisans with secondary education working in urban areas with those in rural areas.
- Artisans with primary education working in urban areas with those in rural areas.
- Trained artisans working in urban areas with those in rural areas.
- Artisans trained-on-the-job working in urban areas with those in rural areas.
- Artisans working in urban areas with those in rural areas.

Table 2: DIT Testing Centres and Number of Participating Artisans

DIT Centre (Province)	Education Level	Urban		Rural		Total
		F	**I**	**F**	**I**	
1. NIVTC	Primary	2	2	0	0	4
(Nairobi)	Secondary	2	3	0	1	6
2. Ruaraka	Primary	1	0	0	0	1
(Nairobi)	Secondary	1	2	0	0	3
3. Kakamega	Primary	0	0	1	1	2
(Western)	Secondary	0	0	1	0	1
4. Turbo	Primary	0	0	4	0	4
(Western)	Secondary	0	0	11	1	12
5. Kiambu	Primary	0	0	2	2	4
(Central)	Secondary	0	0	0	1	1
6. Machakos	Primary	0	0	3	7	10
(Eastern)	Secondary	0	0	0	2	2
7.Mombasa	Primary	0	5	0	0	5
(Coast)	Secondary	1	2	0	1	4
8. Eldoret	Primary	0	0	0	0	0
(Rift Valley)	Secondary	0	1	0	0	1
9. Nakuru	Primary	0	0	0	1	1
(Rift Valley)	Secondary	1	0	1	0	2
10.Kisumu	Primary	3	1	0	1	5
(Nyanza)	Secondary	0	2	1	1	4
Total		**11**	**18**	**24**	**19**	**72**

F – Formally Trained; I – Informally Trained (i.e. trained-on-the-job)

2.3 Data Generation Tools

Two instruments were used to collect the required data. These were:

i) Structured questionnaires, and
ii) Assessment of fabricated product.

The questionnaire was used mainly to get information regarding the artisan's attributes and business characteristics. The participating artisans were generally observed to find out how proficient they were in using the welding equipment and methods/techniques as outlined in the introduction.

2.4 Assessment of Product Design

A drawing of the product shown in figure 1 was used in the research. The welding project was marked out 100%. The product was designed in such a way that most of the welding techniques were to be used in fabricating it. In this study, manual welding was employed; the artisans were given materials in the form of sheets and they were supposed to measure and cut the parts to the sizes shown. The parts were joined together using arc welding processes. The assessment was carried out by checking for the correct part sizes (by using verniercalipers), and examining for the correct part alignment, correct welding and product finish. The quality of welded joints depends upon the design of the product, the performance of welding equipment, the welding procedures followed, and the skill of the operator. In this study any deficiency in the design and equipment affected all artisans equally. Therefore, the skill of the welder was to determine the scores obtained.

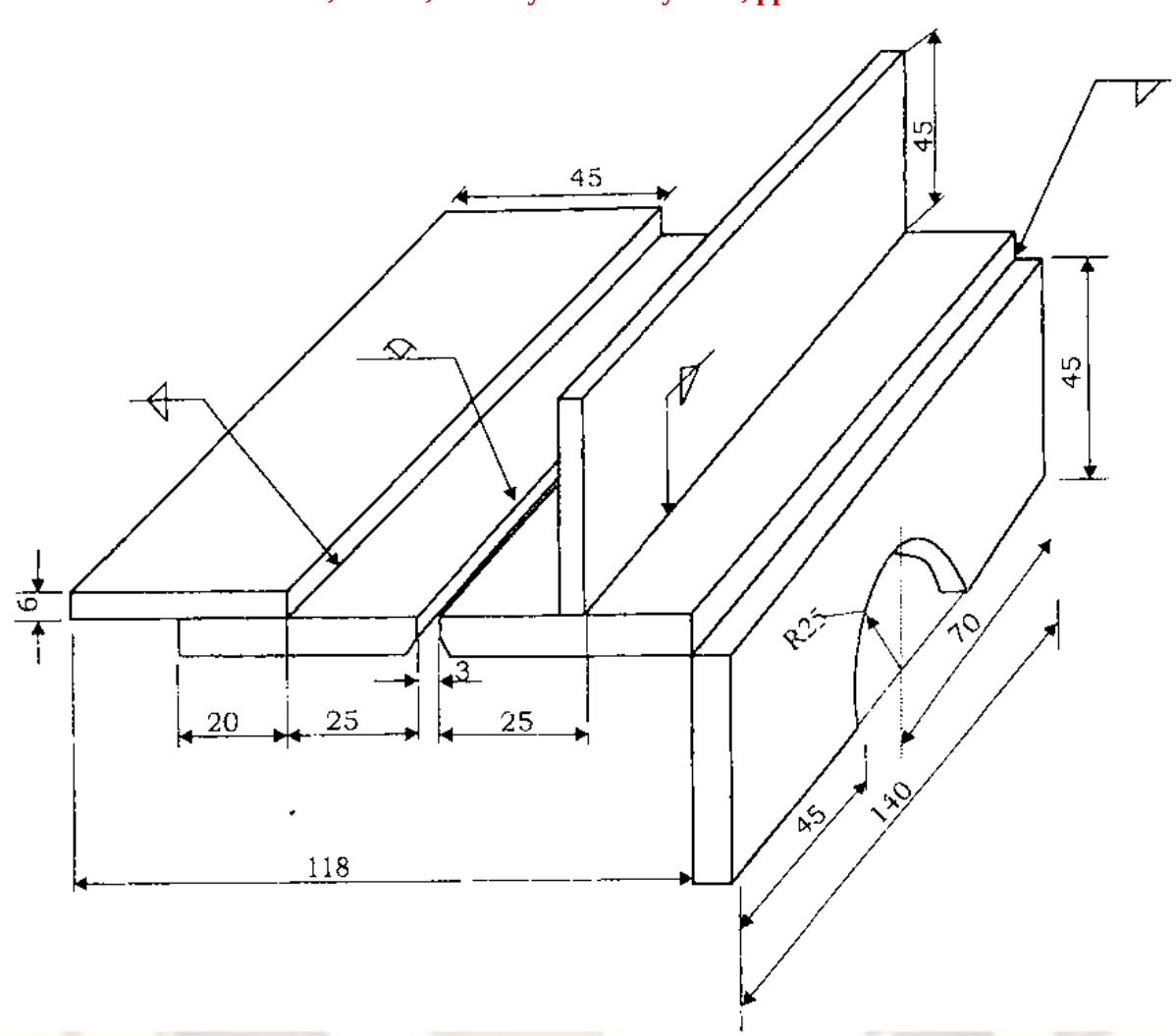

Figure 1:Mild Steel Welding Project

2.5 Weld Inspection and Testing

Weld inspection and testing was carried out to determine the quality of the welded product from each artisan by way of awarding scores. This was also to ensure the artisans prepared and fitted up the work properly with particular reference to whether:

- The parts are formed and dimensioned within the tolerance limits in accordance with the drawing specifications;
- The parts to be welded are spaced properly at the joint;
- The fusion faces are free from dirt, rust, grease, etc.

Welding inspection and testing are also to confirm whether the artisans used the correct welding procedures, including welding current, weld angles, electrode size, welding sequence and number of weld runs, arc length, welding speed, inter-run deslagging, chipping back when a sealing run is applied, etc. ; the use of correct welding procedures and parameters produce quality products and earn more marks.Visual inspection was used to detect surface defects; careful visual inspection of welds can detect about 80% to 90% of the defects and flaws (Parmar, 1997); this was carried out at the testing centers.Radiographic and hardness testing was carried out by the Ministry of Roads, department of material testing.

3. Results and Discussion

The data (scores) collected were analyzed using the Statistical Analysis System (SAS) and excel spreadsheet. The means and standard deviations were generated to describe the quality of arc welding with regard to the education level / mode of training/business location. The scores were matched with the artisans' attributes and business characteristics to find their relationships. The analysis of variance (ANOVA) was used to show any variation in the quality of arc welding in each of the eight groups of artisans due to the different treatments, that is, education level, mode of training and business location. Comparisons of all possible pairs of means using the Least Significant Difference (LSD) method with alpha set at 5% were done to determine which pairs of

artisans with quality performances that was significantly different.

3.1 Effect of education level on product quality

The artisans' marks awarded for quality of arc welding provided the data for determining the impact of education level on product quality. The analysis of variance was carried out and the results are presented in Tables 3 and 4. Table 3 shows mean scores of product quality for education level for primary groups of artisans with the same attributes, and Table 4 showsmean scores of product quality for education levels for combined groups of artisans with different other attributes.

Table 3: Mean scores of product quality for education levels from primary groups of artisans with same attributes

Education Level	Urban (Mean Score =70.33)		Rural (Mean Score =61.57)		Overall Mean
	Formal Training	Informal Training	Formal Training	Informal Training	
Secondary	68.700[a]	73.450[a]	69.857[a]	65.071[b]	**69.96[a]**
Primary	66.583[a]	70.250[a]	60.350[b]	50.875[c]	**60.43[b]**

The means followed by the same letter in the same column are not significantly different at α = 5% using LSD.

The results in Table 3 for both formally and informally trained artisans with secondary and primary education working in urban areas show no significant differences, while the results for the rural artisans in both cases differ significantly with the secondary education holders having higher mean scores. This means that education level does not have a significant impact on product quality from artisans working in urban areas. However, it is noted that the mean scores from artisans formally trained in the rural are higher in comparison to those from artisans trained-on-the-job in the rural. The overall mean scores are significantly different, with that for artisans with secondary education being higher than the mean score for artisans with primary education.

Table 4: Mean scores of product quality of education levels for combined groups of artisans with different other attributes

Education Level	Formal Training	Informal Training	Urban Areas	Rural Areas	Overall Mean
Secondary	69.55[a]	70.00[a]	71.83[a]	68.26[a]	**69.76[a]**
Primary	62.69 [b]	58.63[c]	68.68[a]	58.18[bc]	**60.43[b]**

The means followed by the same letter in the same column are not significantly different at α = 5% using LSD

Table 4 shows that there is a significant difference in mean scores of both formally and informally trained artisans, with secondary education graduates performing better than primary education graduates. This analysis shows that higher level of education has a higher positive impact on product quality.

Overall artisans with secondary education perform better than artisans with primary education. These results are consistent with the findings of Sonobe*et al*, (2003) who found out that primary graduates took 12.6 years to produce quality machine tools while high school and college graduates took 0.7 of a year to produce quality machine tools. This shows that higher education is essential in learning to produce high quality products.

These results are also consistent with the findings of Mullei (2003) in his study on small manufacturing firms where he sought to identify factors that determine firm growth and transformation among small firms in Kenya. The study covered food processing, woodworking, textile and garments, and metal working sub-sectors. The study found out that for an enterprise to graduate from, say micro to small enterprise, the education level and training of the manager/owner and the sector to which the enterprise belonged to, had a significant influence on enterprise graduation.

Mullei (2003) also found out that more than half of small producers were primary school graduates whose ability to assimilate new technologies, innovate and imitate perfectly is limited. The study, therefore, recommends the raising of managerial, vocational and technical skills of small entrepreneurs for long-term industrial development. This shows the importance of higher level of education and formal training.

3.2 Effect of mode of training on product quality

A total of 35 formally trained and 37 informally trained artisans were selected to participate in this study. The artisans' marks awarded for quality of arc welding provided the data for determining the impact of training on product quality. The analysis of variance was carried out and the results are presented in Tables 5 and 6.

Table 5 shows mean scores of product quality for mode of training for primary groups of artisans with the same attributes, and Table 6 showsmean scores of product quality for mode of training for combined groups of artisans with different other attributes.

Table 5: Mean scores of product quality for modes of training from primary groups of artisans with same attributes

Mode of Training	Secondary		Primary		**Cumulative Mean Scores**
	Urban	Rural	Urban	Rural	
Formal	68.700[a]	69.857[a]	66.583[a]	60.350[b]	**66.41[b]**
Informal	73.450[a]	65.071[a]	70.250[a]	50.875[c]	**63.85[b]**

The means followed by the same letter in the same column are not significantly different at α = 5% using LSD.

Table 5 shows that there are no significant differences in the mean scores of the first three columns. Both formally and informally trained artisans with secondary education perform equally irrespective of their business locations. The same also applies to those artisans with primary education but located in urban areas. However, there is a significant difference in mean scores of the formally trained and informally trained artisans located in the rural areas, with the mean score of product quality from artisans formally trained being higher. The implication from this analysis is that the combined effect of business location and training has very little effect on the performance of artisans with secondary education irrespective of their business locations. In the case of artisans with primary education the combined effect of business location and training has very little effect on the performance of those in urban areas while having a significant effect on those artisans in the rural areas; those informally trained artisans in the rural areas performed poorly. Although the analysis of variance (ANOVA) showed that the combination of education level, mode of training and business location does not have significant impact on the quality of arc welding, it does affect the informally trained artisans in the rural areas significantly.

Table 6: Mean scores of product quality for modes of training from combined groups of artisans with different other attributes

Modes of Training	Secondary	Primary	Urban	Rural	**Overall Mean**
Formal	69.55[a]	62.69[b]	67.55[a]	65.90[b]	**66.41[a]**
Informal	70.00[a]	58.63[b]	72.03[a]	56.11[c]	**63.85[a]**

The means followed by the same letter in the same column are not significantly different at α = 5% using LSD.

Table 6 shows that there are no significant differences in the mean scores in all columns except for the rural column. This means that the performance of both formally and informally trained artisans with secondary and primary education, or working in urban areas does not significantly differ. This implies that the mode of training does not have a significant impact on product quality of products from artisans with secondary and primary education, or working in urban areas. However, there is a significant difference in the mean scores in the rural column. This implies that the mode of training has significant impact on product quality of products from artisans working in rural areas. Overall there is no significant difference in mean scores between the formal training and the informal training; however, the formally trained artisans mean score is slightly better than that from artisans with informal training.

These results are consistent with the findings of Mullei (2003). In his study of small manufacturing firms Mullei (2003) sought to identify factors that determine firm growth and transformation among small firms in Kenya. The study covered food processing, woodworking, textile and garments, and metal working sub-sectors. The study found out that for an enterprise to graduate from, say micro to small enterprise, the education of the manager/owner and the sector to which the enterprise belonged to, had a significant influence on enterprise graduation. Education was found to have a marginal effect on graduation, probably indicating the importance of vocational training skills (formal training), which are lacking among many small producers. Mullei (2003) also found out that more than half of small producers were primary school graduates whose ability to assimilate new technologies, innovate and imitate perfectly is limited. The study, therefore, recommends the raising of managerial, vocational and technical skills of small entrepreneurs for long-term industrial development. This shows the importance of higher level of education and formal training.

In overall there is no significant difference in mean scores from formally and informally trained artisans, as the last column shows. This

further confirms the ANOVA results using SAS which showed that the mode of training has very little impact on product quality from artisans. This also confirms that the combined effect of training and education does not have a significant impact on product quality.

3.3 Effect of business location on product quality

A total of 29 participating artisans was selected from urban areas and 43 participating artisans were selected from rural areas for evaluation in this study. The artisans' scores awarded for quality of arc welding provided the data for determining the impact of business location on product quality. The analysis of variance was carried out and the results are presented in Tables 7 and 8. Table 7 shows mean scores of product quality for business locations for primary groups of artisans with the same attributes, and Table 8 showsmean scores of product quality for business locations for combined groups of artisans with different other attributes.

Table 7: Mean scores of product quality for business locations for primary groups of artisans with same attributes

Business Location	Mean Scores				Cumulative Mean Scores
	secondary		Primary		
	Formally Trained	Informally Trained	Formally Trained	Informally Trained	
Urban	68.70[a]	73.45[a]	66.58[b]	70.25[a]	**70.33[a]**
Rural	69.86[a]	65.07[b]	60.35[b]	50.88[c]	**61.57[b]**

The means followed by the same letter in the same column are not significantly different at α = 5% using LSD

Table 7 shows that there is no significant difference in the mean scores in the first and third columns. Thus the performance of both formally trained artisans with secondary or primary education from urban and rural areas does not significantly differ. This implies that the business location does not have a significant impact on product quality of these groups of artisans.However, there is a significant difference in the mean scores in the second and fourth columns; this implies that the business location has significant impact on product quality of these groups of artisans. The high quality was exhibited by the informally trained artisans with secondary education working in the urban areas, while the low quality was exhibited by the informally trained artisans with primary education working in the rural areas. Overall artisans in urban areas emerged with the best product quality as compared with product quality from artisans in rural areas.

Table 8: Mean scores of product quality for business locations for combined groups of artisans with different other attributes

Business Location	Secondary Education	Primary Education	Formal Training	Informal Training	**Overall Mean**
Urban	71.83[a]	68.68[a]	67.55[b]	72.03[a]	**70.33[a]**
Rural	68.26[a]	58.18[c]	65.90[b]	56.11[c]	**61.57[b]**

The means followed by the same letter in the same column are not significantly different at α = 5% using LSD.

Table 8 shows that there is no significant difference in the mean scores in the first and third columns, that is, the overall performance of artisans with secondary education or with formal training is more else the same irrespective of the business location. However, in the second and third columns the differences in mean scores are significant; this implies that in overall artisans from urban areas with a primary education or informally trained have their product quality higher than their counterparts from rural areas.

Overall artisans in urban areas emerged with the best product quality as compared with product quality from artisans in rural areas. The results agree with Sonobe*et al*, (2002) who, when studying on the performance of garment enterprises in Jili, China, found out that the performance in producing quality products between enterprises in urban and remote centres (rural areas) were different; urban enterprises performed better than rural enterprises.

The mean score for the informally trained artisans working in rural areas is significantly different from the other mean scores. The majority in this group have primary education class eight artisans (12 out of 19 artisans). It is evident from Tables 7 and 8 that the informally trained artisans working in urban areas perform better than their counterparts who are formally trained.

3.4 The Level of Influence on Product Quality by the three Factors

The degree to which the three factors (that is, education levels, modes of training, and business locations) affect product quality were obtained from the SAS results which indicated that:

- Education level has the highest impact on product quality (with a probability of 0.0005) followed by
- Business location (with a probability of 0.0018), and
- The combinations of business location and training (with a probability of 0.0382), followed by
- The combination effect of education and business location (with a probability of 0.0625) followed by
- The impact of mode of training (with a probability of 0.3102)
- The combination effect of education and training follows (with a probability of 0.4997)
- The interaction of all the three factors together has very little or no impact on product quality (with a probability of 0.7394).

3.5 Test for Multicollinearity

Multicollinearity is a violation of the assumption that no independent variable is a linear function of one or more other independent variable.To test for multicollinearity a logic model was estimated at:

$L_i = \text{Ln}\left(\frac{P_i}{1-P_i}\right) = \beta_1 + \beta_2\, Educ + \beta_3 BusLoc + \beta_4\, MoT + u_i$ and three regressions using STATA software, one for each explanatory variable on the remaining others were run and the magnitude of the resulting R-squared were examined.The R-squared (education R^2 = 0.0089, training R^2 = 0.107 and business locationsR^2 = 0.0046) of the three regressions were relatively low, and therefore it was concluded that there is no multicollinearity among education level, mode of training and business location variables.

3.6 Heteroscedasticity

Heteroscedasticity is a violation of one of the classical linear regression model assumptions that requires that the disturbances have the same variance. It is caused by several factors including the presence of outliers in the data, omitted variables, incorrect functional forms, and it is much more present in cross-sectional data. The logit model in the equation

$(L_i = \text{Ln}\left(\frac{P_i}{1-P_i}\right) = \beta_1 + \beta_2\, Educ + \beta_3 BusLoc + \beta_4\, MoT + u_i)$ Was regressed using STATA software, and to control for heteroscedasticity the **robust standard errors** were used. Marginal effects were generated and used in the interpretation.

The following results were found from the marginal effects that were generated after logistic regression of the equation:

- Higher educational level affects positively the probability of producing good quality welding; Having a secondary educational level as opposed to primary education increases the probability of having good quality welding by 0.173 or 17.3%. This coefficient is statistically significant at 10% confidence interval (with p-value of 0.053).
- The probability of producing good quality welding is 0.157 or 15.7% lower for those artisans who have been trained-on-the jobs as compared to those artisans who have been trained formally. This coefficient is statistically significant at 10% confidence interval (with p-value of 0.065).
- The probability of producing good quality welding is 0.269 or 26.9% higher for a business located in urban area as opposed to a business operating in rural areas. This coefficient is statistically significant at 5% confidence interval (with p-value of 0.002).

4 Conclusions and Recommendations

4.1 Conclusions

4.1.1 Education Level:

- Higher level of education has a higher positive impact on product quality. Products made by artisans with primary education level are of lower quality than those products made by their counterparts with secondary education level.
- Artisans with higher levels of education in rural areas perform better than those with lower levels of education.
- The quality of products made by artisans (especially in the rural areas) can be improved by raising the standard of education.
- Artisans with lower education and training are constrained by lack of adequate knowledge to enable them understand the welding theory on their own.

4.1.2 Mode of Training:

- Training alone has very little impact on product quality; however, when combined with business location the impact on product quality is very significant.
- Formal training can improve the product quality from artisans with lower education working in rural areas.
- The product quality from informally trained artisans with low education can be improved by either giving them formal training or raising their education level.
- While formal training improves performance of artisans working in the rural areas, it, however,

contributes very little to those artisans working in urban areas.

4.1.3 Business Location:

- Business location has a significant impact on product quality; urban work experience has a higher positive impact on product quality as compared to rural work experience.
- Urban work experience when combined with higher education level, even without formal training, has a higher positive impact on product quality than higher education level combined with formal training.
- Business location does not affect the performance of formally trained artisans at any education level, but it affects the performance of those artisans trained-on-the-jobs at any education level.
- Urban work experience contributes more significantly to product quality than education level alone and formal training alone.
- Overall, there is a significant difference in product quality between artisans working in urban areas and artisans working in rural areas .
- This implies that business location alone has significant impact on product quality.

All the three variables (education level, mode of training and business location) were shown to be independent of each other by using multicollinearity testing.

4.2 Recommendations

The following recommendations are suggested:

- More resources should be directed towards training and raising education levels of artisans with low education and working in rural areas. Adult education strategies should be used to create and stimulate interest among the trainees.
- *MSE/Jua Kali* artisans should be encouraged to take the Government Trade Tests up to at least Grade II so as to raise their competency level. The Kenya Bureau of Standards should also be asked to enforce quality standards in the informal sector.

The following research studies are recommended to further augment the present achievements of this study:

- This study investigated the impact of education level, mode of training and business location in the metalwork sub-sector. Research studies should be designed to investigate how other attributes affect product quality and/or the performance of the MSE sub-sectors.
- Research should also be conducted to investigate how education level, mode of training and business location affect the quality of product quality in other disciplines especially those that are mostly dominated by women.
- It was observed that artisans working in urban areas with the same education levels, those without formal training performed better than those artisans with formal training. However, it was expected that the formally trained artisans should perform better than those trained-on-the-jobs as was the case with the artisans working in rural areas. It is, therefore, recommended that further research be conducted to investigate this phenomenon.

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