Reliability and Validity Testing of a New Scale for Mesuring Attitudes toward Electronics and Electrical Constructions Subject

Sofia D. Anastasiadou
University of Western Macedonia
3o km Florinas Nikis, 53100, Florina, Greece
Email: sanastasiadou@uowm.gr, Phone: 00302310416056

Lazaros Anastasiadis
Electrical Engineer, Kapetanidi 21, 55131
Thessaloniki, Greece
Email: sofan@uom.gr, Phone: 00302310410000

Abstract

The aims of this paper are to determine the validity and reliability of SATEECS scale as an instrument to measure students' attitudes that monitors affective components relevant to learning the disciple of electronics and electrical construct and its impact on students' career in a Greek sample came from department of Electronics of the Technological Institute of Western Macedonia in Greece. Initially, it was consisted of 30 items concerning 5 conceptual subscales which measure students' attitudes concerning Emotions toward the disipline, Cognitive Competence, Value of the disipline, Difficulty of the disipline, Sufficiency of laboratory of instructive material. In particular, the paper reports the responses of 198 Greek students from the department of Pre-school Education of the Western Macedonia University in Greece. The results of the present study provide the final scale, which is consisted of the all the 30 items of the initial SATEECS Scale and for which strong evidence was ascertained.

Keywords: Reliability, Validity, Electronics, Electrical Constructs, Scale

1. Theoretical Framework

The degree of Electrical Engineers among others includes units covering physics, mathematics, project management and specific topics in electrical and electronics engineering. Initially such topics cover most, if not all, of the sub fields of electrical engineering. Students then choose to specialize in one or more sub fields towards the end of the degree. Moreover Electronics Education described innovative ways computers are being used in undergraduate and graduate Electronics courses and their impact on the way these courses are being taught (Anastasiadou et al., 2011a; Anastasiadou et al., 2011b; Croft, 2000). Many electrical engineering departmnets recently introduced a significant amount of electronic design automation into its digital systems curriculum, which is used by a number of classes at both the undergraduate and graduate levels. The tools include PSpice, Palasm, and Workview, which supply a broad range of important capabilities (Haggard, 1993). For an engineer it is not sufficient to know only DC-circuit theory but to apply it in the lab (Anastasiadou et al., 2011a). Anna-Karin Carstensen and Bernhard (2007) argued that during lab work, students are expected to link observed data to either theoretical models, or to the 'real world' they are exploring. Electronic and electrical Constructions/ Manufactures subject (Laboratory) is also related with mathematics calculations.

One aspect in the successful stydents performance and achievement is attitude. For this reason, students' attitudes toward Electronics and Electrical Constructions' computers have been studied with different samples and instruments by many researchers since the 1990s (Croft, 2000). Croft (2000) among others found that students who consider learning electronics useful, are not very anxious about learning electronics, and are confident about being able to learn electronics. They also had positive attitudes toward mathematics, were confident in learning electronics that involves mathematics, considered learning electronics that involves mathematics as useful, and felt that taking required mathematics classes was useful for learning electronics. He added that electronics technology students who did not take much mathematics while in high school, and don't understand how much mathematics they will take or use as they study college-level electronics. These students while in high school may not have been aware of the role of mathematics in the study of electronics. They also may need to take remedial mathematics classes before enrolling in certain electronics classes.

2. Research goals

Electric engineering education community pays attention to the impact that Electronics and Electrical Constructions Subject may have on the learning Electronics. Therefore, it is of great interest to investigate the attitudes of professionals, students and teachers, towards Electronics and Electrical Constructions Subject.

Due to this reason, the present study aims to create a reliable and valid tool capable to measure students' awareness of Electronics and Electrical Constructions Subject learning in connection with the electronics students development issue by taking into consideration vital parameters such as, positive and negative attitudes concerning electronics and electrical constructs, positive and negative attitudes about intellectual knowledge and skills when applied to Electronic-Electric Manufactures concepts, positive and negative attitudes concerning the usefulness, relevance and worth of Electronic-Electric Manufactures in the student's personal and professional life, positive and negative attitudes about the difficulty of Electronic-Electric Manufactures course, positive and negative attitudes to Sufficiency of laboratory of instructive material. This specific tool is under investigation for its reliability and validity as there are no other relative instruments for this type of measurement.

3. The instrument

The instrument, which intended to measure students' attitudes toward Electronics and Electrical Constructions Subject, is The Students' Attitude toward Electronics and Electrical Constructions Subject (SATEECS). The SATEECS scale is intercultural, meaning that it can be applied in different cultural environments, provided that it is not revoked by local cultural peculiarities. This tool consisted of 30 items referring to five different attitude subscales, as follows: (a) Emotional—'positive and negative feelings about electronics and electrical constructs' (7 items), (e.g. I do not feel insecurity when I find myself confronted with the laboratorial part of Electronic-Electric Manufactures course), (Q14, Q1, Q3, Q27, Q12, Q4); (b) Cognitive Competence – 'attitudes about intellectual knowledge and skills when applied to Electronic-Electric Manufactures concepts' (6 items), (e.g. I will make a lot of mathematical errors in Electronic-Electric Constructions Subject), (Q2, Q20, Q6, Q8, Q9, Q22, Q17); (c) Value –'attitudes about usefulness, relevance and worth of Electronic-Electric Manufactures in the student's personal and professional life' (7 items), (e.g. Electronics technical skills will make students more employable), (Q5, Q7, Q19, Q18, Q28, Q24); (d) Difficulty—'attitudes about the difficulty of Electronic-Electric Manufactures course' (5 items) (e.g. The measurements on the manufacture are particularly specialised), (Q10, Q30, Q20, Q13, Q25, Q16); (e) Sufficiency of laboratory of instructive material (7 items) (e.g. My teacher motivates me to learn physics science concepts) (Q11, Q15, Q29, Q21, Q23).

The 30 items have created the above 5 different attitude subclales, thus those subscales are the results of the explanatory factor analysis.

Each item of the instrument used a 5-point Likert scale that ranged from 1- Strongly Disagree to 5-Strongly Agree. The value of the Cronbach's α coefficient for this instrument in this study's sample was 0.642.

4. Sample

The sample consists of 198 tudents that took part in the research from the department of Electronics of the Technological Institute of Western Macedonia in Greece. 198 valid questionnaires were collected in the beginning of the first semester of the academic year 2010-11. 176 (88.9%) were male and 22 (11.1%) female students. 27 (13.6%) are in the second, 78 (39.4%) in the third year, 49 (24.8%) in the fourth, and finally 44 (22.2%) in the fifth year of studies. 179 (90.4%) have graduated from Lyceum and 19 (9.6%) from TEE. 182 (92%) want to get the their degree, 7 (3,5%) a master degree, 5 (2,5%) for a PhD, and only (2%) a second degree. 169 (85.4%) hope to work in the public sector and 29 (14.6%) in the private sector.

5. Methodology

The aim of this research study is to determine the validity and reliability of the SATEECS Scale which was designed as an instrument to measure students' attitudes towards toward Electronics and Electrical Constructions Subject in a Greek sample. The evaluation of questionnaire reliability- internal consistency is possible by Cronbach's α (Cronbach, 1984), which is considered to be the most important reliability index and is based on the number of the variables/items of the questionnaire, as well as on the correlations between the variables (Nunnally, 1978). The reliability of the instrument means that its results are characterized by repeativenes (Psarou and Zafiropoulos, 2004) and these results are not connected with measurement errors (Zafiropoulos, 2005), was evaluated by Cronbach alpha coefficient. The index alpha (a) is the most important index of internal consistency and is attributed as the mean of correlations of all the variables, and it does not depend on their arrangement (Anastasiadou, 2006). Then a Principal components analysis with Varimax Rotation produces the dimension of differentiation was used in order to confirm or not the scale construct validity. To define if the sub-scales were suitable for factor analysis, two statistical tests were used. The first is the Bartlet Test of Sphericity, in which it is examined if the subscales of the scale are inter-independent, and the latter is the criterion KMO (Kaiser-Meyer Olkin Measure of Sampling Adequacy, KMO) (Kaiser, 1974), which examines sample sufficiency. The main method of extracting factors is the analysis on main components with right-angled rotation of varimax type (Right-angled Rotation of Maximum Fluctuation), so that the variance between variable loads be maximized, on a specific factor, having as a final result little loads become less and big loads become bigger, and finally, those with in between values are minimized (Hair et al., 2005). This means that the factors (components) that were extracted are linearly irrelevant (Anastasiadou, 2006). The criterion of eigenvalue or characteristic root (Eigenvalue) ≥1 was used for defining the number of the factors that were kept (Kaiser, 1960, Sharma, 1996, Hair et al., 1995). Model acceptance was based on two criteria: a) each variable, in order to be included in the variable cluster of a factor, must load to it more than 0.5 and b) less than 0.4 to the rest of the factors) (Schene, et al., 1998). Moreover, each factor must have more than two variables. In addition, it was considered, on the basis of common variable Communalities, that the variables with high Communality (h^2) imply great contribution to the factorial model (Hair et al., 2005). For the statistical data elaboration and check of the questionnaire factorial structure the software S.P.S.S., edition 19 was used.

6. Reliability

The following table of Reliability Statistics (Table 1) inform us about the value of the coefficient a of Cronbach for the research scale is 0.642=64,2%. This gets over the percent of 60%, which is an extra good value for the internal consequence of the conceptual construction of the investigated scale (Anastasiadou, 2010; Nouris, 2006). If we continue with the release of units, in other words with the standardized value of the variables, then the coefficient Cronbach a will slightly increase the value of α=0.656. This means that whether we increase the number of the items, then Cronbach a will take the value of 0.656.

Insert table (1) about here

The table Scale Statistics (Table 2) gives the scores that are related to the scale's entirety, which presents a mean of the class of 96,80 and a standard deviation of the class of 9.126 units.

Insert table (2) about here

The table Item-Total Statistics (Table 3) gives the following important information in particular.

Insert table (3) about here

Especially, in the second column of the above table the particular scale of measurement SATEECS gives mean value 92.09, 92.44, 94.62, 94.71, 92.78, 93.06, 93.82, 92.69, 93.14, 93.33, 94.30, 94, 93.49, 92.91, 92.82, 94.37, 94.41, 92.34, 94.68, 92.85, 92.73, 94.71, 95.07, 94.57, 94.78, 92.65, 93.67, 94.68, 92.69 units, which means that it presents a decrease of 4.71, 4.36, 2.18, 2.09, 4.02, 3.74, 2.98, 4.11, 3.66, 3.45, 2.5, 2.8, 3.31, 3.89, 3.98, 2.33, 2.39, 4.26, 2.12, 3.95, 4.07, 2.09, 1.73, 2.23, 2.02, 4.15, 3.13, 2.12, 4.51 units, in case the specific items Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q11, Q12, Q13, Q14, Q15, Q16, Q17, Q18, Q19, Q20, Q21, Q22, Q23, Q24, Q25, Q26, Q27, Q28, Q29, Q30 are omitted from (taken off) the scale. In the fourth column the number 0.231, 0.138, 0.133, 0.178, -0.036, 0.184, 0.321, 0.290, 0.317, 0.049, 0.245, 0.297, 0.075, 0.399, 0.440, 0.239, 0.188, 0.246, -0.047, 0.082, 0.244, 0.234, 0.375, 0.131, 0.159, 0.145, 0.068, 0.152, 0.278, 0.065 means that the specific items Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q11, Q12, Q13, Q14, Q15, Q16, Q17, Q18, Q19, Q20, Q21, Q22, Q23, Q24, Q25, Q26, Q27, Q28, Q29, Q30 appear the Pearson coefficient of correlation of the class 23.1%, 13.8%, 13.3%, 17.8%, -13.6, 18.4%, 32.1%, 29%, 31.7%, 14.9%, 24.5%, 29.7%, 17.5%, 39.9%, 44%, 23.9%, 18.8%, 24.6%, -14.7%, 18.2%, 24.4%, 23.4%, 37.5%, 13.3%, 15.9%, 14.5%, 16.8%, 15.2%, 27.8%, 16.5% with the sum of the rest variables that remain in the scale when these items Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10, Q11, Q12, Q13, Q14, Q15, Q16, Q17, Q18, Q19, Q20, Q21, Q22, Q23, Q24, Q25, Q26, Q27, Q28, Q29, Q30, vanish each one separately. All the items appear from good up to medium to high correlation coefficients and they will not omit from the scale.

7. Sample suffiency test and sphericity test

The following table 4 (Table 4) gives information about two hypotheses of factor analysis. From the following table, we find out that sample sufficiency index KMO by Kaiser-Meyer-Olkin, which compares the sizes of the observed correlation coefficients to the sizes of the partial correlation coefficients for the sum of analysis variables is 76.4%, and it is reliable because it overcomes 70% by far. In addition, supposition test of sphericity by the Bartlett test (Ho: All correlation coefficients are not quite far from zero) is rejected on a level of statistical significance $p<0.0005$ for Approx. Chi-Square=787.098. Consequently, the coefficients are not all zero, so that the second acceptance of factor analysis is satisfied. As a result, both acceptances for the conduct of factor analysis are satisfied and we can proceed to it.

Insert table (4) about here

8. The Scree plot graph

The scree test (Figure 1) produces the following graph, which proceeds to a graphic representation of eigenvalues and guides us to the determination of the number of the essential factorial axes.

Insert figure (1) about here

The above graph 1 (Graph 1) presents a distinguished break up to the fifth component, whereas after the eighth factor an almost linear part of the eigenvalue curve follows. Thus, we can take under consideration the eigenvalues, which are over 1 for all the five components (4.071, 3.165, 1.925, 1.726 and 1,633 for the 1st, 2nd, 3rd, 4th and 5th respectively) and decide whether they interpret data in a satisfactory way.

9. Results

The 99 valid questionnaires were collected with the aim of carrying on a pilot study. It concerns the validity and reliability of the questionnaire which was designed for the working out of a doctoral writing work. We chose to base our estimate on the Principal component analysis with the variance-covariance matrix, because the 30 variables were obtained on a 5-point scale of Likert. The adequacy indicator of the sample KMO=0.764>0.70 indicated that the sample data are suitable for the undergoing of factor analysis. The control of sphericity (Bartlett's sign<0.001) proved that the principal component analysis has a sense. Through this analysis, data grouping was based on the inter-correlation with the aim of imprinting those components which describe completely and with clarity the participants' attitudes towards the research subject. According to the analysis (Table 6), arise 5 uncorrelated componets, which explain the 62.737% percentage of the whole inertia of data and are described separately afterwards. The coefficient of internal consistency (reliability) Crobach's a is statistically significant and equals to 64.2% for the total number of questions. That is why the scale of 30 questions was considered as reliable in terms of internal consistency of the conceptual construction that was composed for the students' attitudes toward Electronics and Electrical Constructions Subject. The reliability coefficient (Crobach's a) is statistically significant and equals to 72.18%, 62.63%, 63.05%, 65.18% and 61.92% for the 1st, 2nd,3rd, 4th and 5th factorial axis correspondingly. Eventually, from the values of the common communality (Table 5) we ascertain for each question that the majority of them have a value higher than 0.50 which represents satisfactory quality of the measurements from the model of 5 factors or components.

Insert table (5) about here

Table 6 presents the components and the factor loadings produced after Principal Components Analysis. More specifically, based on student attitudes as presented by the factor analysis, questions Q14, Q1, Q3, Q27, Q12 and Q4 particularly with high loadings (0.774, 0.743, 0.718, 0.679, 0.636, 0.623) load mainly on the component F1, with eigenvalue 4.071, which explains, following Varimax rotation, 17.570% of the total dispersion. Factor F1 represents students' inability and incapability to deal with analysis and designing of circuits because they find them highly technical although they value electronics technical skills. This component highlights the difficulty of electronics constructions discipline. The reliability of the first factor is a=0.7305, which is particularly satisfactory It is important to mention that all the above items Q14, Q1, Q3, Q27, Q12 and Q4 without exception appear with high loadings (0.774, 0.743, 0.718, 0.679, 0.636, 0.623) on the first component, have the Pearson correlation coefficient (39.9%, 23.1%, 13.3%, 16.8%, 29.7%, 17.8%, from good to high and this result to problem non existence in reliability. Reliability of the first factor is a=0.7218, which is particularly satisfactory.

Insert table (6) about here

Questions Q2, Q20, Q6, Q8, Q9, Q22 and Q17 particularly with high loadings (0.768, 0.762, 0.729, 0.711, 0,707, 0.683, 0.635) load on the second component (F2), with eigenvalue 3,165, which explains 13.551% of the total dispersion. The second component (F2) consists of the statements of students who may think that they will have not major troubles understanding electric-electronics constructions science concepts because experiment helps in the comprehension of theory and generally theoretical analysis of course is considered to be easy. The fact indicates that using the design and improvement of learning environments in regard to electric-electronics constructions is useful in the understanding of the relative theory.Moreover students think that elements of safety of appliances and Technology elements of passive and active equipments can be easily understood. Thus there is no need to be insecurity when they have to do the laboratorial part of course Electronic-electric Manufactures because Requirements and appropriateness of material analysis is useful in the formal profession of technologist of electricity.

All the items Q2, Q20, Q6, Q8, Q9, Q22 and Q17 without exception appear to have high loadings loadings (0.768, 0.762, 0.729, 0.711, 0.707, 0.683, 0.635) on the second component, have the Pearson correlation coefficient (13.8%, 18.2%, 18.4%, 29%, 31.7%, 23.4%, 18.8%) from good to high and this result to problem non existence in reliability. The reliability of the second component is a=0.6263, which is satisfactory. Questions Q5, Q19, Q7, Q18, Q24 and Q28 particularly with high loadings (-0.718, 0.716, 0.708, -0.679, 0.643, 0.586) load on the third component (F3) with eigenvalue 1,925 which explains 12.418% of the total dispersion. The third component highlights the negative attitude towards calculation of circuits understanding due to mathematical errors and the laboratory that it does not serve the needs of course and toward the manufacture of electric and electronic provisions in plaques.

All the items Q5, Q19, Q7, Q18, Q24 and Q28, without exception appear to have either high or low loadings(-0.718, 0.716, 0.708, -0.679, 0.643, 0.586) on the third component, have the Pearson correlation coefficient from good to high (-13.6%, -14.7%, 32.1%, 24.6%, 13.1%, 15.2%) and this results to problem non existence in reliability. The reliability of the third component is *a*=0.6305, which is satisfactory. Questions Q10, Q30, Q26, Q13, Q25 and Q16 particularly with high loadings (0.692, 0.651, 0.630, 0.593, 0.545, 0.539) are load on the fourth component (F4) with eigenvalue 1,726 which explains 10.753% of the total dispersion. The fourth component (F4) consists of variables that concern the facility of Electronic-Electric Constructions as a Subject. It is important to stress that the items Q10, Q30, Q26, Q13, Q25 and Q16 appear to have high loading loadings (0.692, 0.651, 0.630, 0.593, 0.545, 0.539) on the fourth component, as well as high correlation coefficient Pearson with the sum of the rest variables (49%, 16.5%, 18.2%, 17.5%, 15.9%, 23.9%) that remain in the scale and this results to problem non existence in reliability, and ascertains their remains in the scale. The reliability of the fourth component is *a*=0.6518, which is satisfactory.

The fifth and final component (F5) with eigenvalue 1,633 which explains 10.52% of the total data inactivity, is constructed and interpreted by questions Q15, Q11, Q29, Q23 and Q21 with quite high loadings (0.83, 0.659, 0.643, 0.627, 0.598). The fifth component consists of variables that concern the value of the course and its projects in their future working environment thus they are not satisfied with the laboratory because the equipment is not sufficient. It is important to give emphasis that the items Q15, Q11, Q29, Q23 and Q21 appear high loading on the fifth component (0.83, 0.659, 0.643, 0.627, 0.598) as well as high correlation coefficient Pearson with the sum of the rest variables (44%, 24.5%,43.6%, 37.5%, 24.4%) that remain in the scale, and this ascertains their remains in the scale. The reliability of the fourth componet is *a*=0.6192, which is satisfactory. Finally, the principal factor analysis totally arise seven factor-composite variables, which are named: Emotional, Cognitive Competence, Value, Difficulty and Sufficiency of laboratory of instructive material. It must be noted that none of the items of the SATEECS questionnaire have factor loading on any other factor mentioned above, and therefore the factors are not interrelated. Therefore, a model of five factors is created. Furthermore, it is essential to investigate whether there is a problem in the adaptability of this model.

10. Test of good adaptability

The control of good adaptability as well as the sphericity control prerequisite multidimensional normality. The test of good fit of the five factor model was based on the method of Generalized Weighted Least Squares. By this test the null hypothesis Ho assumes that there is no problem with the good fit of the model to the examined data. From the table 7 (Table 7) further down we ascertain that the observatory level of statistical significance sign.=0.755>0.05 is over of the cutoff point 5% and therefore we accept the null hypothesis Ho, or in other words, we accept that the estimated five factor model has good fit.

Insert table (7) about here

11. Conclusions

Therefore, a model of five factors has created after the examination of the validity and reliability of the initial Students' Attitude toward Electronics and Electrical Constructions Subject Scale (SATEECS). The SATEECS Scale constitutes of a 30 item questionnaire and is an instrument useful for measuring students' attitudes toward Electronics and Electrical Constructions Subject and its impact on individual personal and professional life. Principal component analysis made evident five subscales, named as: Emotional, Cognitive Competence, Value, Difficulty and Sufficiency of laboratory of instructive material. It is worth mentioning that Students' Attitude toward Electronics and Electrical Constructions Subject Scale (SATEECS) was developed based on student input and was designed as either a pretest or a posttest measure; it appeared to hold considerable promise as a research instrument for identifying the structure of attitudes toward Electronics and Electrical Constructions Subject.

Although this study has provided new insights into the dimensions of Electric engineering education as these are outlined in a lab learning enviroment or supported electronics teaching within Design and and Technology according to new challenges and demands, future research will be needed to more fully understand these dimensions to cotemporary education demands for achieving high achivements. Future studies with students from similar electronics technology departments need to be conducted and then compared with this study. In addition Croft (2000) argued that due to the fact that mathematics plays a role in the learning and degree completion requirements of college-level students studyingelectronics technology it seems appropriate that this groups' attitudes toward of their attitude toward mathematics may provide information about their perception of the relevance mathematics has to studying electronics technology. This future research could be used to determine whether students from other electronics technology departments have a similar attitude toward Electronics and Electrical Constructions Subject, mathematics, Mathematics in Electronics technology, and Electronics Technology.

A qualitative research can complement and enrich this quantitative research study and the same research may take place at the end of the studies of our sample graduate students as the comparison of two seems to have huge interest and create new discussions and implications.

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Table 1: Reliability Statistics

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,642	,656	30

Table 2: Scale Statistics

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
96,80	83,285	9,126	30

Table 3: Item-Total Statistics

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Q1	92,09	80,757	,231	,453	,634
Q2	92,44	80,270	,138	,498	,638
Q3	94,62	79,974	,133	,489	,639
Q4	94,71	78,862	,178	,477	,635
Q5	92,78	83,134	-,136	,400	,651
Q6	93,06	78,935	,184	,406	,635
Q7	93,82	75,212	,321	,524	,620
Q8	92,69	78,401	,290	,424	,627
Q9	93,14	76,939	,317	,343	,623
Q10	93,33	81,510	,149	,341	,646
Q11	94,30	77,744	,245	,328	,629
Q12	94,00	76,857	,297	,401	,624
Q13	93,49	81,416	,175	,436	,643
Q14	92,91	74,859	,399	,531	,614
Q15	92,82	75,069	,440	,483	,612
Q16	94,37	77,461	,239	,322	,629
Q17	94,41	78,592	,188	,432	,634
Q18	92,54	79,047	,246	,536	,630
Q19	94,68	82,976	-,147	,392	,657
Q20	92,85	81,048	,182	,434	,643
Q21	92,73	78,547	,244	,444	,630
Q22	94,71	76,373	,234	,430	,630
Q23	95,07	76,740	,375	,539	,620
Q24	94,57	79,126	,131	,437	,640
Q25	92,57	80,167	,159	,360	,637
Q26	94,78	79,113	,145	,518	,639
Q27	92,65	80,761	,168	,362	,646
Q28	93,67	76,837	,152	,603	,642
Q29	94,68	75,690	,278	,436	,625
Q30	92,69	81,176	,165	,336	,645

Table 4: KMO and Bartlett's Test

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,764
Bartlett's Test of Sphericity	Approx. Chi-Square	787,098
	df	435
	Sig.	,000

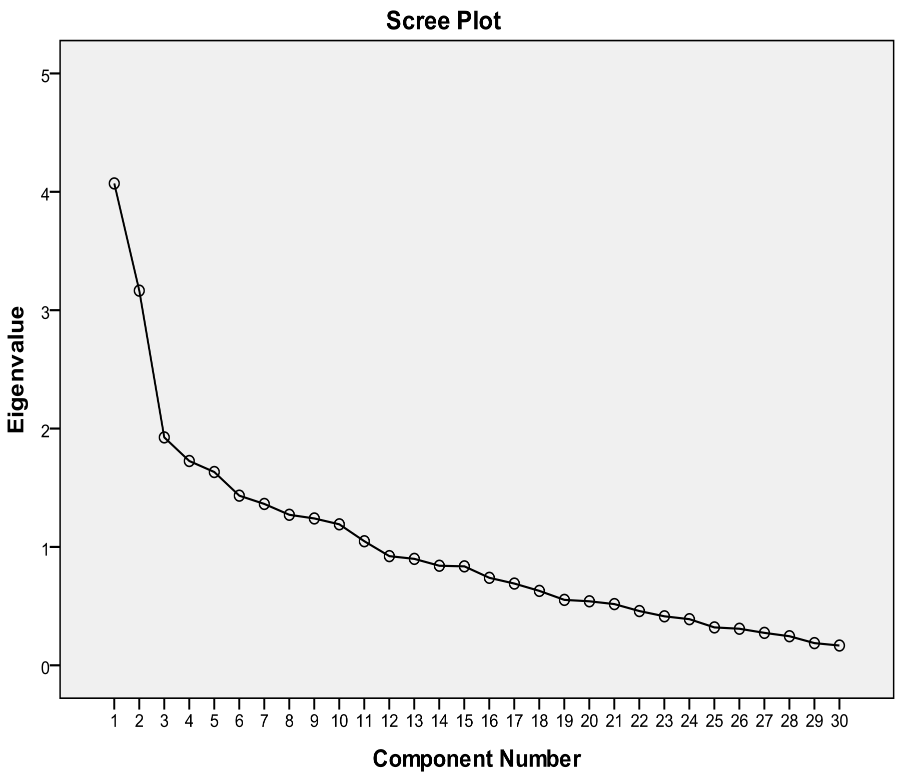

Figure 1: Scree Plot

Table 5: Commuality Table

Communalities

	Initial	Extraction
Q1	1,000	,798
Q2	1,000	,739
Q3	1,000	,768
Q4	1,000	,673
Q5	1,000	,689
Q6	1,000	,696
Q7	1,000	,683
Q8	1,000	,671
Q9	1,000	,658
Q10	1,000	,610
Q11	1,000	,628
Q12	1,000	,688
Q13	1,000	,613
Q14	1,000	,813
Q15	1,000	,613
Q16	1,000	,531
Q17	1,000	,595
Q18	1,000	,632
Q19	1,000	,686
Q20	1,000	,704
Q21	1,000	,501
Q22	1,000	,630
Q23	1,000	,523
Q24	1,000	,532
Q25	1,000	,586
Q26	1,000	,636
Q27	1,000	,716
Q28	1,000	,528
Q29	1,000	,607
Q30	1,000	,658

Extraction Method: Principal Component Analysis.

Table6: Principal Components Analysis' Results

		Factors				
Items- questions	F1	F2	F3	F4	F5	Communality
Q14: Electric/electronic Technical skills will make me more employable	0.774					0.813
Q1: Theory helps in the manufacture of experiment	0.743					0.798
Q3: I find it difficult to understand the analysis of circuits	0.718					0.768
Q27: Notes of laboratory are sufficient	0.679					0.716
Q12: Measurements on the manufacture are particularly specialised	0.636					0.688
Q4: I don't comprehend the designing of circuits	0.623					0.673
Q2: Experiment helps in the comprehension of theory		0.768				0.739
Q20: Requirements and appropriateness of material analysis is useful in the formal profession of the technologist of electricity		0.762				0.704
Q6: Technology elements of passive and active Equipments can be easily understood		0.729				0.696
Q8: Elements of safety of appliances can be easily understood		0.711				0.671
Q9: theoretical analysis of course is easy		0.707				0.658
Q22: I do not feel insecurity when I have to do the laboratorial part of course Electronic-electric Manufactures		0.683				0.630
Q17: finding elements of material in Data book and network are not without value		0.635				0.595
Q5:I understand the calculation of circuits			-0.718			0.689
Q19: The use of basic tools of their bench will not be essential in work			0.716			0.686
Q7:I make a lot of mathematical errors in calculations			0.708			0.683
Q18: The way of manufacture of work is very dexterity useful in the formal profession of technologist of Electrology			-0.679			0.632
Q24:I will be under stress during the manufacture of electric and electronic provisions in plaques			0.643			0.532
Q28: The pace of laboratory does not serve the needs of course			0.586			0.528
Q10: Designing of printed circuit is easy				0.692		0.610
Q30: Equipment of laboratory facilitates in the finalisation project				0.651		0.658

Q26: I am not afraid of projects manufacture				0.630		0.636
Q13: The formulation of bulletins of handling of manufacture, maintainance and repair are easily learned by most persons/students				0.593		0.613
Q25: I enjoy to follow courses of manufacture of printed circuit				0.545		0.586
Q16: Programs of circuits planning and PCB are useful in the formal profession of technologist of electrician				0.539		0.531
Q15: Technical abilities of electric/electronic manufactures it should be integral part of their professional education					0.683	0.628
Q11: Project' manufacture requires specialized way of thinking					0.659	0.613
Q29: The equipment of laboratory is not sufficient					0.643	0.607
Q23: I get frustrated going over measurements in class					0.627	0.523
Q21: like to follow lectures of theoretical part of course					0.598	0.501
Eigenvalue	4.071	3,165	1,925	1,726	1,633	
Variance Explained %	17,570%	13.551%	12.418%	10.753%	8.443%	
Cronbach's a	72,18%,	62,63%,	63,05%,	65,18%	61,92%	
Total Variance Explained %	62.737%					
Total Reliability Cronbach's α	64.2%					
Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.764 Bartlett's Test of Sphericity: x^2=787.098, df=435, p=0.000						

Table 7: Goodness-of-fit Test

Goodness-of-fit Test

Chi-Square	df	Sig.
277,906	295	,755