Impact of the Two-Tier System on Learning of Physics Concepts: A Case of Electrical Trade Skill and Circuits

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Abstract

This study investigated the influence in form of attitude, performance, interest to those learners taking electrical engineering at trade test level, on their ability to understand electrical circuits a physics topic in the science 5124 curriculum.

The learners were purposefully selected from Solwezi School for Continuing Education (SSCE) and the research was a descriptive design. The results were analysed using a descriptive and inferential statistics including the SPSS software for research analysis.

A pilot study was conducted, instruments adjusted, and survey implemented, instructional model designed and evaluated for its effectiveness. Data was collected using questionnaires, test results analysis and interviews. The reliability of the instruments was tested using Cronbach's alpha (α). The findings of the research pointed to the fact that, when well-coordinated, learning electrical engineering under the two-tier system, improves pupils' academic performance in the subject of physics. It is hoped that this study will help to scientifically legitimize the benefits of the two-tier system which the ZECF 2013 formulated into the new curriculum of 2013.

Keywords: academic performance, two-tier learning system, electrical engineering trade, attitude, daily life, learner, motivation

1. Introduction

Physics is taught so that learners understand the world around them, develop a positive scientific attitude, stimulate the learners' curiosity and sense of enquiry. The ultimate goal of promoting quality science learning and teaching is to transform learners at all levels into educated nation builders, proactive and creative, culturally rooted, and committed to universally shared values (UNESCO, 2007). However, Physics knowledge contents and concepts are challenging to teach and more still, challenging to learn especially by novices

primarily due to the undetermined nature of physics enquiries that often results into a variety of solutions.

Studies conducted by Palmer (1995) reviewed that, pupils take physics and its concepts to be something difficulty and alien to their lives. In addition to this, pupils find it challenging to link the knowledge acquired from physics in the resolution of practical daily problems. In order to make physics education more meaningful and linked to real life, it is important to present to learners, physics concepts and knowledge that exists within the sphere of their world experiences.

This study recognizes the two-tier system, provided for in the Zambia Education Curriculum Framework of 2013 (ZECF2013), as that providing this sphere of experiences to school pupils. It is hoped that, apart from achieving the economic objective of providing a skills foundation to future professionals for the technology industry, the two-tier learning system has and will also help in achieving the social objective by stimulating the development of creative thinking, problem solving and impart good values to learners.

The focus of this study is to establish if the two-tier learning system has had any effect on the academic performance of learners taking it. The study will also labour to establish if the two-tier learning system has any effect on the learners' attitude towards physics and to what extent is the two-tier learning system influencing the day to day lives of the learners.

The curriculum, which the ZECF2013 has provided, promotes the teaching of skills courses to pupils alongside their academic learning materials. It is envisaged that the curriculum, made this way, will equip learners with vital knowledge, skills and values that are necessary for contributing to the development of society and the economy. A curriculum made in this way will have an enriched impact on the attitude, retention of science concepts and performance in basic science among pupils taking it. The Science 5124 (Grades10–12) syllabus has twelve (12) topics, thus, General Physics, Mechanics, Thermal Physics, Wave Motion, Sound, Light, Magnetism, Static Electricity, Current Electricity, Electromagnetic Induction, Basic Electronics and Atomic Physics.

This research will help to determine whether the vision for the revised curriculum of making a real difference to learners both in school and in their lives is being realized or achieved, TCIG2013 page 2. This research is meant to bring to light the changes in academic performance of pupils in the subject of physics, the attitudes and skills acquired of learners taking electrical engineering under the two-tier learning system. This was arrived at by examining their physics test results during the period the pupils enrolled to learn electrical engineering. Interviews and questionnaires have also been used to determine the attitudes and skills gained by the pupils.

2. Problem Statement

There has been poor academic performance in physics at Solwezi School for Continuing Education. The table below tabulates the overall pass percentages in physics Continuous Assessment Tests (PCAT) for the years 2018, 2019 and 2020.

Table 1. Physics Grades 10, 11 and 12 CAT results for Solwezi School for Continuing Education (SSCE) (2018-2020)

Year	Overall Pass Percentage.
2018	32%
2019	54%
2020	28%

Source: (School statistician, Solwezi School for Continuing Education, 2020).

The underperformance in physics has been attributed to many factors that includes lack of exposure of pupils to scientific material, lack of science books and equipment, teaching methodologies being used by teachers, teachers' qualifications and school infrastructure. However, there have been no research conducted at Solwezi School for Continuing Education to support these attributed underperformance explanations.

The two-tier system, conceptualised as work integrated learning and teaching (WIL) based approach to teaching academic disciplines (Patrick & et al, 2008), can contribute towards pupils' improved performance. It is visualised that the two-tier learning system can contribute to holding

the learners' interest, developing a deeper understanding of the concepts and increasing the retention of new information to the learners.

Therefore, this study was designed to investigate the impact of the two-tier system on learning of physics concepts. Its focus was on the learning of electrical trade skill and the values gained, retention of knowledge and improvement in performance by pupils on the topic of electrical circuits.

This study was designed to cover the entire senior grades of 10, 11 and 12 pupils taking physics at Solwezi School for Continuing Education in Solwezi district of North-Western Province of Zambia. The research is designed to concentrate on examining the impact of the two-tier learning system on the pupils' performance on the topic of circuit solving skills.

The research is intended to further explore the attitude, which the two-tier system brought to learners, towards the subject of physics and in addition, the research is meant to determine the extent of the influence on the pupils' daily lives brought in by the two-tier system.

3. Purpose of the Study and Research Questions

The purpose of this study was intended to investigate the impact of the two-tier system on learning of physics concepts. The study focused on the case of electrical trade skill being offered in schools and the direct academic performance of pupils taking it especially on the topic of electrical circuits.

This study was designed to provide answers to the following research questions:

(a) What is the impact of the two-tier system on learners' performance in circuit solving skills?

(b) What is the effect of the two-tier system on learners' attitude towards physics?

(c) How is the two-tier system influencing learners' daily lives with regard to practical trade in electrical engineering?

4. Research Design

Salkind (2010) states that, research design is the researcher's plan of how to proceed to gain an understanding of some group or some phenomenon in its context. Based on that theory, the research design of this research is descriptive in nature because the phenomenon is not manipulatable. According to Gay (1992, p217), descriptive research involves collecting data in order to answer questions concerning the current status of the subject of the study. A descriptive study determines and reports the way things are. In this study, the researcher attempts to gather data in order to establish the relationship between the two-tier system and the academic performances of learners at Solwezi School for Continuing Education (SSCE).

The variables for this research are the two-tier learning system, in form of electrical engineering, being taken up by learners at Solwezi School for Continuing Education. Learner performance is reflected in the academic performances, attitude of learners and the ability of learners to post-apply their learnt skill. The researcher's goal is to determine whether there exists a relationship between the variables, by observing traits in the purposefully chosen group of learners. This group of learners undertook electrical engineering as a two-tier learning in their three years of learning from grade ten to grade twelve.

5. Research Findings and Analysis

5.1 Views of the Respondents

The personal views relating to the respondents were considered. The data collected under the views of the respondents included the rating to indicate the effectiveness of how the skills trade of electrical engineering is taught to school pupils at SSCE; and, if the said pupil respondents had any desire to further their studies in electrical engineering, taking it as a career.

5.2 Rating of the Effectiveness of Teaching of Electrical Engineering at SSCE

The distribution table 4.5 implied that a whopping 53.8% of the respondents rated the teaching of electrical engineering trade skills to academic class at SSCE as good. In addition to this, another 43.8% of the respondents rated the teaching to be very good. Only a negligible 2.5% rated the teaching to be average. This implies that the collected views were from respondents who had a very positive rating of the teaching of electrical engineering at SSCE.

5.3 Desire to Take a Career in Electrical Engineering

The data in table 4.6 implies that 86.3% of the

respondents had the desire to advance their career in electrical engineering given the chance to do so. On the contrary a 13.8% of the respondents had other careers in mind.

5.4 Descriptive Statistics for Electrical Engineering as a Two-Tier Learning System

The descriptive statistics for Electrical Engineering as a two-tier learning system are tabulated in the table 4.7. This gave findings as analysed from the questionnaire on a Likert scale. The minimum score was 2 and the maximum score was 5. This showed that the scoring for the items was fairly spread. The overall mean for the variable was 4.10. the value was above 3 and indicates that upper scores on the scale dominated. The standard deviation of 0.49 indicate that the spread of the scores was fair. normality tests of the scores under the variable were done using skewness and kurtosis. The skewness value of -2.311 indicate a clustering of scores at the high end or right-hand side of the graph. This means that most of the responses ranged from agree to strongly agree. The kurtosis value of 3.427 indicate that the distribution is rather peaked or clustered in the centre with long thin tails.

5.5 Descriptive Statistics for Academic Performance in Physics

The descriptive statistics for Academic Performance in Physics are tabulated in the table 4.8. The minimum score was 2 and the maximum score was 5. This showed that the scoring for the items was fairly spread. The overall mean for the variable was 3.99, the value was above 3 and indicates that upper scores on the scale dominated. The standard deviation of 0.14 indicate that the spread of the scores was fair. Normality tests of the scores under the variable were done using skewness and kurtosis. The skewness value of 0.316 indicate a positive skew of clustering of scores to the left at the low values. The kurtosis value of 0.960 indicate that the distribution is relatively peaked or clustered in the centre with long thin tails.

5.6 Descriptive Statistics for Attitude Towards Subject of Physics

The descriptive statistics for Attitude towards the subject of Physics are tabulated in the table 4.9. The minimum score was 1 and the maximum score was 5. This showed that the scoring for the items was fairly spread. The overall mean for the variable was 4.02, the value was above 3 and indicates that upper scores on the scale dominated. The standard deviation of 0.56 was and indicate that the spread of the scores was fair. Normality tests of the scores under the variable were done using skewness and kurtosis. The skewness value of -0.361 indicate a clustering of scores at the high end or right-hand side of the graph. This means that most of the responses ranged from agree to strongly agree. The kurtosis value of 2.453 indicate that the distribution is rather peaked or clustered in the centre with long thin tails.

5.7 Descriptive Statistics for Influenced Daily Life

The descriptive statistics for Electrical Engineering trade influenced the respondents' daily lives are tabulated in the table 4.10. The minimum score was 1 and the maximum score was 5. This showed that the scoring for the items was fairly spread. The overall mean for the variable was 3.80, the value was above 3 and indicates that upper scores on the scale dominated. The standard deviation was 0.58 and indicate that the spread of the scores was fair. The skewness value of 0.106 indicate a clustering of scores at the high end or right-hand side of the graph. This means that most of the responses ranged from neutral, agree to strongly agree. The kurtosis value of 1.122 indicate that the distribution is relatively peaked or clustered in the centre with long thin tails.

5.8 Validity Statistics

The validity of the collected data was analysed to establish how well the research instrument measured the concepts. The statistics used to establish validity were extracted by carrying out Exploratory Factor Analysis (EFA). The statistics included the Kaiser-Meyer-Olkin (KMO) value, which was used to determine whether it was worth it to perform factor analysis; the factor loadings which explained the relationship between the components and the items or questions for each variable. The factor loadings also indicated the degree to which the components explained the variance in the data for the items. The total variance explained by each component was also used to assess the validity of the quantitative data.

6. Discussion

6.1 Electrical Engineering as a Two-Tier Learning

System

The findings on the Electrical Engineering as a Two-tier learning system shows that the majority of the respondents agreed with the objective that electrical engineering is a very beneficial two-tier learning system. The responses implied that electrical engineering, as a two-tier learning system has had a very positive impact on the learners' academic performance in the subject of physics. This was explained by the overall mean for the variable, which was 4.10 way above the standard 3, which indicated that the upper scores on the scale dominated.

The skewness value of -2.311 provided an indication of the symmetry. It indicated a clustering of scores at the high positive end of the graph to represent responses that ranged from agree to strongly agree with the objective. Most of the respondents agreed with this variable showing the effectiveness of the electrical engineering as a two-tier learning system.

6.2 Learners' Academic Performance

From the responses on this variable, it is noted that the majority of the respondents agreed with the variable that their academic performance in physics was strongly improved due to their strong performance in electrical engineering. This was indicated by the overall mean for the variable which was 3.99 way above the standard 3.

This positive response is further confirmed by the skewness value of positive 0.316, which indicates that the size of the positive responses surpasses the negative responses. We can firmly report that the majority of the respondents agree with the fact that learners' academic performance is improved by taking electrical engineering as a two-tier learning system.

6.3 Learners' Attitude Towards Physics

The information describing the attitude of learners towards physics subject showed that the respondents agreed with the motion that learners' attitude towards the subject of physics was improved upon enrolling to study electrical engineering as a two-tier learning system. This is indicative from the overall mean of the variable standing at 4.02 a value way above the value of 3.

6.4 Learners' Daily Lives Influenced by the Two-Tier System

The descriptive statistics on whether learning electrical engineering trade had an influence on the daily lives of respondents in practicing the trade showed a positive response. The overall mean for the variable was above 3 standing at 3.80. the respondents agreed with most of the variable questions that tried to find out if the respondents were practicing the skills, they learnt from electrical engineering trade in their daily lives when faced with a related situation.

6.5 Performance Test Results

The performance test (PT) results for the learners making the study sample were analysed to show trends of improvement either positively or negatively. The trends shows that learners taking electrical engineering were positively improving in their physics termly results as compared to learners not taking electrical engineering as a two-tier learning system.

7. Conclusion

This research study had revealed that there exists a relationship between the trade skill a learner is taking, under the two-tier learning system, and the academic performance of the learner in the subject of physics. The trade skill's impact is actually positive on all the objectives outlined.

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