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Impact of a Developed Electrical Energy Management Instructional Module on Employees' and Students' Knowledge at the Federal University of Technology Minna, Nigeria

[1]Saba, T. M., [2]Mayaki, J., [3]Yisa, S. N., [4]Tsado, J., [5]Raymond, E., [6]Usman, G. A.
[1,3,5&6]Industrial and Technology Education Department
[2]Statistics Department,
[4]Electrical and Electronics Engineering Department
Federal University of Technology Minna Niger State, Nigeria

ABSTRACT

The study investigated the impact of the training using develop electrical energy management instructional module on employees' and students' knowledge at the Federal University of Technology (FUT) Minna, Nigeria. Three objectives and three research questions guided the study. One hypothesis was formulated and tested at 0.05 level of significance. The study adopted convergent parallel design. Quantitative and qualitative data are collected at the same time, analyzed separately, and then merged for interpretation. Quantitative design used is One-Group Pretest–Posttest Design. The training was carried out in Bosso campus of FUT Minna with 134 students from four different Departments in Bosso Campus and 32 employees working in Bosso campus. The training lasted for seven hours. 15 students and 5 employees were interviewed on the impact of the training module. Instrument for pretest and post-test was 50 multiple choice questions, each marked one mark total 50 marks. This instrument was subjected to validation by three experts. Mean and standard deviation were used to answer research questions one and two. While research question three was analyzed through thematic analysis. Paired Samples t-test that is dependent t-test was used to test null hypothesis. There is generally low baseline knowledge and noticeable variation among them students and employees and training increased awareness and understanding on electrical energy, energy efficiency and conservation. The following recommendations were made among others are; university should incorporate electrical energy management concepts into general studies or technical-related courses to build long-term awareness and responsible energy-use habits and University should organize annual or bi-annual workshops on energy conservation and safety management.

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INTRODUCTION

Energy is the capacity that a physical system has to change its states or the states of other physical systems, like changing their velocity or their temperature. The mass of the system is a measure of its energy content. It is one of the essential elements for human development. Various sources of energy can be used to power human activities and often this energy must be transferred from source to a useful form. The quality of life of individuals and the university is affected by energy choices. Today, energy decisions are influenced by education, economic, environmental, and social factors in all countries. All changes that occur in nature are caused by some form of energy exchange. Energy is always

Corresponding author: Saba, T. M.
mosessaba@futminna.edu.ng
Industrial and Technology Education Department, Federal University of Technology Minna Niger State, Nigeria.

a transference between systems and cannot be created or destroyed. There are many forms of energy, but they can all be categorized in two groups: Potential energy, which describes the forms in which energy is stored in a system, like nuclear, chemical, gravitational, or thermal Kinetic energy, which describes the forms in which energy is transferred between systems, like work mechanical, electrical and heat.

Among the various forms of energy in nature, electrical energy stands out as the most outstanding because of its unique qualities and importance to modern life (Saba, et al 2025). It is highly versatile, as it can be easily converted into almost all other forms of energy such as heat, light, sound, motion, and chemical energy. Unlike many other forms, electrical energy can be transmitted over long distances with high efficiency, making it accessible to homes, industries, and institutions worldwide. It is also clean at the point of use since it does not directly produce smoke or harmful gases, which makes it environmentally friendly compared to burning fossil fuels. Another outstanding feature is its ability to be controlled with great precision, which is why it is the backbone of technology, communication, healthcare systems, and industrial processes. In essence, while other energy forms like solar or nuclear are important as sources, electrical energy is the universal carrier that enables and sustains modern development (Saba, etal, 2025; Edison, 2023).

Electricity costs represent the largest expense in the budget of universities (Edison, 2023) This is because universities are using large amounts of electricity to ensure that all facilities are safe, comfortable, secure, and conducive to learning for students. This leads to the high consumption of electricity and high electricity bills. But this consumption is not only acquainted with the useful consumption but also with the electrical losses due to the inefficient electrical system wastages as a result of human behaviour. As educational institutions, they play a crucial role in shaping future generations; however, rising energy costs have become a major obstacle to their growth and development. For these reasons, Higher institutions worldwide are increasingly committed to electrical energy management.

Electrical energy management is the body of knowledge that deals with the use of the electrical energy system in the most efficient way. Improving electrical energy efficiency is central to reducing energy demand. Investment in energy efficiency is prioritized across all educational institutions, residential buildings and industrial operations. Short-term measures create awareness and increase end-user energy savings with attractive payback periods. Adopting electrical energy efficiency measures can also reduce carbon emissions, save money and generate substantial social and environmental co-benefits. Through energy conservation and improved energy efficiency, energy management is considered to provide the most significant scope for reducing the requirements for energy and its impacts on the environment (Mansur, et al 2024). Implementation of energy management in any facilities requires actions like service or retrofits of equipment or change of process demands for investment which can lead to energy cost savings. Energy conservation is the concept of minimizing energy consumption by reducing activities; sometimes, it is a certain degree of sacrifice. On the other hand, energy efficiency maintains the same quality and quantity of output while using less energy. Energy efficiency and conservation are integral parts of energy management.

According to Mansur *et al.* (2024), knowledge of electrical energy savings involves knowing how much energy appliances used, how efficient they are and how activities affect energy consumption. Poor knowledge of electrical energy savings among operators implies the inability to adopt maintenance practices for efficient electrical energy use. The employees and students also need to be aware on the knowledge of energy problem, the potential and actual employees and students' impact on energy use and publicity of energy conservation progress (Fatoki, 2022). Information to employees on energy management will serve as a reminder on when to do things, the things to be done and give imagery on the impact of new and ongoing conservation activities (Saba *et al.,* 2023; Ekundayo, 2018). A well-designed

Corresponding author: Saba, T. M.
mosessaba@futminna.edu.ng
Industrial and Technology Education Department, Federal University of Technology Minna Niger State, Nigeria.

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structure and equipped with efficient technology features, but if the users of that structures lack knowledge of electrical energy management, the efficiency of the structures would not be guaranty thereby may lead to electrical energy wastages (Mansur, *et al,* 2024). Hence the need for training energy users using training module. The utilization of instructional module improves the learner competencies and opportunities to master the subject. This is because a well-planned module present teacher's concepts in a logical order, like building blocks and in its pace-to-pace strategy. In an educational module learner's focus on specific skills are given opportunities to continue to improve on them. Unlike in traditional method, only the teacher has a book and the teacher will deliver the lesson in a conventional manner.

STATEMENT OF THE RESEARCH PROBLEM

Universities uses large amounts of electricity to ensure that all facilities are safe, comfortable, secure, and conducive to learning for students. This leads to the high consumption of electricity and high electricity bills (Edison, 2023). But this consumption is not only acquainted with the useful consumption but also with the electrical losses due to the inefficient electrical system and inappropriate behavioural intentions (Saba, et al 2025).

The behavioural interventions aimed at households have been proving to be cost effective in reducing energy use and reduce emission. To achieved these employees and students must, play notable role in the operation of electrical energy consuming equipment in university. Effort should be made to integrate energy education in university education curriculum. To achieve this, first step is to gain an understanding of university education student's and employees' current energy knowledge and their habit towards energy usage. The developed module, used to trained university employees and students will have a great and long-lasting impact. Awareness is noted to be the seed of tomorrow's change.

Aim and Objectives

The study investigated the impact of developed electrical energy management instructional module on Employees and Students knowledge in Federal University of Technology Minna. Specifically, the study assessed the;

1. baseline knowledge of participants before the intervention on electrical energy management in university.
2. effect of the intervention pretest and posttest results on training received by employees and students
3. extent to which the intervention improves knowledge on electrical energy management

Research Questions

The study sought the answers to the following questions

1. What is the baseline knowledge of participants before the intervention on electrical energy management in university?
2. What is the effect of the intervention pretest and posttest results on training received by employees and students?
3. To what extent the intervention improves knowledge on electrical energy management among participants?

Hypothesis

H_{01}: There is no significant difference in participants' outcomes between the pretest and posttest scores.

METHODOLOGY

The study adopted convergent parallel design (Concurrent Triangulation Design) Quantitative and qualitative data are collected at the same time, analyzed separately, and then merged for interpretation. Quantitative design used is One-Group Pretest–Posttest Design. This design is a type of pre-experimental research design in which a single group is studied before and after a treatment or intervention.

In this design, the group is first given a pretest to measure the baseline condition, then exposed to the treatment, and finally given a posttest to assess any changes that occurred. This approach is often used in situations where it

Corresponding author: Saba, T. M.
mosessaba@futminna.edu.ng
Industrial and Technology Education Department, Federal University of Technology Minna Niger State, Nigeria.

is not possible or practical to have a control group. Interview was conducted to gathered qualitative data. The training was carried out in Bosso campus of FUT Minna with 134 students from four different Departments in Bosso Campus and 32 employees working in Bosso campus. The training lasted for seven hours. 15 students and five employees were interviewed on the impact of the training module on their knowledge in electrical energy Management.

Instrument for pretest and post-test was 50 multiple choice questions, each marked one mark total 50 marks. The questions and answers were re-arranged to guide against familiarization during posttest. This instrument was subjected to validation by three experts, two from the field of Electrical Engineering and one from the field of Electrical Technology Education. The corrections observed were effected before administration of the instrument. Mean and standard deviation were used to answer research questions one and two. While research question three was analyzed using thematic analysis. Paired Samples t-test that is dependent t-test was used to test null hypothesis at 0.05 level of significance.

RESULTS

Research Question One

Table 1a: Baseline knowledge of Students before the intervention on electrical energy management in university

	N	Minimum	Maximum	Mean	Std. Deviation
Students Pretest	134	6.00	34.00	18.05	5.770
Valid N (listwise)	134				

Table 1b: Baseline knowledge of Employees before the intervention on electrical energy management in university

	N	Minimum	Maximum	Mean	Std. Deviation
Employees Pretest	32	20.00	39.00	29.81	5.828
Valid N (listwise)	32				

Table 1a and 1b revealed that Students (N = 134) had scores ranging from 6 to 34, with an average score of 18.05, indicating a generally low baseline knowledge and noticeable variation among them. Employees (N = 32) scored between 20 and 39, with a higher average score of 29.81, showing a substantially higher baseline knowledge compared to students. Before the intervention, employees demonstrated a much higher level of knowledge on electrical energy management than students, suggesting that students had greater knowledge gaps that the intervention aimed to address.

Research Question Two

Table 2a: Effect of the intervention pretest and posttest results on training received by students

	N	**Minimum**	**Maximum**	**Mean**	**Mean Difference**	**Std. Deviation**
Students Pretest	134	6.00	34.00	18.05	**15.96**	5.77
Posttest	134	23.00	47.00	34.01		5.59

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mosessaba@futminna.edu.ng
Industrial and Technology Education Department, Federal University of Technology Minna Niger State, Nigeria.

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Table 2b: Effect of the intervention pretest and posttest results on training received by employees.

	N	Minimum	Maximum	Mean	Mean Difference	Std. Deviation
Employees Pretest	32	20.00	39.00	29.81		5.83
Valid N (listwise)	32	34.00	48.00	40.75	**10.94**	3.98

The results are presented in Tables 2a and 2b examines the impact of the intervention (training) on the knowledge of students and employees regarding electrical energy management. Both groups improved significantly after the intervention, confirming its effectiveness. Students gained more (mean difference 15.96) because they started with lower baseline knowledge and had more room for improvement. employees improved moderately (mean difference 10.94) but achieved higher overall posttest scores.

Research Question Three

Table 3: Extent to which the intervention improves knowledge on electrical energy management.

Theme	Participant Supporting	Summary
Improved Knowledge	100%	Training increased awareness and understanding on electrical energy, energy efficiency and conservation
Intention to save electrical energy	100%	Participants plan to adopt conservation habits in their office, hostels, classes to saved energy.

Some participants agreed and stated, *"The training opened my eyes. I now know how to reduce energy use and curtail wastages, and we plan to start applying it in hostel and offices."* Another added, *"My knowledge on energy usage has improved significantly, and I'm now committed to saving electrical energy.*

Hypothesis One

There is no significant difference in participants' outcomes between the pretest and posttest scores**.**

Table 4a: Significant difference in Students' outcomes between the pretest and posttest scores

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Students Pretest	36.21	133	.000	18.05	17.07	19.03
Students Posttest	70.47	133	.000	34.01	33.05	34.96

Table 4b: Significant difference in employees' outcomes between the pretest and posttest scores

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Employees Pretest	28.94	31	.000	29.81	27.71	31.91
Employees Posttest	57.86	31	.000	40.75	39.31	42.19

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p-values (.000) indicate highly significant differences. Posttest scores far exceed pretest scores, demonstrating real learning gains. The magnitude of t-values and mean differences proves that the developed instructional module had a strong positive impact on knowledge acquisition. Therefore, the claim that "there is no significant difference" is disproven. The results instead show a clear, statistically significant improvement for both students and lecturers after the intervention. The statistical evidence overwhelmingly supports that the instructional module was effective, as both students and lecturers demonstrated significant increases in knowledge following the training. Thus, Hypothesis is rejected.

FINDINGS

1. There is generally low baseline knowledge and noticeable variation among them students and employees.
2. Both groups improved significantly after the intervention, confirming the effectiveness training received.
3. Training increased awareness and understanding on electrical energy, energy efficiency and conservation
4. There is significant difference in participants' outcomes between the pretest and posttest scores.

DISCUSSION OF FINDINGS

Low baseline knowledge and noticeable variation between students and employees this revealed the low awareness and knowledge among the participants. This may likely attribute to electrical energy wastages experience in campus. The low level of awareness and knowledge observed is not coming as a surprise. The outcome agreed with the study that revealed that Nigerian universities and other contexts report limited electrical energy awareness among students and staff and wide between group variability, often because formal energy topics are unevenly covered in curricula and because practical exposure differs by role (Saba et al 2025; Saba et al 2023). This heterogeneity is consistent with work showing differing knowledge levels across cohorts and the need for targeted content rather than one-size-fits-all training. This is in line with the finding of Saba *et al* (2023) that employees` attitudes towards electrical energy conservation in the work place is not positive, as many of the staff do not ensure adequate practice of electrical energy saving while at work and do not make it a habit to switch off the light while leaving the office. To ensure the right attitudes towards electrical energy savings, they need to be motivated by educating the staff to see the need to save energy.

Significant improvement after the training was effective. Improvements replicate a robust body of evidence that well-designed educational or awareness packages reliably increase knowledge and self-reported conservation behaviours. Electrical energy management practice awareness among electricity users is very essential. A well-designed structure and equipped with efficient technology features, but if the users of that structure, lack awareness of energy management, the efficiency of the structure would not be guaranty thereby may lead to electrical energy wastages (The Energy and Resources Institute, 2022).

Awareness is the first and a reliable step among other electrical energy conservation techniques. Awareness of electrical energy conservation and efficiency is an all-important element of electrical energy management practices, as lack of awareness may be the barrier for electrical energy wastages (Oyedepo, *et al.,* 2019). Awareness helps in behavioural change and without the knowledge by the consumers on electrical energy management practices, it will be difficult to provide electricity users with better electrical energy conservation programmes.

The study revealed that training increased awareness and understanding on electrical energy, energy efficiency and conservation. Employees and students' engagement and training play a critical role in promoting a culture of energy efficiency within university. Organizing training on electrical energy management among employees and students provides numerous benefits, including significant cost savings, environmental impact

Corresponding author: Saba, T. M.
✉ mosessaba@futminna.edu.ng
Industrial and Technology Education Department, Federal University of Technology Minna Niger State, Nigeria.

reduction, enhanced safety, and the promotion of a sustainable culture within the organization or institution (Saba, et al 2023). By understanding how to use electricity more efficiently, employees and students can significantly lower the overall energy consumption of buildings and equipment, directly reducing utility bills. Proper use and maintenance techniques taught in the training can prevent overuse or misuse of electrical devices, leading to less frequent repairs and replacements (Ogbuanya and Nungse, 2021).

It is important for university to educate employees and students about the importance of saving energy and involve them in the implementation of energy-saving initiatives. This may involve conducting training sessions on best practices for conserving energy at university, raising awareness about the environmental impact of excessive energy consumption, and providing incentives for employees who actively contribute to reducing energy usage (Bishoge and Mvile, 2024; Alghamidi and El-Hassan, 2019). Saba et al, (2022) agreed that knowledge helps in changing attitudes of people, thereby encouraging users of electricity to look out for ways to save electrical energy and also help in positive behavioural changes towards electrical energy. It ensures that the users of energy take action on electrical energy savings and habits to keep and continue to maintain electrical energy saving appliances/equipment when being installed.

It is certain that the first step towards behavioural change is raising awareness, as awareness is the seed of tomorrow change without which there will be no accurate action to save energy (Wang et al, 2021). Martings et al (2022) observed that knowledge served to provide citizens with tools and motivations to make necessary changes and achieve efficient consumption habits. In this regard Wang et al (2021), mentioned that several researchers have found that there is correlation between an increase in energy literacy and an increase in sustainability of energy use. In an era where sustainability and efficiency are at the forefront of every successful company's agenda, the importance of energy management training cannot be overstated. Understand that managing energy effectively is not just about reducing costs; it's about fostering a culture of sustainability and efficiency that echoes throughout every level of an organization. Electrical energy management training module is designed to equip university student's and employees with the knowledge and skills needed to navigate the complexities of energy usage and management, ensuring they are well-positioned to thrive in today's competitive landscape.

CONCLUSION

The findings of the study revealed that both students and employees had varying levels of baseline knowledge of electrical energy management before the intervention. Students demonstrated low initial knowledge**,** while employees possessed moderate to high pre-intervention knowledge. Following the training intervention, there was a significant improvement in the knowledge levels of both groups. Students' mean score increased from 18.05 to 34.01**,** while employees' mean score increased from 29.81 to 40.75**,** indicating that the instructional intervention was effective in enhancing understanding of electrical energy management practices. The results show that the training programme had a positive and meaningful impact on both students and employees, with students experiencing the highest level of improvement due to their lower starting point. The intervention therefore proved successful in addressing knowledge gaps and improving capacity for electrical energy management within the university environment.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made:

1. Given the low baseline knowledge among students, universities should incorporate electrical energy management concepts into general studies or technical-related courses to build long-term awareness and responsible energy-use habits.
2. Employees showed good initial knowledge, the improvement after training indicates the relevance of

Corresponding author: Saba, T. M.
✉ *mosessaba@futminna.edu.ng*
Industrial and Technology Education Department, Federal University of Technology Minna Niger State, Nigeria.

periodic refresher courses. Universities should organize annual or bi-annual workshops on energy conservation and safety management.

3. The university should introduce sensitization campaigns, inclusions of energy management awareness in weekly newspaper, seminars, or awareness weeks to sustain the gains achieved through the intervention.
4. Students should be involved in hands-on activities such as energy audits, safety inspections, and conservation projects within the campus to reinforce their learning.

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Corresponding author: Saba, T. M.
✉ *mosessaba@futminna.edu.ng*
Industrial and Technology Education Department, Federal University of Technology Minna Niger State, Nigeria.