OPEN ACCESS

ISSN: 2835-6764

Bawaneh AK (2026) 1880
American J Sci Edu Re, 2026; 5(1):100291
DOI: 10.71010/AJSER-2026-e291

Research Article

American Journal of Science Education Research

The effectiveness of the 5Es Strategy in Enhancing Students' Learning of Electrical Circuit Design. Action Research

Dr. Ali Khaled Bawaneh*

Department of Math, Science and ICT, Bahrain Teachers College, University of Bahrain, Zallaq, Bahrain.

***Corresponding author:** Dr. Ali Khaled Bawaneh

Citation: Bawaneh AK (2026) The effectiveness of the 5Es Strategy in Enhancing Students' Learning of Electrical Circuit Design. Action Research. American J Sci Edu Re: AJSER-291.

Received Date: 13 December, 2025; **Accepted Date:** 28 December, 2025; **Published Date:** 06 January, 2026

Abstract

This action research study aimed to investigate the role of the 5Es learning cycle in enhancing students' learning about electrical circuits. The study was conducted in a class of 28 students at a school in Jordan during the 2024/2025 academic year. Lessons were designed according to the 5Es strategy, and data was collected using various methods, including observation, rating scales, and learning cards. The results indicated an effective role for the 5Es in enhancing students' learning about simple electrical circuits and series and parallel connections, emphasizing the importance of involving students in pivotal and fundamental roles in constructing and applying knowledge.

Keywords: *5Es, action research, enhancing learning, learning electricity, learning electrical circuit design.*

Introduction

Effective teaching practice is not limited to simply conveying information to learners; it extends to stimulating their thinking, cultivating their curiosity, and empowering them to construct knowledge independently. From this perspective, I was deeply passionate about undertaking action research. From the outset, I felt I wasn't merely conducting an educational experiment, but rather embarking on a genuine journey of discovery, re-evaluating my teaching methods and reflecting on their real-world impact on my students in the classroom. I found this experience exceptionally rewarding, as action research provided me with an opportunity to delve deeper into my interactions with my students and observe tangible, positive shifts in their understanding and participation.

My interest in this research topic stems from my accumulated experience in teacher training and instruction in teaching strategies. Over the years, I've observed that many students struggle to grasp the design of parallel and series electrical circuits, differentiate between them, and connect theoretical information to real-world applications. This observation led me to seek a more interactive and effective teaching strategy, ultimately choosing the 5Es strategy, a prominent inquiry-based learning approach, due to its proven effectiveness in fostering deep understanding and enhancing critical thinking and analytical skills [1-5].

This action research was conducted in a public girls' school, specifically in the second year of secondary school (science stream), within the subject of physics, on a sample of (28) female students with varying academic levels. This diversity in academic level provided a suitable opportunity to examine the effectiveness of the 5Es strategy in supporting students across different levels, and to test their responsiveness to inquiry within a real classroom environment, which is not without the usual challenges in public schools, such as limited resources or varying motivation.

Educational Literature

Educational literature plays a pivotal role in guiding the educational process and enhancing its effectiveness, especially when applying inquiry-based active learning strategies. This research, which investigates the effectiveness of using the 5Es strategy in enhancing second-year secondary school students' understanding of electrical concepts and the design of series and parallel electrical circuits, relies on three fundamental pillars of educational literature: cognitive content, pedagogical content (PCK), and authentic assessment [6,1].

Firstly, in terms of knowledge content, understanding the fundamentals of electrical circuits and their design is a prerequisite for delivering accurate and in-depth scientific material, as emphasized by science education research that recommends considering the basic principles of electricity [7,8]. This knowledge is not merely an end, but a foundation for building learning activities that are more relevant to real-life contexts.

In terms of pedagogical content, recent studies have demonstrated the importance of employing interactive strategies that enhance student understanding and engagement. Foremost among these is the 5Es strategy, which comprises five integrated stages: engagement, exploration, explanation, extension, and evaluation. Arab and international educational studies have shown that this strategy contributes to fostering deep understanding and building active learning experiences based on curiosity and discovery, such as the studies by Grace et. al., (2025) [1] and Garcia et. al., (2021) [9].

Thirdly, I adopted an inquiry-based learning approach, which is supported by modern educational literature that emphasizes its role in developing critical thinking and problem-solving skills in learners, particularly in applied environments that require a practical interpretation of scientific knowledge [10,11]. This approach helped me design activities based on experimentation,

group discussion, and research, which enhanced student engagement and practical understanding.

Regarding assessment, the researcher adopted authentic assessment, measuring understanding through real-world tasks that reflect the practical application of knowledge, as proposed in the study by [12,13]. Therefore, various assessment tools were employed, such as worksheets, classroom observation, a satisfaction questionnaire, and a "raise the answer card" tool, to accurately measure understanding and skills.

Despite the abundance of educational literature supporting the 5Es strategy in general science, its application in physics contexts, particularly in electricity, makes this research a valuable contribution that bridges theory and practice and promotes active, inquiry-based learning [2,1].

Educational literature played a pivotal role in all stages of my inquiry-based research, from question formulation to data collection and analysis. It helped me formulate a clear and realistic question that reflected students' interests and measured the impact of the 5Es strategy on their understanding of the phases of series and parallel electrical circuit design. By reviewing recent studies, such as Bawaneh & Alnamshan, (2023) [14] and [6,1] works, I was able to see how this strategy is applied in professional contexts, which encouraged me to use it in this research. Educational literature also contributed to a deeper understanding of the inquiry-based approach as a teaching practice focused on question-based and discovery-based learning. Melinda & Joseph, (2025) [6], and Grace et. al., (2025) [1] distinguished between traditional and inquiry-based education, highlighting the importance of the teacher's role as a facilitator and motivator of learning, not as the sole source of knowledge.

In planning lessons, the researcher relied on models presented in educational literature for effectively implementing the 5Es strategy. Each lesson began with an "engagement" phase to capture students' attention, followed by exploration activities leading to comprehension and evaluation. Recent educational studies have demonstrated how to design interactive lessons that integrate practical activity with critical thinking.

The literature also assisted in designing data collection tools such as worksheets, observation checklists, and satisfaction questionnaires, based on the principles of authentic assessment. Instead of relying solely on exams, the approach emphasized methods that measure practical application and genuine understanding. Previous studies have offered numerous models for interpreting data based on thinking styles and individual differences among learners, thus enhancing the credibility of the results.

Procedures

This research began with a deep understanding of the educational inquiry cycle, which comprises several interconnected stages. These stages begin with defining the inquiry question, proceed through gathering relevant educational literature, then lesson planning and implementation, and finally data collection and analysis [10,13]. Furthermore, the educational literature supported this approach, particularly recent studies on inquiry-based learning using the 5Es strategy. These studies emphasize the importance of engaging students in an interactive learning process that fosters deep understanding rather than superficial rote memorization.

Through this literature review, the inquiry-based research question was carefully formulated: "How effective is the 5Es strategy in enhancing students' learning to design electrical circuits?" This question reflects my interest in applying science teaching methods and my desire to implement an innovative educational approach that aligns with the developments in active teaching methods.

The inquiry-based learning strategies were implemented in a public school in Jordan, within a specialized science class for second-year secondary students. The sample consisted of 28 female students distributed across three achievement levels. This sample was chosen because it was representative of the classes taught by the student-teacher collaborator, allowing me to observe the strategy's impact on students with varying levels of understanding. I planned a series of nine lessons covering the concept of electricity, Ohm's law and its applications, and the design of series and parallel electrical circuits. These lessons were designed according to the five phases of the 5Es strategy: Engage, Explore, Explain, Enrich, and Assess. For example, each lesson began with an activity that stimulated students' thinking and curiosity (Engagement), followed by the analysis of real-life images or videos (Exploration), then a structured explanation of the concepts, enrichment exercises to reinforce understanding, and concluded with authentic assessment methods demonstrating the students' mastery of the concepts.

Data collection tools included worksheets, a student satisfaction questionnaire, classroom observations, a "raise the card" tool, and a verbal rating scale. These tools were designed to ensure coverage of cognitive, skill-based, and affective aspects. Lesson planning followed this structure to support the collection of evidence directly answering the inquiry question. Focusing on each product in a separate lesson allowed the researcher to observe students' progress in understanding the design steps, differentiating between products, and applying concepts, in line with the national curriculum objectives and subject requirements. Furthermore, the use of the 5Es strategy fostered an active learning environment based on deep understanding rather than rote memorization, encouraging student interaction and participation. This inquiry process was not merely the application of educational theory, but a comprehensive experience that blended scientific content with an effective pedagogical approach.

Results

Multiple tools were used to evaluate the effectiveness of the 5Es strategy in enabling students to design series and parallel electrical circuits. The main tools used were worksheets, a "raise the answer card" assessment, and a verbal rating scale. The aim of these tools was to measure students' understanding of the concepts, their ability to apply them, and their level of engagement with classroom activities. This section of the research will analyze the results of these tools in detail.

Results Multiple tools were used to evaluate the effectiveness of the 5Es strategy in enabling students to design series and parallel electrical circuits. The main tools used were worksheets, a "raise the card" assessment, and a verbal rating scale. The aim of these tools was to measure students' understanding of the concepts, their ability to apply them, and their level of engagement with classroom activities. This section of the research will analyze the results of these tools in detail.

Verbal Rating Scale

A verbal rating scale was used to evaluate student participation in classroom activities and discussions. The results showed that students who actively participated in group activities and presentations on simple and advanced circuit design methods received high ratings, while other students received lower ratings due to their limited participation in classroom discussions.

In one lesson—designing circuits through drawing and preliminary design—students who participated in presentations on traditional and industrial methods performed very well. On the other hand, some students did not actively participate in the discussions, resulting in lower ratings in this area. This indicates that active participation in discussions and group activities enhances students' understanding and supports their ability to grasp the content more deeply. Some students showed significant improvement in their participation levels after receiving additional support from the teacher on points they found complex. The verbal rating scale was useful in measuring this improvement and identifying students who needed further encouragement.

Raise Card" Assessment

The "Raise Card" tool was used to assess immediate comprehension through rapid interaction during the lesson. The results of this assessment showed that students responded positively, with the majority actively participating by raising their cards to answer the questions posed. By observing these immediate reactions, areas requiring further clarification were identified. There was some variation in student responses between lessons. In the Parallel Circuit Design lesson, the response was high, and the answers to questions about series circuit configurations and their design variations were accurate. However, in the Parallel Circuit lesson, some students found it more difficult to answer questions about configuration variations. This difficulty stemmed from the practical nature of the lesson and the slightly more complex configurations compared to series circuits. This tool proved effective in measuring immediate comprehension and identifying areas for future focus.

Worksheets

Worksheets were distributed after each lesson on electricity, Ohm's Law, and series and parallel circuits to assess students' ability to apply theoretical knowledge in a practical context. The results showed that most students demonstrated a good understanding of the basic steps involved in designing simple and advanced circuits. They provided clear and precise answers regarding the design phases, focusing on the factors affecting product quality.

When comparing the worksheet results across the lessons, the best performance was observed in designing simple and series circuits, where students were able to provide a comprehensive explanation of the different phases. However, challenges were evident in the worksheets for designing parallel circuits, where some students struggled to understand and analyze certain technical details. These results indicate that students with difficulties in reading, writing, or translating ideas into a real-world product may find it difficult to organize their thoughts logically and coherently, leading to challenges in producing a sound and functional design.

Overall Performance Assessment

Based on the tools used, it can be concluded that the 5Es strategy was effective in enhancing students' learning of the content and supporting their understanding of the stages of electrical circuit design. The three assessment tools (worksheets, "raise the card" assessment, and verbal rating scale) proved effective in measuring the level of understanding and design in an integrated manner. However, it can be observed that students with learning difficulties in writing, reading, manual work, and translating ideas into a tangible product faced challenges in providing detailed explanations, especially in lessons that relied more heavily on theoretical concepts. But with repeated practice and overcoming their fear and hesitation to try, these activities led to a significant improvement in their ability to analyze quality and apply design skills, highlighting the effectiveness of the 5Es strategy in motivating practical application.

Conclusions

Based on the results, it can be concluded that the 5Es strategy significantly enhanced student engagement and understanding of the subject matter. The assessment tools also proved capable of accurately identifying levels of comprehension and providing clear indications of areas requiring further focus.

Reflective Discussion

The experience of implementing the inquiry-based approach in teaching the subject of "Electrical Circuit Design" marked a turning point in developing teaching practices from a different perspective, one that focuses on engaging students in constructing knowledge, rather than simply receiving it. This experience clearly demonstrated the importance of inquiry as a teaching approach that promotes active learning and directs the educational process towards interaction, critical thinking, and discovery.

Furthermore, this experience revealed that inquiry is not merely a method of delivering a lesson, but rather a comprehensive educational approach that shifts education from the traditional model to a stimulating learning environment that encourages research and inquiry. It reverses the roles of both teacher and student; the teacher is no longer the sole source of information, but rather a facilitator, guide, and supporter of student learning by providing them with appropriate tools and questions, thus empowering them as the central focus of the teaching and learning process. This fosters student independence and increases their motivation to learn. In conclusion, this inquiry was a knowledge-rich and transformative experience, confirming that inquiry-based education is not only more effective, but also more humane, as it gives learners their natural role as active participants in the journey of knowledge.

References

1. Grace Oakley, Vaille Dawson & Mark Pegrum. (2025) Using extended reality (XR) technologies to teach literacy in primary school science within a 5E instructional model. Research in Science & Technological Education 43:4, pages 1269-1285.
2. Khan, K., Aurangzeb, W., & Tahir, T. (2020). Effectiveness of 5es Learning Cycle Model on Students Learning in Physics at Secondary School Level in Pakistan. Global Social Sciences Review, V(I), 469-478. doi:10.31703/gssr.2020(V-I).48.

3. Mahmoud, E., & Bawaneh, A. (2025). Best practices of effective classroom management strategies supported by digital ICT in higher education. International Journal of Evaluation and Research in Education,14(3), 2337-2345 https://doi.org/10.11591/ijere.v14i3.3217
4. Vesta Vančugovienė, Erno Lehtinen & Ilona Södervik. (2025) The impact of inquiry-based learning in a botanical garden on conceptual change in biology. International Journal of Science Education 47:7, pages 915-939.
5. Walia, P. (2012). Effect of 5E instructional model on mathematical creativity of students. Golden Research Thought, 1(10), 1-4.
6. Melinda Kirk & Joseph Paul Ferguson. (2025) REAL possibilities: innovative and responsive curriculum enactment enabling impactful inquiry in primary science. International Journal of Science Education 47:15-16, pages 2156-2179.
7. Qablan, A. M., & DeBaz, T. (2015). Facilitating elementary science teachers' implementation of inquiry-based science teaching. Teacher Development, 19(1), 3-21.
8. Turan, S., & Matteson, S. M. (2021). Middle school mathematics classrooms practice based on 5E instructional model. International Journal of Education in Mathematics, Science, and Technology (IJEMST), 9(1), 22-39. https://doi.org/10.46328/ ijemst.1041
9. Garcia I Grau, F., Valls, C., Piqué, N., & Ruiz-Martín, H. (2021). The long-term effects of introducing the 5E model of instruction on students' conceptual learning. International Journal of Science Education, 43(9), 1441–1458. https://doi.org/10.1080/09500693.2021.1918354
10. Al-Hattami, A., & Bawaneh, A. (2024). The effect of lesson study approach on developing teachers' reflective thinking as a self-assessment tool. International Journal of Evaluation and Research in Education,13(5), 3306-3313. https://doi.org/10.11591/ijere.v13i5.29354.
11. Al Salman, S., Alkathiri, M., & Khaled Bawaneh, A. (2021). School off, learning on identification of preference and challenges among school students towards distance learning during COVID19 outbreak. International Journal of Lifelong Education, 40(1), 53–71. https://doi.org/10.1080/02601370.2021.1874554
12. Bawaneh, A., Al-Salman, S., Salem, T., & Altarawneh, A. (2025). AI Shaping the Future of Education: Science and Math Teachers' Satisfaction Level and Motivating Factors towards Integrating Artificial Intelligence in Teaching and Learning. International Journal of Information and Education Technology, 15(3), 496-509. https://doi.org/10.18178/ijiet.2025.15.3.2261
13. Bawaneh, A., & Moumene, A. (2020). Flipping the Classroom for Optimizing Undergraduate Students' Motivation and Understanding of Medical Physics Concepts. EURASIA Journal of Mathematics, Science and Technology Education, 16(11), em1899. https://doi.org/10.29333/ejmste/8561.
14. Bawaneh, A., & Alnamshan, M. (2023). Design Thinking in Science Education: Enhancing Undergraduate Students' Motivation and Achievement in Learning Biology. International Journal of Information and Education Technology, 13(4), 621-633. https://doi.org/10.18178/ijiet.2023.13.4.1846
15. Developing a Remedial Teacher Training Program. Global Social Sciences Review (GSSR).