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Preface

Pioneering Educational Perspectives: Series 2025 is a collection of thought-provoking insights and research contributions exploring contemporary educational trends and practices. This eBook presents a diverse range of perspectives on innovative teaching methodologies, digital learning strategies, and transformative approaches in education. Designed to serve as a resource for educators, researchers, and practitioners, it aims to inspire meaningful discussions and advancements in the field. Through carefully curated chapters, this publication offers fresh ideas and practical solutions to enhance learning experiences in an ever-evolving educational landscape.

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STUDENT ONLINE LEARNING EXPERIENCE WITH INTEGRATION OF HANDS-ON SIMULATION

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ABSTRACT

In the context of electronic devices and circuits education, traditional face-to-face hands-on lab activities are crucial for deepening students' understanding of semiconductor device principles, such as diode operations. However, challenges arise in remote learning scenarios, such as during a pandemic, where direct lab experiences are not feasible. To address this, this paper proposes a novel approach utilizing free-license simulation tools to replicate hands-on lab experiences for first-year students in an electronic devices and circuits course. The approach involves collaborative simulation assignments where students explore various diode configurations and principles through virtual labs and group discussions. Each student submits a report reflecting their comprehension of the topic, which is evaluated by the instructor. This method not only enhances students' learning experiences but also positively influences their cognitive and psychomotor skills. The findings suggest that this approach effectively bridges theoretical knowledge with practical application and is beneficial for extending to other programs and courses. It provides a viable alternative to traditional lab work, fostering an enriched learning environment.

KEYWORDS: Hands-on, Simulation, Electronics.

PROBLEM AND OBJECTIVE

In face-to-face settings, hands-on lab activities are essential for teaching electronic devices and circuits. However, remote learning, such as during pandemics or other distance restrictions, poses challenges in replicating these experiences. Without physical labs, students miss out on practical experimentation. To address this, we propose using free-license simulation tools for remote learning. This approach will enhance understanding of diode operation by simulating lab activities, allow virtual experiments and circuit analysis, offering practical learning without physical labs, and also provide a flexible, accessible alternative that supports diverse learning environments and styles, ensuring all students can grasp the subject effectively.

DESIGN DESCRIPTION

In the era of Industry 4.0, engineering graduates must blend theoretical knowledge with practical skills to solve complex problems and work effectively in teams (Atik et al., 2023). To produce high-quality engineers, a shift to student-centered learning is essential. Hands-on activities are a key component of experiential learning, allowing students to gain practical experience alongside theoretical understanding. Studies by Coker et al. (2017) and Atousa et al. (2020) highlight the benefits of such activities, including real-time experiments with circuits.

Simulation tools also support effective learning (Supriyo, 2023). Overall, hands-on activities are crucial for developing the skills and competencies needed in engineering. This paper

introduces a hands-on simulation assignment for first-year students in electronic devices and circuits. Students explore diode configurations through simulations and discuss their findings in groups. They then submit a short report to the lecturer to demonstrate their understanding. This method enhances their learning experience, improves cognitive and practical skills, and shows positive impacts. It is recommended to apply this approach to other programs and courses due to its effectiveness.

VISUALS

The collaborative assignment is adapted on the New Academia Learning Innovation (NALI) framework (Zaini et al. 2017) as shown in Figure 1 have been implemented to the first year of electrical engineering student taking electronic devices and circuits course. Based on Figure 1, this teaching and learning approach is constructively aligned between the intended learning outcome, learning activities and assessment which is through written report.

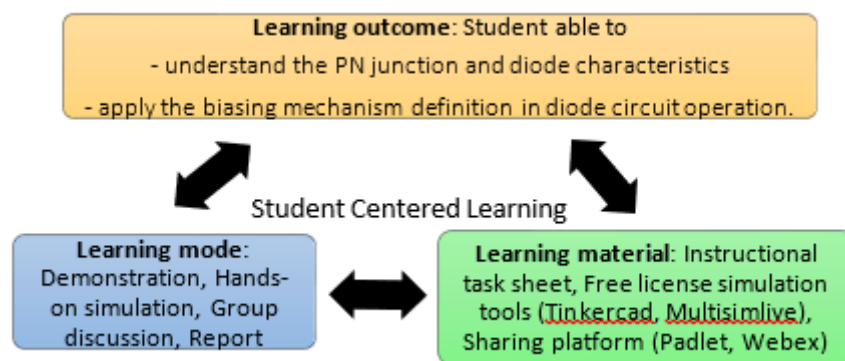


Figure 1: Adapted NALI Framework for Collaborative Assignment Activities

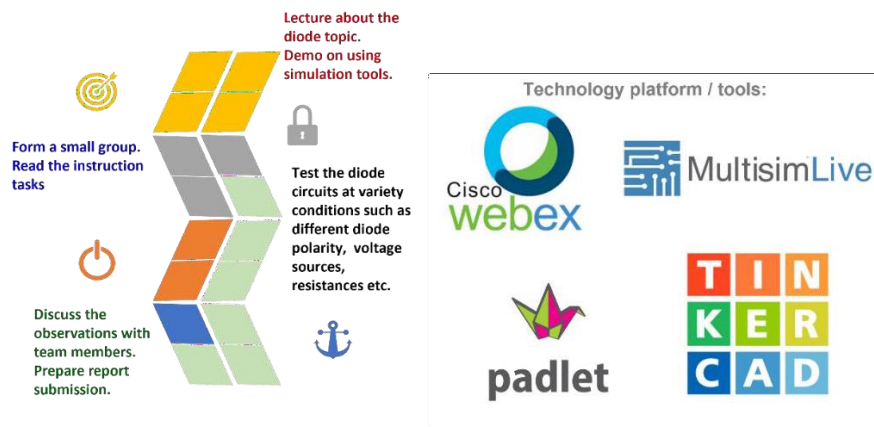


Figure 2: Learning activity flow using the proposed aiding tools

Figure 2 illustrates the activity flow together with platform/tools used in this approach. Prior to the implementation of the collaborative assignment, the student will go through lecture session with the instructor where they will be taught the theoretical part about diode. This is followed by in class activity such as tutorial and discussion session, also quick demonstration on using the

related simulations tools available. The instructor then prepares the task sheet where the students need to validate the circuit functionality through computational simulation. Table 1 listed some excerpts from the student collected when the activities have been done. Generally,

the use of hands-on simulation as learning aid seems beneficial to the student as it helps in enhancing their learning experience. Besides that, majority of students agreed with the implementation of this kind of activity as shown in Figure 3.

Table 1: Excerpts from Student Feedback

“Simulation is also fun”
“Those activities can make myself learn more about this course”
“The activities are quite new for me, i learnt new things. As well the multism experiment, because in previous semester i used Tinkercad.”
“They are great especially group discussions.”
“Quick experiment - fun and easy to understand because we can really see what will happen.”
“Understand the topic better”
“I can relate the result with the theory that I learned in class which I think that quick experiment/hands-on is very helpful for me.”

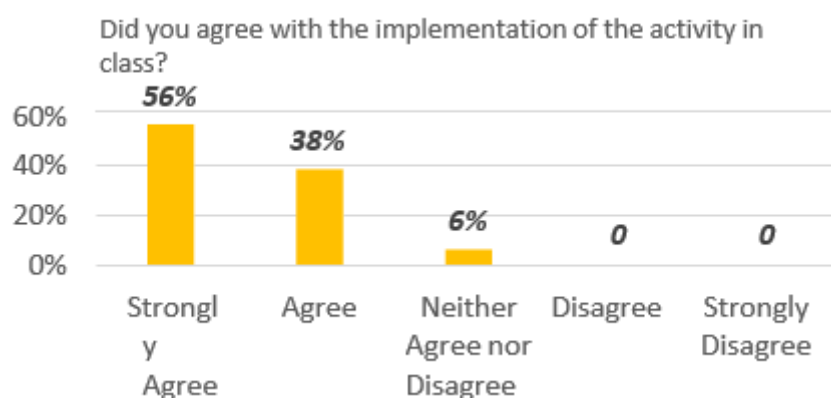


Figure 3: Students' rating on the activity's implementation.

NOVELTY AND UNIQUENESS

Our design stands out for its innovative approach to integrating active learning with practical skill development. Unlike traditional methods that often rely on passive instruction, our solution emphasizes hands-on, interactive experiences that actively involve students in the learning process. This approach not only enhances engagement and understanding but also systematically builds essential skills such as teamwork and time management, which are often overlooked in conventional methods. In essence, our design offers a more immersive and adaptive learning experience, bridging the gap between theoretical knowledge and practical application, thus setting a new standard in educational innovation.

BENEFITS TO MANKIND

Our design enhances classroom engagement by promoting active participation and diverse learning modes. By integrating hands-on activities, students gain a deeper understanding through personal experience rather than passive listening. Additionally, it fosters essential skills such as teamwork, effective communication, and time management.

This approach not only improves academic comprehension but also equips students with practical skills for their future endeavours.

COMMERCIAL POTENTIAL

Our design has great market potential with its educational tools like Peer Teaching Modules, Learning Kits, Smart and Lab Classrooms, and E-Portals/Apps. Its competitive edge comes from blending interactive learning with modern technology. It can scale easily to different programs and schools. We can monetize through licensing tools and subscription services. The value of our unique copyrights, such as ©2020 UTM IP/CR/01155 and ©2020 UTM IP/CR/01222, adds further advantage, making our solutions highly attractive in the educational market.

CONCLUSION

Our design positively impacts the learning environment by harmonizing theoretical knowledge with practical skills, integrating cognitive and psychomotor learning. This approach enhances student engagement and comprehension through interactive, hands-on experiences. To build on this success, future directions could include expanding these methods to additional programs and courses, tailoring them to diverse subject areas and educational levels. By applying this innovative approach broadly, we can further enrich the educational landscape, offering a more comprehensive and effective learning experience across various disciplines.

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