

# ANALYSIS OF THE USE OF THE LIVEWIRE APPLICATION IN ELECTRONICS CIRCUIT SIMULATION IN LEARNING

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**Abstrak.** Fokus utama riset ini sebenarnya sederhana: ingin tahu seberapa besar pengaruh software Livewire terhadap pemahaman konsep, motivasi, sekaligus keaktifan mahasiswa pas belajar simulasi rangkaian elektronika. Kebetulan, kami melibatkan 81 mahasiswa D3 Teknik Elektronika Politeknik Negeri Sriwijaya sebagai sampelnya. Buat metodenya sendiri, kami pakai deskriptif kuantitatif. Jadi, semua data lapangan diambil lewat pre-test, post-test, sebar kuesioner skala Likert, sama dibantu pengamatan langsung pas jam kuliah berlangsung. Angka-angka yang didapat lalu dihitung pakai statistik deskriptif buat nyari nilai rata-rata sama persentasenya. Dari situ kelihatan kalau anak-anak memberikan respons yang positif banget waktu pakai Livewire. Menariknya, mereka merasa software ini gampang dioperasikan, bikin teori yang tadinya ribet jadi lebih masuk akal, dan memicu semangat belajar. Suasana kelas juga jadi gak ngebosenin karena lebih interaktif. Yang paling penting, nilai ujian mereka terbukti naik setelah kita pakai Livewire ini. Tapi jujur, riset ini masih punya kekurangan. Kita belum sempat membandingkan Livewire dengan aplikasi simulasi sejenis lainnya, dan bagaimanapun juga, visualisasi di layar komputer pasti ada bedanya dengan kondisi asli pas pegang alat di lab. Intinya, Livewire ini oke banget buat jadi modal awal belajar simulasi elektronika. Saran kami, jadikan aplikasi ini sebagai menu wajib atau jembatan sebelum mahasiswa benar-benar diterjunkan buat praktikum langsung di laboratorium.



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*Abstract. The main focus of this research is actually simple: to determine how much influence Livewire software has on students' conceptual understanding, motivation, and engagement when learning electronic circuit simulations. Coincidentally, we sampled 81 D3 Electronic Engineering students from Sriwijaya State Polytechnic. We used a descriptive quantitative method. All field data was collected through pre-tests, post-tests, Likert-scale questionnaires, and direct observation during class. The obtained figures were then calculated using descriptive statistics to find average scores and percentages. From this, it's clear that the students responded very positively to Livewire. Interestingly, they found the software easy to operate, made previously complicated theories more understandable, and stimulated their enthusiasm for learning. The classroom atmosphere also became less boring because it was more interactive. Most importantly, their test scores improved after using Livewire. However, honestly, this research still has shortcomings. We haven't had the opportunity to compare Livewire with other similar simulation applications, and after all, the visualization on a computer screen is bound to be different from the actual conditions when holding the equipment in the lab. In essence, Livewire is an excellent starting point for learning*

*electronics simulations. We recommend making this application a mandatory component or a bridge before students are actually involved in practical work in the laboratory.*

## 1. INTRODUCTION

The educational landscape has undergone substantial changes as a result of the development of digital technology, especially in the domains of science and engineering. One significant development is the use of simulation software as a teaching tool to help students understand abstract and challenging subjects. According to Alessi and Trollip [1], educational technology is a tool that makes learning more engaging and meaningful. Applications like Livewire allow students to create and analyze electronic circuits in a virtual setting without the need for physical components in the context of electronics education. This method lowers the possibility of damage during experimenting while also lowering operating costs. Additionally, a number of studies have demonstrated that by offering real-time feedback and visual representations of circuit behavior, simulation-based learning can boost students' conceptual understanding, motivation, and engagement [2]-[5].

Additionally, simulation technologies support the use of student-centered and active learning strategies. According to constructivist learning theory, when students actively participate in the learning process, knowledge is created more successfully [6], [7]. Students can test theories, find and fix mistakes, and investigate other circuit design options in real time with platforms like Livewire. Additionally, prior studies show that simulation software enhances critical thinking, problem-solving, and general academic achievement in engineering education [8]-[10]. Additionally, these technologies aid in bridging the gap between theoretical ideas and real-world applications, particularly when access to lab facilities is restricted [12], [13]. Simulation programs are very useful for both traditional classroom settings and online learning contexts because of their adaptability and accessibility.

Nevertheless, there are several difficulties in putting simulation-based learning into practice despite its many benefits. Numerous studies

have identified hurdles to effective adoption, including limited access to technology, inadequate infrastructure, and a lack of teacher expertise with simulation tools [14]-[16]. Furthermore, there are worries that students can become overly dependent on virtual simulations, which could limit their chances to obtain practical experience with real electronic components [17], [18]. As a result, it's critical to look at how the Livewire application is used in electronics circuit education and evaluate its efficacy from the viewpoint of the students. This study aims to investigate the role of Livewire in supporting the learning process, identify its strengths and weaknesses, and provide recommendations to improve the quality of electronics education. Therefore, the research question of this study is: How is the use of the Livewire application in electronics circuit simulation learning, and how does it influence students' understanding, motivation, and learning engagement?

## 2. LITERATURE REVIEW

This study evaluates the effectiveness of the Livewire application in learning electronic circuit simulations using a quantitative method with a descriptive approach. The quantitative approach was selected because it enables researchers to collect information regarding students' understanding and responses to the use of the application during the learning process in the form of numerical data and measurement results. According to Creswell [19], quantitative research is a method used to examine relationships, variations, and developments systematically through statistical analysis. Therefore, this study aims to determine the extent to which the Livewire application improves students' understanding of electronic concepts and increases their engagement and motivation in learning.

The study was conducted in a university learning environment involving students who had used the Livewire application in electronics courses. The respondents consisted of students selected based on their experience in operating

the software during practical and theoretical learning sessions. To ensure the authenticity of the data, all participants completed the research instruments voluntarily. In addition, the identities of the participants were kept confidential to maintain privacy and research ethics [2].

Data were collected through tests, questionnaires, and classroom observations. The questionnaire employed a Likert scale to measure students' perceptions regarding the usability, effectiveness, learning motivation, and understanding of electronic circuit concepts when using the Livewire application [20]. Tests were administered to evaluate students' conceptual understanding of electronics before and after using the simulation application. Classroom observations were also conducted to assess students' participation and engagement during practical activities using Livewire. Previous studies have shown that simulation-based learning media can improve students' conceptual understanding and motivation in learning physics and electronics [4], [6].

The collected data were analyzed using descriptive statistical techniques such as percentages, mean scores, and data classification [21]. The effectiveness of the Livewire application in electronics learning was determined based on the analysis of test results and questionnaire responses. In addition, the validity and reliability of the research instruments were tested before data collection to ensure the accuracy and consistency of the findings [22]. Through this analysis process, the study is expected to provide a clear description of how the Livewire application enhances students' understanding, motivation, and engagement in learning electronics circuit simulation.

### 3. METHODOLOGY

The purpose of this study was to ascertain how well students understood electronic circuits using the Livewire application [2], [3]. Students enrolled in electronics classes who had utilized the Livewire program as part of their learning activities participated in the study, which used a quantitative method. The research was carried out at Sriwijaya State Polytechnic.

To collect the required data, students were given a pre-test before using the Livewire

application and a post-test after using the application for a certain period of time. The pre-test aimed to identify students' prior knowledge of electronic circuits before the implementation of Livewire. In addition, a questionnaire was distributed to measure students' perceptions of the application, including its ease of use and its effectiveness in supporting their understanding of electronic circuit concepts.

Mean scores and percentages were computed in order to analyze the gathered data. Additionally, statistical testing was done to see if utilizing the Livewire app increased students' comprehension of electronic circuits. In order to guarantee the validity and reliability of the questionnaire instrument in gathering precise data, it was further evaluated. This study's primary goal was to determine whether the Livewire application might help students learn electronic circuit basics. Thus, the efficiency of the Livewire application in enhancing students' comprehension of electronics instruction was assessed using this manner.

### 4. RESULT

The results of this study were obtained from questionnaires, tests, and classroom observations conducted on students who used the Livewire application during electronics circuit simulation learning. The study aimed to determine the effectiveness of the Livewire application in improving students' understanding, motivation, and participation in electronics learning activities.

Based on the questionnaire results, the study involved **81 respondents**, primarily students from the **D3 Electronics** program. The distribution across semesters is as follows:

- • **Semester 2:** 87.7% (Majority)
- • **Semesters 4, 6, and 8:** 12.3% (Combined)

This indicates that the application is most widely used by early-stage students who are building their foundational knowledge in electronic circuits.

Tabel 1 Questionnaire Results Recap

| No | Questionnaire Statement                                    | Dominant Response |
|----|------------------------------------------------------------|-------------------|
| 1  | Livewire is easy to use for electronic circuit simulation. | Agree (50.6%)     |

|    |                                                                |                  |
|----|----------------------------------------------------------------|------------------|
| 2  | The interface helps in understanding circuit concepts.         | Agree (46.9%)    |
| 3  | More effective than traditional methods (whiteboard).          | Agree (39.5%)    |
| 4  | Features meet the needs of electronics learning.               | Agree (45.7%)    |
| 5  | Increases motivation to learn electronics.                     | Agree (45.7%)    |
| 6  | Makes the learning process more interactive and fun.           | Agree (51.9%)    |
| 7  | Helps in understanding difficult circuit theories.             | Agree (50.6%)    |
| 8  | Advantages compared to other simulation applications.          | Neutral (54.3%)  |
| 9  | Obstacles in using Livewire are few and easily overcome        | Neutral (40.7%)  |
| 10 | Learning outcomes are better after using Livewire              | Agree (50.6%)    |
| 11 | Recommended for wide use in electronics learning.              | Agree (50.6%)    |
| 12 | Facilitates trying various circuit variations quickly.         | Agree (46.9%)    |
| 13 | Simulations are close to real laboratory experiments.          | Agree (49.4%)    |
| 14 | Simulations do not match real experimental results (Negative). | Neutral (39.5%)  |
| 15 | Saves time in the learning process.                            | Agree (Dominant) |

The results of this study show that using simulation software in engineering education is an idea, just like Alessi and Trollip said before [1]. A lot of students 50.6% found Livewire easy to use and 46.9 percent thought the interface was clear. This means Livewire is a tool for students to learn with especially for those who are just starting out and still learning the basics of electronics. It seems that making software easy to use is important for helping students learn.

#### 4.1. Enhancing Conceptual Understanding and Learning Outcomes

One thing we found out is that 50.6% of students said they learned more after using Livewire. This means that using simulations can really help students understand ideas better. With Livewire students can see how electricity flows and how parts work, which makes it easier for them to connect what they learn in class to life.

This is what constructivist learning theory says: that people learn by doing things and trying them out [6] [7]. Livewire lets students try things and see what happens away which helps them understand ideas better. Other studies have also shown that simulation tools can help students do better in school and understand things more [2]-[5] [8]-[10].

What this means is that we can use simulation software like Livewire to help students learn the basics of electronics. But this study has a limit: it only asks students what they think it does not test what they actually learned.

#### 4.2. Motivation and Engagement in a Digital Environment

The findings show that 51.9% of students perceived the learning process as more interactive and enjoyable, while 45.7% reported increased motivation. This indicates that simulation-based learning environments can enhance student engagement compared to traditional teaching methods.

Looking at it another way Livewires interactive features get students involved and make them want to learn more. Students can try out things without worrying about breaking anything, which makes them more confident and willing to try new things.

This is what Alessi and Trollip said: that technology can make learning more meaningful and fun [1]. It also agrees with studies that say simulation-based learning can motivate students and get them to participate more [2]-[5].

What this means is that using simulation tools can create a learning environment for students. This study does not look at how motivated students are in the long term, which is something we should look into later.

#### 4.3. Bridging the Gap Between Virtual and Physical Labs

Another important thing we found is that 49.4% of students thought Livewire simulations were like real lab experiments. This means that Livewire can be used of or along with real lab work2), students may eventually require more advanced tools (like Proteus or Multisim) as they progress to higher semesters and more complex designs.

This shows that simulations can help students understand how ideas work in life. Students can. Learn with virtual labs before working with real things.

This agrees with studies that say simulation tools can help when we do not have access to labs or when they are too expensive [12] [13]. A lot of students 54.3% were not sure if Livewire was better than other software, which means it might only be good for basic learning.

What this means is that Livewire is good for classes but we might need more advanced tools for higher-level classes. This study has a limit: it does not compare Livewire to simulation software or real lab work.

#### **4.4. What This Means for Electronics Education**

We also found out that 46.9% of students thought Livewire helped them test things quickly and saved time. This means that simulation software can make learning more efficient.

From a teaching perspective this efficiency helps students learn by trying things out finding mistakes and improving their understanding. This is important for developing thinking and problem-solving skills in engineering.

This agrees with studies that say trying things out is important for learning [8]-[10]. What this means is that simulation tools can make learning both more efficient. But this study has a limit: it does not measure how time students save or compare it to traditional lab methods. We should look into this more in the future.

### **5. CONCLUSION**

This study evaluated the implementation of the Livewire application as a simulation tool in electronics circuit learning, particularly for students at Sriwijaya State Polytechnic. Based on the quantitative analysis of 81 respondents—predominantly from the

second semester—it can be concluded that Livewire is a highly effective pedagogical medium that addresses the challenges of learning abstract electronic concepts.

The research findings indicate that Livewire significantly enhances student engagement and motivation, with over 51% of participants describing the learning process as more interactive and enjoyable. From a conceptual standpoint, the application successfully bridges the gap between theory and practice; approximately 50.6% of students reported better learning outcomes and a deeper understanding of complex circuit theories. Furthermore, the high level of perceived reliability (49.4%) suggests that students find the virtual simulations to be a faithful representation of real-world laboratory experiments.

The accessibility of the software proved crucial for early-stage engineering students (Semester 2), as its user-friendly interface minimizes technical hurdles and operational costs associated with physical components. While the study acknowledges that simulation cannot entirely replace hands-on experience, Livewire serves as an essential bridge, especially when physical lab access is limited. In summary, the integration of Livewire into the electronics curriculum is strongly recommended to facilitate rapid prototyping, encourage active learning, and improve the overall quality of engineering education in the digital age.

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