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Student-Designed Circuit Problems as a Strategy to Support Metacognitive Development and Address Misconceptions in Electrical Engineering Education

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1. Introduction

Undergraduate students in electrical and computer engineering (ECE) frequently struggle with diagnosing their own errors in circuit analysis [1]. Many students tend to have additional practice problems before exams to increase their comfort and confidence through self-assessment. While they may correctly apply standard procedures or formulas, they often lack the metacognitive awareness necessary to verify the soundness of their reasoning or identify conceptual inconsistencies in their solutions [2]. This challenge becomes especially apparent when students are asked to analyze unfamiliar or complex circuits, where deep conceptual understanding is essential [3].

Prior research has documented persistent misconceptions in both DC and AC circuit analysis. Common challenges include misunderstanding series and parallel connections, confusing voltage across a device and node voltage, misapplying Ohm’s law, incorrectly using Kirchhoff’s laws and so on. Students may also hold inaccurate intuitions about equivalent resistance, impedance in AC circuits, semiconductors, etc. [4][5] Some misconceptions often remain hidden during routine course work because traditional instruction and assessment frequently emphasize correct answers over explanation or reflection. As a result, students can develop unwarranted confidence in their methods while remaining unaware of conceptual mistakes [6].

Metacognition plays a crucial role in helping students identify and correct these misunderstandings. Activities that make students monitor their understanding and evaluate the correctness of their reasoning can lead to improved conceptual learning and greater adaptability when solving unfamiliar problems [7][8]. However, introductory ECE courses typically offer limited opportunities for metacognitive engagement. Most assignments focus on procedural proficiency, giving students little practice articulating assumptions or critiquing their own or others’ solutions.

Different instructional remedies have been implemented or discussed, such as misconception inventories and diagnostic tests or open-ended interviews [9], Prediction–Observation–Explanation (POE) activities [10], simulation-based and digital learning [11], etc. Among them, student-generated problems offer an interesting and promising strategy for supporting both conceptual development and metacognitive awareness. Studies in STEM education have shown that when students design their own questions or problems, they are more likely to reflect on what they understand, recognize what they find confusing, and grapple with the structure and meaning of the underlying concepts [12]. Designing circuits shifts students from problem solver to designer, requiring them to consider why a circuit behaves as intended and whether the problem is conceptually coherent. This process can deepen engagement and provide instructors with insight into students' thinking processes [13].

Motivated by these ideas, this work introduces a classroom strategy that engages students as creators of circuit problems throughout introductory ECE courses. Students design circuits that may be correct or unintentionally flawed, share them with peers, and see representative examples incorporated into class discussions and exams. Particularly, flawed designs may contain inconsistencies, impossible configurations, or incorrect applications of principles. These errors expose misconceptions that may not appear through traditional assessments, and can be used as powerful learning tools in class discussions or assessment tools in the exams. This approach aims to help students confront their misconceptions, practice evaluating circuit behavior critically, and reflect on their own learning. It further provides instructors with examples of both productive and problematic student reasoning that can be leveraged instructionally.

This study investigates the pedagogical value of student designing circuits for supporting both conceptual learning and metacognitive development in ECE education. Specifically, it addresses the following research questions:

1. How does the process of designing circuit problems, which are either correct or flawed, influence students' metacognitive awareness and understanding of circuit concepts?
2. In what ways does the use of peer-generated circuit designs support learning when embedded in instruction and assessment?
3. What do student reflections reveal about the perceived benefits and challenges of this strategy?

Through analysis of student-generated circuits, reflective responses, and course feedback, this work seeks to offer a practical, scalable model for fostering deeper conceptual understanding and self-regulated learning in ECE courses.

2. Instructional Design and Implementation

The instructional strategy examined in this study was implemented across multiple semesters in a sophomore-level circuits course and an electronics course in an ECE program at a large public university. The circuits course covers fundamental DC and AC circuit analysis, including Kirchhoff's laws, equivalent resistance, phasor methods, and steady-state sinusoidal analysis. The electronics course further discusses circuit analysis and designs involving operational amplifiers (op-amp), diodes, and transistors. Students enrolled in these courses vary widely in their conceptual understanding and prior exposure to electrical systems. The intervention was designed to integrate seamlessly into the existing course structure while creating new opportunities for metacognitive engagement and meaningful feedback.

There were multiple exams in these courses, each preceded by a Q&A session. In addition to asking and answering exam-related questions, students were asked to design and turned in their own circuit diagrams aligned with the concepts covered on the exams. No specific question or explanation was required when they designed the circuits. Students were encouraged to share the designs in small groups or online discussion platform, to analyze the circuit behavior for practice and self-assessment. They were additionally informed that selected designs, whether correct or flawed, could be incorporated into exams, with revisions as needed. About 40-60% circuits in the exams (except the final exam) were from student designs, and the rest were created by the instructor. However, in the final exam, all circuits were designed by the instructor. In addition, students were reminded repeatedly during the semester that they should prepare to understand and apply basic concepts to solve new circuits instead of memorizing circuit patterns or formulars, in all exams including the final exam. During regular lectures, students could also volunteer to share self-designed circuits for in-class discussions.

3. Methods

There were 19 students enrolled in the circuits course in both Spring 2024 and Spring 2025, all of whom were ECE majors. Enrollment in the electronics course was 49, 37, and 65 students in Fall 2024, Spring 2025, and Fall 2025, respectively, with more than 95% majoring in ECE. All instructional activities were part of regular coursework, and only de-identified data from students were used for research purposes. All procedures followed Institutional Review Board (IRB) guidelines for educational research.

The data analyzed in this study included exam scores and the anonymous online end-of-semester course evaluations administered college-wide. Because the course evaluation is intended for instructional improvement rather than educational research, the questions assess the overall course experience and do not specifically target the student-designed circuit activity. To obtain more focused feedback, the instructor administered an additional anonymous paper survey in Fall 2025, that addressed students' perceptions of the circuit-design activity. This survey was completed one week before the end of the semester, with the instructor waiting outside the classroom to ensure anonymity. 38 out of 65 students voluntarily completed and submitted the paper survey. The paper survey included eight Likert-scale items addressing perceived benefits of the activity, metacognitive awareness, conceptual understanding, and learning strategies. Students responded on a six-point scale ranging from "strongly disagree" to "strongly agree". The survey also contained an open-ended question to gather additional details about students' experience and feedback.

Quantitative and qualitative analyses were further conducted to address the research questions. For quantitative analysis, exam scores were analyzed descriptively to identify overall performance trends. Likert-scale items in the end-of-semester evaluations and the survey were summarized using descriptive statistics to characterize students' perceptions of the activity. For qualitative analysis, comments from end-of-semester evaluations and open-ended responses from the additional survey were analyzed using thematic coding.

4. Results and Discussion

This section presents findings organized around the three research questions. The findings result from examples of student-designed circuits, exam performance data, and student perceptions collected through surveys and course evaluations.

4.1 RQ1: Evidence of Metacognitive Awareness and Conceptual Understanding

Analysis of student-generated circuit problems and their reflective statements revealed clear evidence of both conceptual understandings and metacognitive growth. Students created a wide variety of circuit designs related to different topics in the courses, including both correct and unintentionally flawed problems. The flawed designs were especially informative, providing insight into students' internal reasoning and difficulties.

Figure 1(a) is an example of the student design in early semester of the circuits course, which was selected to analyze series or parallel connection in the first exam. Looking at the definition of parallel connection, R1 and R2 share the same two nodes and the voltages across them are both 0 V, so they could be considered parallel connection. However, there is no current going through R1 and R2, so they don't affect to the circuit behavior at all and could be removed from the design. This creates an interesting situation that challenges students to deeply consider the concept of parallel connection.

Figure 1(b) is also a student design in early semester of the circuits course, which was adopted in the exam to discuss the feasibility. Many students pointed out that this was not the normal way to place the ammeter, but didn't realize that the ammeter created a short circuit and that some components could damage because of it.

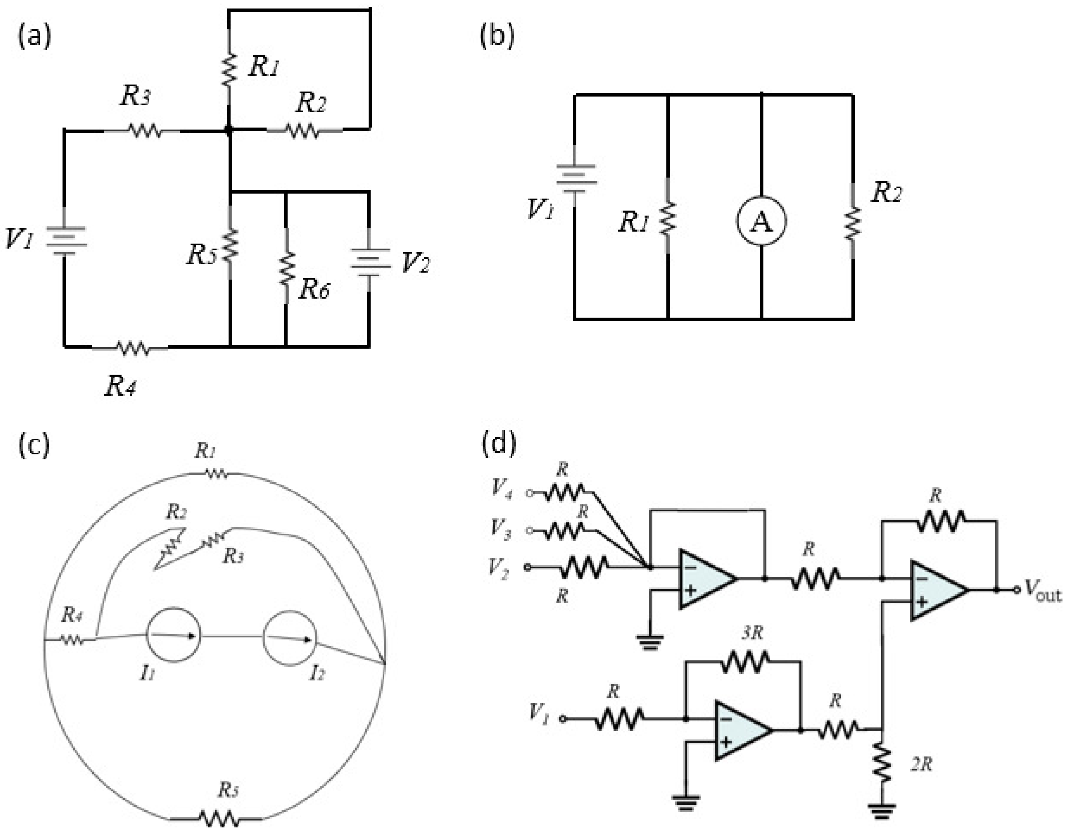

Figure 1. Examples of student-generated circuits in the circuits and electronics courses.

Figure 1(c) is a creative design in the middle of the semester in the circuits course, before the exam involving nodal-voltage and mesh-current analysis. This is an impossible configuration violating the function of independent current sources, and many students could recognize this mistake. Later, the instructor used this design in the exam after replacing one current source with a voltage source, and asked students to apply both nodal-voltage and mesh-current analysis. More than 70% students made different mistakes in the revised design. Some students thought a voltage source and a current source couldn't be connected to each other, because they had never seen similar structures before.

Figure 1(d) shows a student design from the electronics course that was used in the op-amp exam. Although the entire circuit appears complex, it is simply a combination of three configurations previously discussed in lectures and labs: a weighted summer, an inverting amplifier, and a difference amplifier. The only flawed component of the design is the absence of a feedback resistor in the upper-left op-amp. Without the feedback resistor, that op-amp output is forced to 0 V, eliminating the influence of input signals V_2, V_3, and V_4 on the rest of the circuit. More than half of the students overlooked this issue, noting that the structure resembled the weighted summer example from the textbook and directly applying the standard formula $V_o = -(V_1R_f/R_1 + V_2R_f/R_2 + V_3R_f/R_3)$, without recognizing that $R_f = 0$ in this design. Because most resistors in the circuit were labeled as "R," some students assumed the feedback resistor was also "R" and substituted that value into the formula, leading to incorrect results. Others recognized that the feedback path was unusual but were unsure how to interpret it and left R_f in symbolic form, resulting in an incomplete analysis.

Table 1. Common misconceptions reflected from student-generated circuits.

1. Unfamiliarity with Circuit Symbols	
2. Lack of Awareness of Short-Circuit Conditions	Fig. 1(a) and 1(b)
3. Invalid or Impossible Circuit Topologies	Fig. 1(c)
4. Misconceptions About Op-Amp Feedback	Fig. 1(d)
5. Misapplication of Diode Operating Principles	

Table 1 summarizes the most common misconception themes identified from the student-designed circuits across the two courses, with several categories of errors recurring consistently. Students also exhibited other misconceptions that typically emerge during circuit analysis in traditional exams, and those misconceptions are not included in the table.

Unfamiliar with circuit symbols: students demonstrated difficulty using standard circuit notation. For example, several battery symbols were drawn with positive and negative plates of equal length, causing the component to resemble a capacitor. In other cases, students omitted labels for component or neglected to indicate input and output voltage signals, making the intended function of the circuit ambiguous.

Lack of awareness of short circuit conditions: some designs contained inadvertent short circuits. Examples included a branch that bypassed some components (Figure 1(a)), an ammeter connected in parallel with a voltage source (Figure 1(b)), or an inductor placed directly in parallel with a battery. These errors indicate difficulty recognizing short-circuit, probably due to the lack of conceptual understanding of the circuit components.

Invalid or impossible circuit topologies: some circuits featured physically impossible configurations, such as connecting two current sources with different values in series (Figure 1(c)) or two voltage sources with mismatched values in parallel. Such topologies violate fundamental constraints of circuit behavior and suggest that students may apply symbolic circuit laws without considering the function of each circuit component.

Misconception about op-amp feedback: some student-generated operational amplifier circuits revealed misunderstandings of the feedback behavior. Examples included incorrect placement of components within the feedback path (up-left op-amp in Figure 1(d)) or configurations that unintentionally produced positive feedback.

Misapplication of diode operating principles: examples included connecting a 5 V supply directly to a p–n junction diode which normally takes 0.7 V drop in forward region, without considering any resistors for protection; or constructing diode networks whose orientation prevented any current flow.

These types of misconceptions are rarely revealed in traditional exams, where instructors typically provide correctly designed circuits for students to analyze. However, such misconceptions may appear when students design circuits themselves, which is an important consideration given the complexity and responsibility they will face as future engineers. Providing opportunities to recognize these misunderstandings early can help students strengthen their conceptual foundations and enhance their metacognitive awareness. Student comments from the paper survey reflect these benefits. One student said "*It exposed gaps. I had to apply circuits laws to analyze the feasibility, hence thinking process happens*", and another said *"Designing circuits helped to make me properly understand how components work individually and together. It is challenging to make sure the circuit is actually possible to work."* These reflections highlight how the activity prompted students to confront misconceptions, evaluate feasibility, and think more deeply about circuit behavior.

4.2 RQ2: Use of Student-Generated Circuits in Instruction and Assessment

When student-generated circuits were utilized into class discussion, it provided opportunities for collaborative reasoning and reinforcing conceptual thinking. Figure 2(a) is a student design before the midterm exam in the electronics course, which was selected for in-class discussion. The diodes will be the major focus in this exam, and the instructor encouraged students to incorporate any component learned from prior courses. This was the first time for most students to see a diode and an op-amp integrated. Although the instructor announced that this circuit would only be used for in-class discussion instead of the exam, students engaged enthusiastically in analyzing the peer-generated design. Several students offered incorrect analysis, but they appeared more comfortable sharing their reasoning and remained focused on exploring the underlying concepts. Some students even proposed further revisions, such as reversing the diode direction or incorporating additional components, demonstrating a higher level of engagement and creative problem solving.

Figure 2(b) illustrates a student-generated circuit proposed during a review session before the final exam in the electronics course. Although the final exam would focus mainly on transistor behavior, the instructor reminded students that components from earlier units could be combined with a transistor to form a novel exam problem. In response, one student voluntarily sketched this circuit on the classroom whiteboard, leading to a full-class discussion. The student's initial design included a resistor in series with diode D_1, and the instructor recommended removing it to reduce computational steps and maintain conceptual focus. Through this collaborative analysis, students also developed a clearer understanding that the exam would emphasize conceptual reasoning rather than extensive numerical calculation.

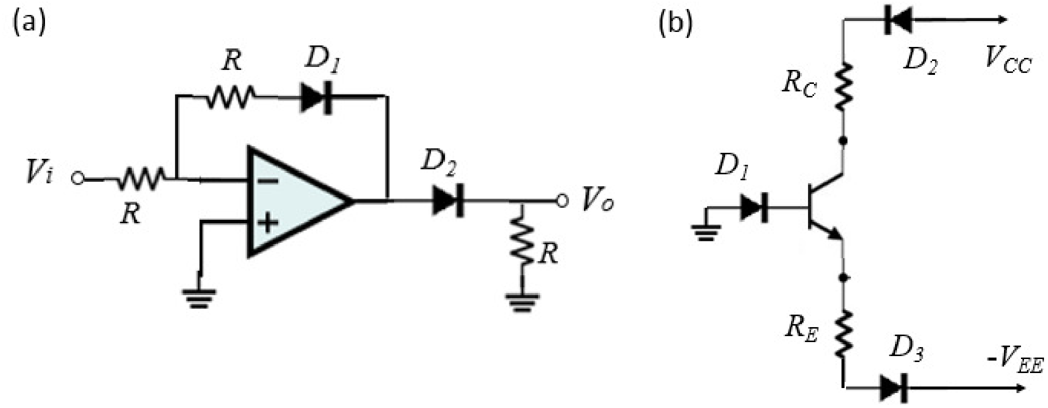

Figure 2. Examples of student-generated circuits for in-class discussion.

Table 2. The average scores of each exam.

	Exam1	Exam2	Exam3	Final exam
Circuits:				
Spring 2024	70.8	56.8	77.5	76.3
Spring 2025	57.5	52.4	69.6	69.3
Electronics:				
Fall 2024	47.2	55.5	N/A	76.9
Spring 2025	65.9	62.5	N/A	79.2
Fall 2025	44.2	60.8	N/A	71.8

The exploration of student-designed circuits in exams began in the circuits course in Spring 2024, when only Exam 2 incorporated student-generated problems. The average score on that exam was considerably lower than on the others in the same semester, as shown in Table 2. Beginning in Fall 2024, student-generated circuits composed approximately 40–60% of each exam, except for the final exam only including instructor-designed problems. The difficulty level of circuits created either by students or by the instructor was kept consistent. Because students were able to share and practice with peer-generated circuits prior to several exams, one might expect better performance on these assessments than on the final exam. However, the score patterns reveal a different trend: average scores increased over the semester, suggesting that students needed time to shift their study strategies and adapt to the greater emphasis on conceptual understanding required by these novel problem types This score patterns also suggest a need for instructors to employ complementary methods, such as test corrections or activities for bonus points, to support student performance early in the course so that students maintain confidence as they adjust to the expectations.

Students provided positive feedback in the paper survey and supported this activity in instruction and assessment. One student said "*I found that having a large quantity of circuits designed by others to analyze broadened my understanding. More practice is always useful",* and another said *"Thinking about our design: if it works or not. This also make me think what I need to review."* Also, another student said *"I felt I was able to quickly assess circuits after having to design my own. I felt led to use a more applicable designer-style approach to learning."*

4.3 RQ3: Student Perceptions of the Activity

Table 3. Survey items and the number of students selecting each choice.

1. Designing circuit problems helped me engage more deeply with the course material.											
strongly disagree	0	disagree	0	slightly disagree	5	slightly agree	11	agree	14	strongly agree	8
2. I found the activity enjoyable and motivating.											
strongly disagree	0	disagree	1	slightly disagree	7	slightly agree	12	agree	11	strongly agree	7
3. I monitored my thinking process while creating the problems.											
strongly disagree	0	disagree	4	slightly disagree	5	slightly agree	12	agree	15	strongly agree	2
4. The activity made me more aware of gaps in my understanding.											
strongly disagree	0	disagree	1	slightly disagree	4	slightly agree	8	agree	12	strongly agree	13
5. This activity improved my understanding of fundamental concepts.											
strongly disagree	0	disagree	6	slightly disagree	3	slightly agree	10	agree	11	strongly agree	8
6. I feel more confident applying circuit concepts after this activity.											
strongly disagree	0	disagree	2	slightly disagree	9	slightly agree	9	agree	10	strongly agree	7
7. This activity encouraged me to use new strategies for learning circuits/electronics.											
strongly disagree	1	disagree	3	slightly disagree	1	slightly agree	12	agree	10	strongly agree	12
8. I would prefer similar design-based activities in future courses.											
strongly disagree	0	disagree	1	slightly disagree	2	slightly agree	12	agree	13	strongly agree	10

Student perceptions of the circuit-design activity were examined through the paper survey administered by the instructor in Fall 2025 and through open-ended comments from end-of-semester course evaluations across multiple semesters. Collectively, the responses indicate that students viewed the activity positively, particularly in terms of increasing engagement, promoting metacognitive awareness, and deepening conceptual understanding.

Table 3 summarizes the results of the paper survey administered by the instructor in Fall 2025. For each survey item, the majority of respondents selected a positive rating (slightly agree, agree, or strongly agree). Notably, more than 85% of students responded positively to items 1, 4, 7, and 8, which addressed the extent to which the circuit-design activity increased their engagement, heightened their awareness of misconceptions, motivated them to adjust their learning strategies, and encouraged them to want more design-based activities in future courses. The proportion of positive responses for the remaining items (items 2, 3, 5, and 6) was somewhat lower, ranging from 65% to 80%. Some students indicated that they did not actively monitor their thinking while designing circuits, implying that they assembled components without clear reasoning or imitated circuits they had previously seen. Additionally, as students became more aware of their misconceptions, several realized that their understanding of fundamental concepts was weaker than they had believed, which in some cases reduced their confidence. These results also emphasize the important of additional instructional support, to help student correct misconceptions and maintain confidence as they adjust learning methods and strengthen conceptual understanding.

Representative student comments include:

- *"Designing circuits helps me truly test my knowledge. I realize the gaps I have, but I don't know how to fix it yet."*
- *"Seeing these complex circuits does create a sense of fear, but sticking to the basics helps, which is very important."*
- *"This design activity makes me much more aware that I need to deeply understand the concepts, not any specific circuit problem. It takes focus away from memorizing formulas or problem solutions."*
- *"This activity made me realize how complex the world is and how new circuits will always be popping up in real life. If you have the fundamentals down, you can handle anything."*
- *"It made me realize that I need to focus more on how things work, instead of practice problems."*

Although the end-of-semester course evaluations did not specifically target the student-designed circuit activity, it still served as a useful supplementary data source, with completion rates typically exceeding 90%. Table 4 presents selected evaluation items and the corresponding average student ratings, related to engagement, conceptual understanding, and assignment effectiveness in the course. Responses were reported on a five-point scale ranging from "1 – strongly disagree" to "5 – strongly agree". All average scores are above 4, reflecting positive student perceptions that are consistent with the survey findings reported in Table 3.

Table 4. Selected items in the end-of-semester course evaluation and the average student rating.

Selected items in the end-of-semester course evaluation:	Circuit		Electronics		
	Spring 2024	Spring 2025	Fall 2024	Spring 2025	Fall 2025
The instructor effectively engaged students in class.	4.64	4.72	4.45	4.60	4.21
I have a deeper understanding of the subject matter in this class.	4.79	4.78	4.30	4.79	4.29
The course challenged me to think critically and learn new concepts.	4.86	4.83	4.67	4.82	4.68
Assignments, tests and other activities were useful for helping me learn the subject.	4.50	4.72	4.17	4.55	4.22

Comments from the end-of-semester course evaluation include:

- "*Teaching the concept and ideas in a way that you can look at any problem and should be able to solve it.*"
- *"I specifically love how he provides examples. Rewarding students for learning from mistakes suits his goal of understanding above all else."*
- *"This course pushed us to understand the course material. This helped me develop the fundamental knowledge better than focusing on passing tests."*
- *"The course prioritizes truly understanding a few basic concepts, and being flexible enough to apply those concepts to any random circuits. We learned how to think of circuits as "boxes' that the user can put an input and expect an output, and this really helped me look at circuits in a more product-based approach, thinking about how they act in different systems."*

Overall, despite the initial difficulty students reported when adapting to this novel exam style, their reflections and evaluations demonstrate strong perceived value. Students recognized that designing problems required deeper engagement, critical thinking, and self-monitoring. For this novel type of exam, students also adjusted their learning method, focusing on the fundamental concepts rather than memorizing circuits or formulas. Their comments align closely with the metacognitive patterns observed in their written reflections and the conceptual misconceptions revealed in their designs. Such perceptions reflect a meaningful shift from procedural learning toward more reflective and conceptually grounded reasoning, which is the key goal of engineering education reform.

5. Limitations and Future Work

While the findings from this study provide promising evidence of the benefits of student-designed circuit tasks for promoting metacognition and revealing misconceptions, several limitations should be acknowledged when interpreting the results and considering implications for broader instructional practice.

5.1 Limited Sample Size and Course Context

The study was conducted in a single institution within a specific set of electrical and computer engineering courses. The sophomore circuits course had relatively small enrollments (19 students per semester), and the junior electronics course, although larger, represented only one cohort. These enrollment sizes limit the generalizability of the quantitative results, particularly exam score trends and survey percentages. Future work involving additional institutions or larger multi-section courses would strengthen external validity.

5.2 Influence of Instructor Facilitation

Instructor decisions played a significant role in how student designs were used in class discussions and exams. The extent to which flawed circuits were highlighted, corrected, or revised depended heavily on instructor judgment. These differences may influence student perceptions and performance, introducing variability that is difficult to control. Future studies could systematically examine how different facilitation strategies affect learning outcomes.

5.3 Confounding Factors Affecting Exam Performance

Although exam score trends suggest that students required time to adapt their study strategies, these patterns may also be influenced by factors not directly related to the circuit-design activity, such as varying exam difficulty, cumulative content load, or increased familiarity with course expectations. Additionally, students' ability to share and practice peer-generated circuits before exams may have introduced advantages that differed by cohort. A more controlled experimental design would help isolate the activity's impact on exam performance.

5.4 Self-Report Bias in Survey and Evaluation Data

Survey responses and end-of-semester course evaluations relied on students' self-report, which may be subject to bias. Students who enjoyed the activity may have been more likely to participate or to respond positively, while others may have hesitated to express critical views despite anonymity. Complementing self-reported perceptions with structured interviews, focus groups, or observational data could provide a richer understanding of student experiences.

5.5 Short-Term Measurement of Metacognitive Development

Although students reported increased awareness of their misconceptions and reflection on learning strategies, the study did not measure whether these metacognitive gains persisted beyond the course. Longitudinal studies following students into subsequent courses could reveal whether designing circuit problems supports deeper, longer-term conceptual understanding or improved performance in advanced ECE coursework. In addition, this study did not employ a validated metacognitive instrument, and therefore claims regarding metacognitive development should be interpreted cautiously. A validated metacognitive instrument would be used to assess changes more rigorously in metacognitive awareness.

6. Conclusion

This study examined an instructional strategy in which students designed their own circuit problems, either correct or unintentionally flawed, to deepen conceptual understanding and promote metacognitive development in undergraduate electrical engineering courses. The findings address the three research questions posed at the beginning of the work.

First, student reflections and the analysis of their circuit designs revealed that the activity prompted meaningful metacognitive engagement. As students created and then attempted to solve these novel circuits, many recognized inconsistencies in their reasoning, confronted misconceptions they had not previously detected, and reflected more intentionally on how circuit principles work. Designing circuits required students to articulate assumptions, verify feasibility, and evaluate correctness, which aligned with core metacognitive processes of planning, monitoring, and evaluating. These findings suggest that the activity helped students develop a deeper and more self-aware understanding of circuit behavior.

Second, the flawed and correct circuit designs provided rich opportunities for conceptual exploration during class discussions and assessments. Analyzing peer designs helped students identify misconceptions, critique reasoning, and collaboratively refine their understanding of circuit principles. Incorporating these designs into exams encouraged students to move beyond procedural problem-solving, prompting them to evaluate circuit validity and interpret unfamiliar configurations. Although exam scores initially dipped when these novel problems were introduced, performance improved over the semester as students adapted their study strategies and embraced a more conceptually focused approach.

Third, survey responses and end-of-semester evaluations showed strong student support for the circuit-design activity. Students reported increased engagement, greater awareness of their misconceptions, and motivation to adopt more effective learning strategies. At the same time, some students expressed initial discomfort or reduced confidence when recognizing their misconceptions, suggesting that additional guidance may help them adjust more smoothly. Nevertheless, student perceptions reinforce the activity's positive impact on metacognitive development and course engagement.

Overall, these findings suggest that incorporating student-generated circuit problems is a practical, scalable, and pedagogically impactful strategy for strengthening conceptual understanding, supporting metacognitive growth, and increasing engagement in circuits and electronics courses. By shifting students from passive solvers to active problem designers, the activity affords richer opportunities for reflection, conceptual inquiry, and collaborative learning. As engineering programs continue to emphasize deeper conceptual mastery and adaptive expertise, student-designed problem tasks represent a valuable and versatile addition to the instructional toolkit.

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