

CHAPTER I

INTRODUCTION

1.1 Background

One of the STEM subjects that causes students difficulty understanding and confusion is electricity. Students believed physics is one of the most difficult sciences in education, which contributed to their lack of enthusiasm and disinterest in learning (Yasin et al., 2018). This was also justified after the researchers conducted interviews with one of the schools in Bandung, grade 8th junior high school students, and grade 9th junior high school students in Cimahi. 37 of 45 students said that physics lessons were very difficult to understand and their interest in learning physics was lacking. In the interviews in grade 9 junior high school, they did not do electricity experiment, there was no clear reason why their teacher did not do an experiment on electricity, even though electricity is a challenge, since it contains exceedingly abstract and sophisticated concepts and is entirely dependent on models, analogies, and metaphors (Mulhall et al., 2001; Yasin et al., 2018). That it is difficult for students to explain the role of the electric field in the interaction of the various elements of a circuit (Cao & Brizuela, 2016). There was also an alternative concept about electric current in the electric circuit that the students generated (Yasin et al., 2018). STEM educational approach to learning about magnetism, electricity, and electrical energy can stimulate students' interest in science, provide deep and meaningful learning, and improve students' thinking and hands-on skills (Anwari et al., 2015).

Understanding electricity circuits is crucial for students for several reasons: 1). Basic Understanding of Technology: In today's world, technology is deeply integrated into our lives, and much of it relies on electricity and circuits. Understanding circuits helps students grasp the foundation of how devices and technologies work, from simple gadgets to complex electronic systems. 2). Problem-Solving Skills: Circuitry involves troubleshooting and problem-solving. When a circuit doesn't work as

Arnie Novianti Zulkarnain, 2023

***PAPER CIRCUIT PROJECT-BASED STEAM LEARNING TO ENHANCE
STUDENT UNDERSTANDING AND CREATIVITY***

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

intended, students need to analyze the components, connections, and potential faults to identify and fix the issue. This process develops critical thinking and analytical skills. 3) STEM Education: Science, Technology, Engineering, and Mathematics (STEM) education is highly valued as it prepares students for future careers in various fields. Understanding circuits forms the basis for many STEM subjects and careers, such as electrical engineering, electronics, computer science, and more. 4) Innovation and Creativity: Knowing how circuits work allows students to create and innovate. They can design new devices, improve existing technologies, and explore their own ideas by manipulating and connecting components in unique ways. 5) Real-World Application: Circuits are present in numerous aspects of daily life, from household appliances to transportation systems. Understanding circuits helps students make informed decisions about energy consumption, safety, and the proper use of electronic devices. 6) Career Opportunities: Many high-paying and in-demand careers are related to electronics and electrical engineering. Jobs in these fields often require a strong foundation in circuit theory and design. By understanding circuits at a fundamental level, students open up pathways to these career opportunities. 7) Sustainable Energy: As the world moves towards more sustainable energy solutions, understanding circuits becomes important for harnessing and distributing renewable energy sources like solar and wind power. 8) Safety: Electric circuits can be dangerous if not handled properly. Understanding circuits helps students learn about safety precautions, such as the importance of grounding, proper insulation, and avoiding overloads. 9) Digital Literacy: In the digital age, even non-engineers need a basic understanding of circuits. From setting up a home network to troubleshooting basic electronics, this knowledge is essential for functioning effectively in a technology-driven society. 10) Personal Empowerment: Understanding circuits empowers individuals to take control over their technology. They can perform basic repairs, modifications, and upgrades to their devices instead of relying solely on professionals.

Arnie Novianti Zulkarnain, 2023

***PAPER CIRCUIT PROJECT-BASED STEAM LEARNING TO ENHANCE
STUDENT UNDERSTANDING AND CREATIVITY***

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

In summary, understanding electricity circuits provides students with a strong foundation in technology, problem-solving skills, and career opportunities. It enables them to engage with the modern world, make informed decisions, and contribute to advancements in various fields.

In Indonesia there are still many the learning-teaching process is often teacher-centered. In fact, student learns better when they engage in meaningful learning activities. The learning teaching process itself still occurs in the form of direct transfer of knowledge from teacher to students. In fact, student learns better when they engage in meaningful learning activities. Project-based STEM learning is one of the alternative teaching strategies to encourage students bengage in meaningful learning (Hanif et al., 2019). STEM learning in many schools is heavily focused on science and mathematics while ignoring the critical role of engineering and technology (Christine & McDonald, 2016). Over the last few years, Science, Technology, Engineering, and Mathematics (STEM) have garnered significant attention in many countries across various sectors. In the United States, STEM education has been given national priority status, with the National Science Foundation stressing its significance in all levels of secondary education (Sanders, 2009; Wannapiroon & Pimdee, 2022), to instill critical thinking skills in students so they have the potential to develop students become creative- thinking problem solvers who will ultimately thrive in the workforce (Wannapiroon & Pimdee, 2022; White, 2014). In general, the implementation STEM into learning can enhance students improve their 21st-century skills (Farwati et al., 2021; Permanasari, 2016). However, in Indonesia over the last six years, STEM implementation has primarily involved high school students, reaching 42%. Thus, strong encouragement is required to pique the interest of other education unit-level teachers in innovating by incorporating STEM into classroom learning (Farwati et al., 2021). Today, art has added an "A", and STEAM education now helps students better understand their world through a diversity of knowledge and perspectives, which is conducive to cultivating their innovative abilities (Connor et al., 2015; Miller & Knezek, 2013).

Arnie Novianti Zulkarnain, 2023

***PAPER CIRCUIT PROJECT-BASED STEAM LEARNING TO ENHANCE
STUDENT UNDERSTANDING AND CREATIVITY***

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

Students should cultivate creativity for a variety of reasons, as it offers numerous benefits that contribute to personal, academic, and professional growth:

- 1) **Critical Thinking:** Creativity encourages students to think outside the box, consider multiple perspectives, and develop innovative solutions to problems. This fosters critical thinking skills that are valuable in all aspects of life.
- 2) **Problem Solving:** Creative individuals are often better equipped to tackle complex problems because they can approach challenges from unique angles and devise unconventional solutions.
- 3) **Adaptability:** In a rapidly changing world, adaptability is key. Creative individuals are more open to change, can find new ways to navigate unfamiliar situations, and are willing to embrace novel ideas.
- 4) **Communication Skills:** Creativity involves expressing ideas in diverse and engaging ways. This can improve students' communication skills, helping them convey complex concepts more effectively.
- 5) **Confidence:** Successfully generating creative ideas and seeing them come to fruition boosts self-confidence and self-esteem. This confidence can translate into all areas of life, from personal relationships to academic pursuits.
- 6) **Innovation and Entrepreneurship:** Creativity is at the heart of innovation and entrepreneurship. Students with creative mindsets are more likely to develop groundbreaking ideas and pursue entrepreneurial ventures.
- 7) **Artistic Expression:** Creativity finds an outlet in arts and self-expression. Students can use creative pursuits like painting, writing, music, and dance to explore and communicate their emotions and thoughts.
- 8) **Collaboration:** Creative individuals often bring unique perspectives to group projects and collaborations. They can inspire others, introduce novel ideas, and contribute to a more diverse and well-rounded team dynamic.
- 9) **Lifelong Learning:** Creativity encourages curiosity and a thirst for learning. Creative individuals are more likely to seek out new experiences, explore different subjects, and continue learning throughout their lives.
- 10) **Personal Fulfillment:** Engaging in creative activities provides a sense of fulfillment and joy. Whether it's creating art, solving puzzles, or inventing new things, the act of being creative can be inherently rewarding.
- 11) **Resilience:** Creativity involves experimentation, and not every creative endeavor will be

Arnie Novianti Zulkarnain, 2023

***PAPER CIRCUIT PROJECT-BASED STEAM LEARNING TO ENHANCE
STUDENT UNDERSTANDING AND CREATIVITY***

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

successful. Learning to cope with failure, adapt, and try again fosters resilience and a growth mindset. 12) Future Job Skills: As automation becomes more prevalent, uniquely human skills like creativity are becoming increasingly valuable in the job market. Many industries are seeking employees who can bring fresh ideas and creative thinking to their roles. 13) Cultural and Social Understanding: Creativity helps individuals explore different perspectives, cultures, and historical contexts. This fosters empathy and a deeper understanding of the world and its complexities.

In essence, cultivating creativity equips students with a versatile set of skills that extend beyond traditional academic knowledge. It empowers them to approach challenges with an open mind, adapt to change, and contribute meaningfully to their communities and the world at large.

Therefore, the researchers assume that Paper Circuit Project-based STEAM Learning will be proposed to solve students' problems understanding and creativity in electrical concepts and applications. Project-based STEM learning is a project-based methodology in which Science, Technology, Engineering, and Mathematics (STEM) are integrated into curriculum design. STEM project-based learning is distinguished by its design approach and multidisciplinary training. Project-based STEM learning design approach begins with creating a well-defined result by defining the purpose and organizing the project's summative evaluation. Students will next be assigned an in which they must present their thoughts for solving a complicated problem in a novel way. Project-based STEM learning has the potential to boost creativity since students will build or enhance their product ideas. One crucial talent that students should cultivate is creativity (Dawes & Wegerif, 2004; Hanif et al., 2019). Creativity refers to the creation of a novel and appropriate response, product, or solution to an open-ended task (Amabile, 2012). If creativity is related to study and technology, it will result in high-quality work. STEM project-based learning has been used to assess students' creativity in areas such as adventure, curiosity, imagination, and challenge (Hanif et al., 2019).

Arnie Novianti Zulkarnain, 2023

***PAPER CIRCUIT PROJECT-BASED STEAM LEARNING TO ENHANCE
STUDENT UNDERSTANDING AND CREATIVITY***

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

The educational approach known as STEAM is an expansion of the well-known STEM model and involves the integration of four fundamental subjects: science, technology, engineering, and mathematics. Through the STEAM methodology, students are encouraged to engage in innovative thinking and design, which promotes the development of potential solutions for a range of real-world challenges. Real problems due to the engineering design process. Below are process-based teaching and learning models for structural design: (1) Problem identification (2) Finding relevant information (3) Solution design (4) Planning and development (5) Testing and evaluation and design improvement (6) Presentation. Art integration under the STEAM concept is an innovative way to enable students to work through creative processes, experiential learning, real-world work practice, problem-solving, analysis, synthesis, evaluation, and creative skill development. Focused on design, resulting in improved cognitive skills, a better understanding of what is being taught, and the development of creative thinking (Wittayakhom & Piriyasurawong, 2020). The key to STEAM education is the word, 'integration' (Ogunleye, 2018). Adding art to STEM increases students' systematic thinking skills, creativity development, and student motivation enhancement (Bazler & Sickle, 2017).

Creativity is defined as novelty or originality; thus, it must generate something new and distinct. Something cannot be deemed innovative if inappropriate or unimaginative. As a result, teachers must be capable of cultivating pupils' creativity. To foster a student's creativity, a teacher's teaching and instructional conduct should meet the following standards: (1) allow free use and movement between spaces; (2) allocate enough time and avoid rushing through activities; (3) incorporate a wide range of educational resources; (4) create engaging and innovative tasks; (5) prioritize learning through play, minimizing pressure and encouraging a structured yet flexible and self-directed learning experience; (6) encourage collaborative work, dialogue, and respect; and (7) involve external organizations and experts who are not affiliated with the school, such as museums and research

Arnie Novianti Zulkarnain, 2023

***PAPER CIRCUIT PROJECT-BASED STEAM LEARNING TO ENHANCE
STUDENT UNDERSTANDING AND CREATIVITY***

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

centers.(Aguilera & Ortiz-Revilla, 2021; Davies et al., 2013). The most significant part that has been addressed is how a teacher can enhance and provide action to students so that they may have many creative ideas and new inventions in developing STEAM learning projects.

Numerous researchers have conducted studies on project-based STEAM learning. Previous research has shown that integrating the arts with science, technology, engineering, and mathematics is not just another curriculum, but an essential response to the urgent need to equip young people with higher-order skills to positively and productively handle the demands of the 21st century (Taylor, 2016). Moreover, digital literacy for children based on steam in family education also plays an important role for the success of the program (Purnamasari et al., 2020). In addition, students' concept mastery and creativity in the implementation of project-based STEAM Learning in light and optic lesson is categorized as good (Wandari et al., 2018). Furthermore, the research results indicate that the Project based STEAM learning model improves students' mastery of ecological concepts (Sigit et al., 2022). The research has a limitation related to the assessment of students' attitudes. Project-based STEAM learning can train students critical thinking skills in science learning through electrical bell project (Rahmawati et al., 2021).

Existing research in project-based learning has often focused on generic project implementations, neglecting the nuanced interplay between artistic expression, scientific principles, and interdisciplinary collaboration that characterizes STEAM education. Similarly, studies on STEAM education tend to lack in-depth investigation into specific projects, hindering a comprehensive understanding of their impact on student engagement, creativity, and cognitive development. Various research studies have investigated the implementation project-based STEAM learning using paper circuit in elementary school and secondary school (Weibert et al., 2016). Then to measure the increase in creativity it was not explained in more detail what indicators were used, and to measure students' understanding of electricity topic was not explained in more detail. In addition, Lindberg et al.,

Arnie Novianti Zulkarnain, 2023

***PAPER CIRCUIT PROJECT-BASED STEAM LEARNING TO ENHANCE
STUDENT UNDERSTANDING AND CREATIVITY***

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

(2020) research on improving student's creativity by using STEAM Project Based Learning toward paper circuit project with ethnographic method in High School. Furthermore, the research utilizing STEAM Project-Based Learning on student concept mastery and creativity skills through paper circuit project (Lee & Recker, 2018). However, in this research, the participant are middle school students, and using pre-experimental research. The study aims to investigate how this hands-on, multidisciplinary approach enhances students' creativity and comprehension of electricity concepts. However, in previous research to measure the increase in creativity it was not explained in more detail what indicators were used.

Therefore, the novelty in this research is students' understanding was assessed using an objective test of cognitive levels C1 (remembering), C2 (understanding), C3 (applying) and 25 multiple-choice questions based on the Bloom Classification (Anderson & Krathwohl, 2001). For measuring the enhancing students' creativity, the project was assessed using the instrument for creative product analysis matrix (CPAM) indicator and the results were also assessed by teacher and then it was seen whether students could increase their creativity or not. More information, this research endeavor seeks to bridge this gap and unravel uncharted dimensions by examining how the synergy between the Paper Circuit Project, project-based learning, and STEAM education can redefine educational experiences.

Using a STEAM learning approach through a paper circuit project can effectively enhance student understanding and creativity for several rational reasons, the first is Hands-on Learning, the paper circuit project engages students in a hands-on experience, allowing them to physically create circuits using paper, conductive materials, and components. This tactile interaction helps solidify theoretical concepts through practical application. The second is Interdisciplinary Learning, STEAM projects integrate various disciplines, encouraging students to bridge the gap between subjects. By combining art (designing the circuit layout), science (understanding electrical principles), technology (using conductive materials), engineering (building the circuit),

Arnie Novianti Zulkarnain, 2023

***PAPER CIRCUIT PROJECT-BASED STEAM LEARNING TO ENHANCE
STUDENT UNDERSTANDING AND CREATIVITY***

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

and mathematics (calculating resistance, voltage), students see how these fields connect in real-world applications. The third is Creativity in Design, designing paper circuits involves creativity in planning the layout, choosing components' placement, and deciding on the visual aspects. This fosters creativity as students must think both technically and artistically to create functional and aesthetically pleasing projects. Fourth, Problem-Solving Skills, during the paper circuit project, students may encounter challenges such as non-functional circuits or dim lights. This prompts them to troubleshoot and apply critical thinking to identify issues and find solutions, enhancing their problem-solving skills. Fifth is Visual Representation of Concepts, paper circuits provide a tangible representation of abstract concepts like current flow, circuit connectivity, and component interaction. Visualizing these concepts helps students grasp them more concretely, aiding in understanding complex electrical principles. Six is Personalized Learning, each student's paper circuit project is unique, allowing for personalized learning experiences. Students can explore different designs, experiment with varying components, and adjust their projects to align with their interests and learning styles. Seven is Collaboration and Communication, group projects foster collaboration and communication skills. Students can work together to brainstorm ideas, divide tasks, and share insights, improving their ability to work effectively in teams. Eight is Boosting Engagement, hands-on projects like paper circuits captivate students' interest and curiosity. This engagement can lead to increased motivation to learn about circuitry and related STEAM concepts. Nine is Long-Term Retention, Experiential learning has been shown to lead to better retention of information. Engaging multiple senses through the tactile experience of crafting paper circuits helps embed concepts in students' memory. Eleventh is Introduction to Electronics, The paper circuit project serves as a gentle introduction to electronics for students without prior knowledge. It demystifies the topic and encourages them to explore more complex electronics in the future. Twelfth is Experiential Assessment, teachers can assess students' understanding through their completed paper circuit projects. This alternative assessment method gauges

Arnie Novianti Zulkarnain, 2023

***PAPER CIRCUIT PROJECT-BASED STEAM LEARNING TO ENHANCE
STUDENT UNDERSTANDING AND CREATIVITY***

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

comprehension and creativity beyond traditional tests.

Incorporating paper circuit projects within a STEAM framework is a practical approach that capitalizes on students' innate curiosity, fosters creativity, and enhances understanding across various disciplines. It promotes holistic learning by combining technical knowledge with artistic expression, resulting in a well-rounded educational experience.

1.2 Research Problem

Based on the background already stated, the problem is stated: "How does Paper Circuit Project-based STEAM Learning Enhance Student Understanding and Creativity?"

Several research questions are derived from the research problem to be investigated. The research questions are listed below:

- a. How does the implementation of Paper Circuit after STEAM Learning in Classroom?
- b. How does the improvement of Students' understanding after implementing STEAM Learning in electricity topic?
- c. How does the improvement of Students' Creativity after implementing STEAM Learning in electricity topic?

1.3 Operational Definition

In order to summarize and avoid any misconception about this research, the operational definitions are stated. The research variables are as followed:

- a. STEAM Learning

In this study, the STEAM learning activity will be conducted by using Paper Circuit Project. STEAM is the integration of segmented school subjects such as science, technology, engineering, arts, and mathematics with the addition of arts to curriculum to inspire creativity and imagination as well as activities promoting critical thinking skills in science and across all subjects

Arnie Novianti Zulkarnain, 2023

PAPER CIRCUIT PROJECT-BASED STEAM LEARNING TO ENHANCE STUDENT UNDERSTANDING AND CREATIVITY

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

leading to the development of creativity (Wittayakhom & Piriyasurawong, 2020). In this research, students will create the project and the students fill the worksheet lab on their learning. The researcher can observe how much students understand about electric current, electric circuit and ohm Law in electricity material and how creative are students in making their own projects. STEAM Learning implementation will be evaluated based on video recording data, photos, and student and teacher interviews.

b. Students' Understanding

In this study, Pre-test and Post-test are chosen as the experimental research methods to discover a causal relationship only by involving one group of the subject. At 1st meeting the pre-test was carried out before the students got any material about electricity, the pre-test was carried out to find out how far students know the material about electricity. After that, at 2nd and 3rd meeting the teacher give some treatment (give material about electricity) this is in implementation part and also conducts paper circuit experiments. This experiment is so that students can better understand the concept/material of electricity in STEAM Learning. Then at the last meeting at 4th meeting the students were given a post-test, the use of this post-test is to measure whether there is an increase in students' understanding of electricity material.

c. Students' Creativity

In this study, the improvement of student creativity was measured using creating two projects. Students should to make two different projects at different meetings. Creativity must generate something new and different (Aguilera & Ortiz-Revilla, 2021).

At the 2nd meeting students must make a paper circuit project 1 using one or two LEDs and draw art based on the creativity of each group and at the 3rd meeting students make the same project with a different design using 2-4 LEDs. After making two projects, the results of the 2nd meeting and 3rd meeting of the project were assessed using the instrument for creative product

Arnie Novianti Zulkarnain, 2023

***PAPER CIRCUIT PROJECT-BASED STEAM LEARNING TO ENHANCE
STUDENT UNDERSTANDING AND CREATIVITY***

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

analysis matrix (CPAM) indicator and the results were also assessed by teacher and student fill the worksheet lab. Then it was seen whether students could increase their creativity or not.

1.4 Limitation of Problem

1. STEAM Project-based Learning

Project based STEAM learning is a model with a approach incorporate science, technology, engineering, art and mathematics (STEAM) into curriculum development (Sigit et al., 2022). There are several phases in project-based STEAM learning, which served as, 1). Reflection, students focus on problem contexts related to the content of ecosystem components, interaction of ecosystem components, energy flow, and biogeochemical cycles by carrying out activities of analyzing and connecting concepts. 2) Research, students analyze related issue to science topic, students are trained to develop thinking skills independently. 3). Discovery, teacher and student discuss to related problem and start to make a prototype related with the problem (making paper circuit prototype). 4). Application, students start to make project and teacher is responsible monitoring the activities by facilitating apparatuses and materials (LEDs, Copper Tape, coin Battery). 5). Communication, students are able to present their product and other group evaluate the result of group product.

2. Student Understanding

Cognitive aspect test is in form multiple choice question in order to describe the students' cognitive ability in understanding the concept based on the Bloom Taxonomy revised. The assessment of student's understanding is based on bloom taxonomy, it includes C1 until C3. Bloom's Taxonomy have been revised and it has two dimensional, there are knowledge and cognitive processes. The use of the new taxonomy of learning objectives is very helpful for teachers in compiling questions to measure the level of student success.

3. Student Creativity

Arnie Novianti Zulkarnain, 2023

***PAPER CIRCUIT PROJECT-BASED STEAM LEARNING TO ENHANCE
STUDENT UNDERSTANDING AND CREATIVITY***

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

The concept of STEAM education involves various components such as project-based learning, incorporating technology in creativity and design, adopting multifaceted approaches to problem-solving, and integrating science, technology, engineering, arts/humanities, and mathematics into lessons (Aguilera & Ortiz-Revilla, 2021; Ozkan & Topsakal, 2019). Additionally, cooperative problem solving is encouraged in this approach. For measure creativity, the research uses the CPAM indicator, there are Novelty, Resolution, and Elaboration

4. Electricity

To focus this research, the researcher limits it to several things. First, this study focuses on the topic of Dynamic Electricity and Circuits in grade 8 and grade 9 junior high school based on the Merdeka curriculum or Cambridge curriculum. Second, these topics include electric current, circuit diagrams, and ohm Law.

1.5 Research Objectives

The objectives of this research are outlined and, in the specifications, below:

- a. To design STEAM Learning using Paper Circuit Project
- b. To enhance students' understanding of Electricity and Circuit by using Paper Circuit project
- c. To enhance students' creativity in STEAM learning by using Paper Circuit project

1.6 Research Benefit

- a. Teacher

This research helps the teacher to find a suitable learning activity, especially dynamic electricity, learning model, and learning process. This research also can help teachers to plan teaching and learning processes more understanding and creative.

Arnie Novianti Zulkarnain, 2023

PAPER CIRCUIT PROJECT-BASED STEAM LEARNING TO ENHANCE STUDENT UNDERSTANDING AND CREATIVITY

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

b. Student

This study is beneficial for the students because students can more understand about electricity especially electric current and ohm Law to make their project and help them in learning, create student's creativity in Art design and students can also apply the project in their daily lives inside and outside of school.

c. Researcher

This research is useful for researchers because it will provide data and material about students' understanding and creativity in Electricity topic with the Project-based STEAM learning at the junior high school level and renew the scientific literacy of younger generations, and, with the inclusion of the arts, student creativity is described as a skill.

1.7 Organization of Research Paper

The research structured based on the guidelines for writing research paper from Universitas Pendidikan Indonesia 2019 edition. The arrangement of each chapter is shown below:

1) Chapter I: Introduction

This chapter consists of background, research problem, research objective, research benefit, organization of research paper, and limitation of problem.

2) Chapter II: Literature Review

This chapter discuss detail theory of the research. The theories discuss in this research are Project-Based STEAM Learning, students' Understanding students' creativity, and Electricity. This chapter also discussed the relevant research of the research theories.

3) Chapter III: Research Method

This chapter consists of research method, research design, subject of research including sample and population, research instrument that use to collect the data, data analysis and research procedure.

Arnie Novianti Zulkarnain, 2023

***PAPER CIRCUIT PROJECT-BASED STEAM LEARNING TO ENHANCE
STUDENT UNDERSTANDING AND CREATIVITY***

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

4) Chapter IV: Results and Discussions

This chapter discuss the research finding and explain the factors that can influence the results. In this chapter, research question and hypothesis supposed to be answered.

5) Chapter V: Conclusion, Implication, and Recommendation

This chapter examine the conclusion of the result that already analyzed in the previous research. The implication discuss about how the treatment was implemented during the research. And the recommendation for the future research.

