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Navigating Electrochemistry: Challenges and Coping Strategies of Engineering Students

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Abstract. The research examines engineering students' difficulties in electrochemistry and how they manage these challenges. Electrochemistry is a core but challenging subject in engineering education, which tends to be difficult because of its abstractness, mathematical nature, and laboratory component. Even though it is crucial in many engineering contexts, students struggle to comprehend central ideas, apply reaction quotient and electrochemical equations problems, and extend abstract knowledge to laboratory situations. This study endeavors to determine the particular learning difficulties faced by students in engineering and examine the coping strategies they utilize. With a qualitative study design, an FGD was held with 12 students who had finished the Chemistry for Engineers course. Thematic analysis of the data indicated five main challenges: conceptual complexity, mathematical complexity, laboratory constraints, insufficient prior knowledge and resources, and emotional stress due to academic pressures. To manage these issues, students employed various coping mechanisms, including collaborative learning with peer interaction, reliance on web-based learning materials such as YouTube and electronic textbooks, independent study techniques such as working on problems in practice and mnemonics, and motivational strategies aiming towards perseverance. The study concludes that instructional-focused materials, improved laboratory facilities, and systematic academic support systems are required to improve the education of electrochemistry among engineering students. Such evidence has important implications for teachers and curriculum developers based on the imperative for pedagogical improvements targeting scholarly and psychological requirements to drive student learning success.

Keywords: Coping strategies; Electrochemistry; Engineering education; Learning challenges.

1.0 Introduction

Electrochemistry is a core but demanding subject in engineering education, and it is an important area of application in energy storage, corrosion protection, and industrial electrochemical processes. Nevertheless, various studies have recognized it as one of the most challenging fields of chemistry because of its abstractness, high dependence on mathematical problem-solving, and the need to bridge theoretical and experimental knowledge (Akram, 2014; Mirtachew Tihar et al., 2022). Consequently, engineering students struggle to grasp basic electrochemical ideas like redox reactions, electrochemical cells, and mathematical concepts governing Gibbs free energy and cell potential (Orozco et al., 2022). Such difficulties make it impossible for them to use electrochemical principles efficiently in practical engineering contexts.

Among the leading obstacles to acquiring electrochemistry skills is mathematical complexity. Most students struggle with reaction quotient calculations, logarithmic functions in the Nernst equation, and proper use of constants like Faraday's constant (Salame et al., 2022). Inadequate solid math foundation skills have been found to hinder problem-solving in chemistry, with electrochemistry being the most challenging (Scott, 2012). In addition, electrochemistry demands that students relate macroscopic observations to microscopic and symbolic representations, a challenging task without well-organized instructional materials (Rodriguez-Velasquez, 2013). Furthermore, laboratory limitations add to these difficulties. Kelley (2021) emphasized experiential learning in teaching electrochemical principles, but shortages of laboratory equipment and reagents in most institutions reduce students' opportunities for experiential learning.

Aside from cognitive and technical issues, emotional and psychological determinants also contribute to students' difficulties in electrochemistry. High academic pressure, economic difficulties, and stress to meet performance demands have been associated with reduced motivation and poor academic achievement in chemistry classes (Neba & Niba, 2024; Gao, 2023). The sheer volume of electrochemistry coursework leads to surface-level learning strategies, where grades are given greater importance than in-depth conceptualization (Orozco et al., 2022). To address these challenges, students use various strategies such as collaborative learning, internet sources, independent study methods, and motivational strategies to address these issues. Evidence indicates peer-assisted learning improves academic achievement and retention (Leopold & Smith, 2019; Bacomo et al., 2022). In addition, online platforms like YouTube have been discovered to enhance students' conceptual understanding of chemistry (Maziriri et al., 2020), while organized study strategies like retrieval practice and time management techniques enhance long-term learning (Scott, 2023).

While past research has investigated overall challenges in learning chemistry, limited studies have directly explored the experiences of engineering students in learning electrochemistry, specifically regarding their coping strategies. This study aims to fill this void by establishing engineering students' significant electrochemistry challenges and investigating their coping mechanisms. Through an investigation of students' experiences based on a qualitative analysis, this research provides meaningful contributions to spaces where teaching support can be improved. The findings of this study will eventually guide curriculum development, instructional material improvement, and student support program development to improve engineering students' learning outcomes in electrochemistry.

2.0 Methodology

2.1 Research Design

This research utilized qualitative research design based on focus group discussions (FGD) to investigate engineering students' challenges and coping strategies in learning electrochemistry. The qualitative approach was chosen to understand better students' experiences, perceptions, and coping strategies. Thematic analysis was used to identify recurring themes from student responses. FGDs were chosen over surveys or one-on-one interviews because they encourage interactive questioning, where students can elaborate on one another's answers, uncover common challenges, and share coping mechanisms in an interactive environment. This approach revealed common challenges while also highlighting differences in student experience depending on their academic background, engineering discipline, and previous experience with Chemistry.

2.2 Research Locale

This study was conducted at the Engineering Department of a Catholic University in Tuguegarao City, Cagayan, Philippines. The engineering programs the University offers are Civil Engineering, Computer Engineering, Electrical Engineering, and Electronics Engineering. Chemistry for Engineers is a basic subject of these engineering course offerings. It is worth mentioning that the researcher has taught Chemistry for Engineers at the University for seven years.

2.3 Research Participants

Twelve (12) students who had completed Chemistry for Engineers were selected using stratified random sampling. To ensure equal representation in the focus group discussion, these 12 students represented different groups based on their responses in the Google form. Table 1 summarizes the various groups they represented with their corresponding codes. These codes were used in the focus group discussion results. The codes Student Respondent 1 (SR1), Student Respondent (SR2), etc., refer to participant categories. Of these student respondents, four represented the different engineering programs in the University, two represented the graduates and nongraduates of the high school department in the University, two represented the STEM and non-STEM graduates, two represented those who failed the subject from Teacher X and Teacher Y, and two represented those whose family income belong to the below middle class and middle class and above.

Table 1. *Focus group discussion participants with their corresponding codes*

Code	Category
SR1	Civil Engineering
SR2	Computer Engineering
SR3	Electrical Engineering
SR4	Electronics Engineering
SR5	Graduate
SR6	Non-Graduate
SR7	STEM
SR8	Non-STEM
SR9	Failed – Teacher X
SR10	Failed – Teacher Y
SR11	Below Middle Class
SR12	Middle Class and Above

2.4 Research Instrument

The researcher constructed a semi-structured interview guide. This is focused on engineering students' challenges and coping mechanisms in learning Electrochemistry. The guide's open-ended questions are intended to entice participants to share in-depth experiences and perspectives. After carefully analyzing pertinent literature, the questions were developed and improved in response to expert input. Participants' rights and privacy were safeguarded through informed consent and confidentiality.

2.5 Data Gathering Procedure

The researcher obtained permission from the Academic Dean of the Engineering Department, with the approval of the University President, to conduct the study. Initially, the researcher reviewed the Chemistry for Engineers class records during the first and second semesters of the Academic Year 2023-2024. The students' scores on activities and quizzes on the different topics in Chemistry for Engineers were used to analyze which topic they struggled with the most. After identifying the topic, a focus group discussion (FGD) was conducted. The questions used in the semi-structured interview guide during the FGD were developed based on a literature review on electrochemistry education and expert feedback from chemistry faculty. The findings from the FGD included the challenges and coping mechanisms of students learning Electrochemistry. The Google Form used for participant selection was administered by sending the link through old group chats of former students. The discussion was audio-recorded and transcribed for thematic analysis.

2.6 Data Analysis

The verbatim interviews were coded using MAXQDA, a thematic coding software, to group student answers into primary themes of challenges and coping mechanisms. The software-based analysis guaranteed consistency and systematic coding of repeating patterns. To promote reliability, the researcher hand-checked and polished the themes generated to ensure they reflected the study's aims and the literature in place. This ensured the validation of the findings and reduced potential biases.

2.7 Ethical Considerations

The study adhered to the ethical considerations of the study, where an informed consent letter was given to the participants. All data gathered were treated with utmost confidentiality, and all other sources of information were appropriately cited.

3.0 Results and Discussion

The Focus Group Discussion aimed to explore the engineering students' challenges in learning Electrochemistry and their coping strategies. Each of these themes has sub-themes that highlight the complexity of learning Electrochemistry.

3.1 Challenges of Engineering Students in Learning Electrochemistry

Table 2. *Challenges of Engineering Students in Learning Electrochemistry*

Themes	Subthemes	Verbatim	Literature
Challenges of Engineering Students in Learning Electrochemistry	**Complexity of Electrochemistry Concepts**	*"It is pretty puzzling which formula applies to each scenario, and balancing the chemical equations has been very challenging for me."* (SR11) *"Balancing redox reactions is confusing because you have to check the charges or exponents."* (SR6) *"I don't get the relationship among the variables in the triangle – K, Gibbs free energy, and cell potential. There are too many formulas."* (SR7) *"I cannot determine when the Nernst equation formula is applicable. Whenever standard and non-standard conditions are mentioned, I get confused."* (SR9)	Due to weak conceptual foundations, students struggled with complex Electrochemistry concepts, including the Nernst equation, redox balancing, and parameter relationships (E, Gibbs free energy, K). Akram et al. (2014) found that 67% of concept-based Electrochemistry items were difficult to comprehend, attributing challenges to poor background knowledge, lack of teaching aids, and language misunderstandings.
	Mathematical Difficulties	*"It is easy to mix up constants or enter values wrong in the calculator, which throws off the entire answer."* (SR2) *"I accidentally make the oxidation sign negative. I get confused about the correct sign for reduction potential and oxidation."* (SR3) *"I mix up the values of constants like Faraday's constant. I also don't know when to use the 0.08205 constant."* (SR5) *"Since I was not a STEM student in senior high school, I don't know how to use a scientific calculator properly. That's why sometimes I struggle to keep up with problem-solving."* (SR8) *"I enter the wrong exponents in the calculator when solving the reaction quotient of a redox reaction, which results in the wrong final answer."* (SR10)	Students faced mathematical challenges in Electrochemistry, particularly with constants (e.g., Faraday's constant), reaction quotients (Q), exponents, unit conversions, and scientific calculator use. Salame et al. (2022) found that students struggled with redox problem-solving, emphasizing connecting microscopic concepts (ion and electron movement) with symbolic representations through formulas and calculations.
	Laboratory Limitations	*"We do not have enough equipment, so it is hard to get proper experience."* (SR8) *"There isn't enough equipment, so sometimes we have to do virtual labs. We have chemicals, but they are insufficient, so some experiments cannot be completed."* (SR5) *"Some lab activities were skipped because there was not enough equipment, but not all of them."* (SR6) *"The experiment couldn't be performed because some reagents were missing. However, we were able to do some of the other experiments."* (SR7)	Limited laboratory equipment and reagents hindered hands-on learning, reducing students' confidence in applying theoretical knowledge. Kelley (2021) found that the lack of hands-on experience in chemistry labs, especially during the COVID-19 pandemic, negatively impacted student learning and engagement, emphasizing the importance of psychomotor experiences for developing technical competencies.
	Lack of Prior Knowledge and Resource Constraints	*"It is difficult to study independently without a textbook or proper notes."* (SR7)	Non-STEM participants struggled the most with Electrochemistry due to limited prior chemistry knowledge and difficulty grasping fundamentals early in the syllabus. Limited access to learning materials further hindered independent study. Rodriguez-

		"Lack of reference like books." (SR1) *"The thing that mainly contributes to the challenges I encounter is prior knowledge since it becomes all new to me, not to mention that it becomes overwhelming. There are also no textbooks as basis, which is making it difficult."* (SR2) *"Don't have enough knowledge."* (SR3) *"Prior knowledge is lacking, and there is no module available. A reference is necessary, especially when instructors do not provide PowerPoint presentations."* (SR4) *"There's no textbook."* (SR5) *"There's also a lack of resources, like textbooks."* (SR8) *"Lack of knowledge about the topics, like for instance, the formulas in the triangle, and the unfamiliar terms used in teaching."* (SR10) *"Prior knowledge is important because some terms are hard to understand. It's also difficult to keep up when most of your classmates are already familiar with the topic, so it doesn't get explained further. Since there's no reference or textbook, it's hard to look up unfamiliar topics."* (SR11)	Velasquez (2013) highlighted that understanding electrochemical processes requires familiarity with physics concepts like electric current and resistance, which are often overlooked in introductory chemistry courses and lead to misconceptions about redox reactions and electric circuits.
	Emotional and Psychological Challenges	*"It is overwhelming to have to comply with many requirements on the different subjects. It always made me feel like I am left behind."* (SR12) *"It affects my expectations and my mental state as a whole."* (SR2) *"I felt discouraged because I failed. Losing my scholarship because of this subject made me have a love-hate relationship with Chemistry."* (SR3) *"It's stressful, and when the topic is difficult and I don't understand it, I lose the motivation to review."* (SR4) *"Family pressure."* (SR5) *"Sometimes I lose motivation because no matter what I do, even if I put in so much effort, nothing seems to change."* (SR7) *"I got stressed because of the high tuition fees."* (SR8)	Beyond academic difficulties, participants faced emotional and psychological challenges due to academic workload and financial pressures, leading to anxiety, decreased focus, and reduced motivation. Gao (2023) found that academic stress contributes to burnout, hindering engagement, retention, and overall academic performance while lowering self-esteem and emotional stability.

Complexity of Electrochemistry Concepts

Many participants stated difficulties in comprehending complex concepts in Electrochemistry, specifically in identifying when to use equations such as the Nernst equation. Balancing reduction-oxidation reactions has also been a challenge for most of them. They reported difficulties understanding relationships among parameters such as the cell potential (E), Gibbs free energy (G), and the equilibrium constant(K). For instance, one participant noted. *"It is pretty puzzling which formula applies to each scenario, and balancing the chemical equations has been very challenging for me."* This suggests that students find applying theoretical knowledge to Electrochemistry problem-solving difficult when they lack a solid conceptual foundation. Akram et al. (2014) observed that 67% of the concept-based items in electrochemistry were challenging for students to understand. This finding was consistent with the result of this study. A lack of instructional tools, inadequate foundation knowledge, and a misinterpretation of the language caused conceptual issues in comprehension.

Mathematical Difficulties

A good foundation in Mathematics is a prerequisite for solving Electrochemistry problems. However, participants cited mathematical challenges, especially with calculations involving constants (e.g., Faraday's constant), reaction quotients (Q), and exponents. They reported confusion in using units correctly and interpreting numerical results. Their lack of training in using a scientific calculator during high school also increased their plight. For instance, one participant shared, *"It is easy to mix up constants or enter values wrongly in the calculator, which throws off the entire answer."* These matters reflect students' challenges in integrating mathematics into their understanding of electrochemical reactions. This finding aligned with the study by Salame et al. (2022), who investigated students' learning difficulties in solving redox problems. The participants emphasized the importance of calculators in solving these problems. Students must comprehend the microscopic processes—such as the motion of ions and electrons—and then use formulae and mathematics to translate them to the symbolic level. Students regard calculations and mathematics as the most challenging components of studying redox.

Laboratory Limitations

The lack of necessary laboratory equipment and chemical reagents hindered the participants from performing some laboratory exercises. This undermined their hands-on learning. "*We do not have enough equipment, so it is hard to get relevant experience,*" said one participant, and many students concurred that practical application was complex due to a lack of sufficient resources. Their confidence suffered from unpreparedness to apply theoretical knowledge to practical experiments. This observation aligned with Kelley's (2021) research on Chemistry laboratory learning during the COVID-19 pandemic. Kelley found that the cumulative data from pandemic-related learning attests to the fact that a lack of first-hand, personal experience with wet experiments can hinder student learning and engagement, especially in disciplines that require much benchwork. Notably, research from various courses indicates that the most effective method for developing several crucial technical skills is through psychomotor experiences, including lab activities.

Lack of Prior Knowledge and Resource Constraints

Due to their lack of prior chemistry knowledge, several participants, especially those not STEM participants, faced an additional learning obstacle. Since Electrochemistry is one of the first topics on the syllabus, they needed assistance grasping the fundamentals because they were still getting used to college life and lacked chemistry fundamentals. Most participants also emphasized their limited access to learning materials (e.g., PowerPoint presentations from instructors, textbooks, and modules), which made independent study more challenging and added to participants' academic difficulties. Moreover, one participant remarked, "*It is difficult to study independently without a textbook or proper notes.*" This outcome supported the conclusions of Rodriguez-Velasquez (2013), who stated that a conceptual understanding of the electrochemical process necessitates understanding concepts commonly studied in physics, such as electric current, resistance, and potential, frequently overlooked in introductory chemistry courses. A general lack of understanding of physical concepts causes students to have misconceptions about the relationship between redox reactions and electric circuits. They also recognized the need for instructional materials that promote conceptual understanding of the electrochemical process.

Emotional and Psychological Challenges

Aside from the academic challenges encountered by the participants, some of them also experienced emotional and psychological challenges from high levels of stress due to intense academic workload and financial pressures. Since they also needed to comply with their academic requirements in other subjects, their ability to focus was adversely affected as they felt anxious about meeting other course requirements. One of the participants revealed, *"It is overwhelming to have to comply with many requirements on the different subjects. It always made me feel like I am left behind."* This undermined their confidence, impairing their capacity to understand the material/topic, resulting in lower grades and decreased motivation. This result corroborated the study by Gao (2023), which found that academic stress played a role in developing burnout. This burnout reduces students' ability to engage with and retain academic materials. This leads to decreased academic performance and lower self-esteem among students. According to the study, higher academic stress levels can decrease emotional stability and academic performance.

3.2 Coping Strategies of Engineering Students in Learning Electrochemistry

Table 3. *Coping strategies of engineering students in learning electrochemistry*

Themes	Subthemes	Verbatim	Literature
Coping Strategies of Engineering Students in Learning Electrochemistry	**Collaborative Learning**	"*Studying with friends and classmates helps a lot because we are comfortable explaining things to each other.*" (SR12) "*It's effective because we have close interaction with each other, and the information is retained better.*" (SR2) "*When I don't understand the lesson, I ask my friends for help, and it really helps because I can understand it quickly.*" (SR3) "*I understand the lesson better, especially problem-solving, when I ask a smart classmate. Group study is really effective.*" (SR4) *"Me and my friends collaborate and brainstorm on how we can better understand the concept."* (SR6) "*When I ask classmates from my same grade level, I understand their explanations better because we have the same perception.*" (SR7) "*Sometimes I ask friends when I don't understand a topic or when I'm struggling.*" (SR10) "*Group study is effective because when you ask about a topic you don't understand, it's easy to explain face-to-face, and you feel comfortable asking your friends.*" (SR11)	Participants relied on collaborative learning, seeking academic support from peers and seniors through study sessions and peer tutoring. Leopold and Smith (2019) found that collaborative learning enhances content mastery, academic performance, retention, and problem-solving skills, proving more beneficial than solitary or competitive learning.
	Utilization of Online and Supplemental Resources	"*YouTube videos are very helpful in understanding the lesson because they usually break down problems in ways I can understand.*" (SR9) *"Online materials, modules."* (SR1) "*Using YouTube is helpful because it provides visualizations and detailed explanations.*" (SR2) "*Sometimes I read online PDFs and watch YouTube videos.*" (SR5) *"Self-study and online learning materials."* (SR6) *"Youtube and practice problems. Online materials."* (SR7) "*Through online resources, I can help myself improve my problem-solving skills. I understand better when there are sample problems with complete solutions.*" (SR10)	Participants utilized online resources such as e-books, PDFs, and YouTube videos to supplement their learning due to their accessibility and visual explanations. Ayado and Berame (2022) found that students using supplementary materials performed better academically, while Maziriri et al. (2020) highlighted YouTube's effectiveness in tertiary education.
	Personal Study Techniques	*"Practice makes it easier to remember steps and understand the process better."* (SR4)	Participants adopted study techniques such as flashcards, the Pomodoro technique, and scheduled study sessions to enhance focus and retention. Scott (2023) highlighted that retrieval practice using flashcards improves memory, while structured time management strategies enhance focus and organization.

		"Sleep before going to Chem class and study lessons after class." (SR1) *"Always do advanced study or review to avoid panicking when there's a surprise quiz."* (SR3) *"Music learning. Pomodoro study technique, and watching The Organic Chemistry on YouTube."* (SR5) *"Early morning is the best time to review."* (SR7) *"For me, repeatedly reading and reviewing makes it easier to understand little by little."* (SR8) *"For me, the most effective strategy is asking about topics I don't understand and making an effort to study independently."* (SR10)	
	Motivational Approaches	*"Just try and try. Do not be lazy."* (SR1) *"Understand the lesson carefully."* (SR2) *"Don't be lazy when reviewing."* (SR4) *"My advice is to never stop dreaming and never stop trying."* (SR5) *"You will enjoy this subject as long as it interests you."* (SR6) *"Don't be overwhelmed. It's only hard at the beginning."* (SR7) *"Thinking about all these factors motivates me to do my best and learn so that my efforts and expenses won't go to waste."* (SR8) *"My advice is: don't be lazy."* (SR10) *"Just study. It all depends on the student's learning approach. Use time wisely. If you have free time, scan through your notes."* (SR11)	Participants emphasized the importance of perseverance and resilience, encouraging future students to attend review sessions, solve word problems regularly, get enough sleep, and listen to the teacher. Educational psychology research supports this, showing that students with higher perseverance are more likely to succeed in academic challenges (The Power of Perseverance: Insights From Neuroscience and Psychology Research, 2023).

Collaborative Learning

Most participants turned to collaborative learning as a solution to the difficulties. They turned to their seniors and fellow students who had completed the course for academic support. Since they found these methods successful, they typically set up study sessions in libraries and peer tutoring to review challenging material and work through challenging problems. They asked their seniors for advice on how to solve problems. One participant said, "*Studying with friends and classmates helps a lot because we are comfortable explaining things to each other.*" This highlights how crucial collaborative learning is for improving students' comprehension of their lessons. Similarly, Leopold and Smith (2019) studied collaborative learning in a Chemistry class and found that, under the correct circumstances, collaborative learning yields more learning gains than solo or competitive learning. They also highlighted the academic advantages of collaborative learning, such as a deeper and more complex understanding of the course material, better academic achievement, increased memory and transfer of new knowledge, and improved critical thinking and problem-solving abilities.

Utilization of Online and Supplemental Resources

In response to the need for more comprehensive classroom materials, the participants resorted to various online learning resources that they could use to enhance their education. Examples are electronic books, PDF files, YouTube videos, and other online resources. In addition to the fact that most of these resources are free, participants can access them whenever they need to study. Participants find these materials useful because they offer visual explanations and step-by-step examples. This reliance on digital resources shows students' ability to fill educational gaps. One participant said, "*YouTube videos are very helpful in understanding the lesson because they usually break down problems in ways I can understand.*" This result was consistent with research by Ayado and Berame (2022), which concluded that students who used supplemental learning resources performed better academically than those who used traditional teaching techniques. Students responded well to using YouTube in a formal learning setting, according to Maziriri et al. (2020), indicating that the platform is flourishing in tertiary education. These results confirm that the kids' coping mechanism is effective.

Personal Study Techniques

The participants were keen on countering their academic difficulties by employing different personal study techniques deemed effective. Some of these techniques include using flash cards where they would write formulas and define critical terms. One participant also used the Pomodoro technique, a time management method in which a person does focus work during 25-minute intervals and takes a five-minute break. Some participants also claimed to have a scheduled study session (often early in the morning or late at night) since they were more focused and productive during this time. Many participants also pointed out the importance of consistently practicing solving problems. They emphasized that *"practice makes it easier to remember steps and understand the process better."* This conclusion resonated with the results presented in an article titled "The Science of Effective Studying: Proven Techniques Backed by Research" by Scott (2023), who listed various strategies for improving memory, focus, and comprehension. One method is using flashcards for retrieval practice—actively pulling information from memory. By strengthening brain connections and memory, this activity makes long-term learning more successful. He also underlined how crucial planning and time management are—setting aside particular study times and making a timetable guarantee committed and concentrated study periods, which aid in staying organized and preventing procrastination.

Motivational Approaches

The participants also employed motivational techniques, stressing the importance of perseverance and resilience. They encouraged future students to join review sessions, develop the habit of solving word problems, get enough sleep, and listen to the teacher. The advice given by one participant manifested their dedication to overcoming challenges and enhancing their academic performance in learning Electrochemistry: "*Just try and try. Do not be lazy.*" Persistence is essential in education for student success. According to educational psychology research, students who persevere in academic challenges, such as difficult coursework or learning obstacles, are more likely to achieve success. This claim is supported by research that emphasizes the importance of perseverance in achieving better academic outcomes, as individuals with higher levels of persistence can overcome setbacks and remain engaged in their learning (The Power of Perseverance: Insights From Neuroscience and Psychology Research, 2023).

4.0 Conclusion

The research found that the significant challenges students of engineering experience in learning electrochemistry are conceptual complexity, mathematical issues, laboratory constraints, insufficient prior knowledge and resources, and emotional distress due to academic pressures. Using a focus group discussion and thematic analysis, the study pointed out students' coping strategies, including collaborative learning, online resources, self-directed study strategies, and motivational strategies. These findings pinpoint the need for teacher intervention in producing specific learning resources, upgraded lab conditions, and managed study assistance mechanisms to strengthen learners' academic success. Follow-up studies may probe the effectiveness of computer-assisted instructional instruments, i.e., interactive simulators and learning adapting systems, for compensating knowledge deprivations. Also, additional research would look at the long-term effects of various coping strategies on students' performance in electrochemistry and other challenging engineering courses. By using pedagogical changes from such results, educators and curriculum designers can increase the quality of engineering students' learning process and academic performance.

5.0 Contributions of Authors

The author confirms sole authorship of this study, with no co-authors or contributors. He wrote, revised, and finalized the manuscript for publication.

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7.0 Conflict of Interests

The author declares no conflict of interest about the publication of this paper.

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9.0 References

Akram, M., Surif, J. B., & Ali, M. (2014). Conceptual difficulties of secondary school students in electrochemistry. Asian Social Science, 10(19). https://doi.org/10.5539/ass.v10n19p276

Ayado, D. M., & Berame, J. S. (2022). Effectiveness of supplementary modular learning materials to grade 12 students in science, technology, engineering, mathematics track in stoichiometry. International Journal of Educational Policy Research and Review, 9(4), 112–135. https://doi.org/10.15739/ijeprr.22.013

Bacomo, A. C. C., Daculap, L. P., Ocampo, M. G. O., Paguia, C. D., Pentang, J. T., & Bautista, R. M. (2022). Modular Learning Efficiency: Learner's Attitude and Performance Towards Self-Learning Modules. IOER International Multidisciplinary Research Journal, 4(2). https://doi.org/10.5281/zenodo.6511719

Gao, X. (2023). Academic Stress and Academic Burnout in Adolescents: A Moderated Mediating Model. Frontiers in Psychology, 14. https://doi.org/10.3389/fpsyg.2023.1133706

Kelley, E. W. (2021). Lab theory, hlab pedagogy, and review of laboratory learning in chemistry during the covid-19 pandemic. Journal of Chemical Education, 98(8), 2496–2517. https://doi.org/10.1021/acs.jchemed.1c00457

Leopold, H., & Smith, A. (2019). Implementing reflective group work activities in a large chemistry lab to support collaborative learning. Education Sciences, 10(1), 7. https://doi.org/10.3390/educsci10010007

Maziriri, E. T., Gapa, P., & Chuchu, T. (2020). Student perceptions towards the use of YouTube as an educational tool for learning and tutorials. International Journal of Instruction, 13(2), 119–138. https://doi.org/10.29333/iji.2020.1329a

Mirtachew Tihar, A., Reda Woldu, A., & Geremew, A. Y. (2022). High school students' learning difficulties in electrochemistry: a mini—review. African Journal of Chemical Education, 12(2), 202–205.

Neba, N. P. & Niba, A. T. (2024). The Effects of Academic Related Stress on the Performance Scores of Students of Ordinary Level Chemistry in Bamenda III. International Journal of Trend in Scientific Research and Development, 675–683. https://www.ijtsrd.com/papers/ijtsrd64742.pdf

Orozco, M., Boon, M., & Arce, A. S. (2022). Learning electrochemistry through scientific inquiry. conceptual modelling as learning objective and as scaffold. European Journal of Engineering Education, 48(1), 180–196. https://doi.org/10.1080/03043797.2022.2047894

Rodríguez-Velázquez, S. (2013). Development of an electrochemistry teaching sequence using a phenomenographic approach [thesis]. In North Carolina State University, North Carolina State University

Salame, I. I., Etwaroo, N., Khalil, A., & Kolozian, T. (2022). Examining some of students' challenges and use of algorithmic problem-solving approaches in electrochemical titrations. International Journal of Instruction, 15(3), 465–482. https://doi.org/10.29333/iji.2022.15326a

Scott, F. J. (2012). Is Mathematics to Blame? An Investigation into High School Students' Difficulty in Performing Calculations in Chemistry. Chemistry Education Research and Practice, 13(3), 330–336. https://doi.org/10.1039/c2rp00001f

Scott, P. (2023). The science of effective studying: proven techniques backed by research. The Study Journal.