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Learning Challenges and Coping Strategies in Chemistry Among STEM and Non-STEM Students in the Bachelor of Secondary Education major in Science (BSEd-Science) Program: A Phenomenological Study

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ABSTRACT

This phenomenological study investigated the learning challenges and coping strategies of STEM and non-STEM students in the BSEd-Science program at Sultan Kudarat State University. Focusing on Chemistry education, it found that students face major challenges such as limited lab resources, complex concepts, academic pressure, and weak foundational knowledge. Data from focus group discussions with 14 students revealed four key challenges: poor lab facilities, curriculum issues, academic stress, and conceptual gaps. To cope, students used strategies like personalized study, adaptive habits, collaboration, independent learning, support systems, motivation, and resourcefulness. The study recommends enhancing teaching strategies, improving lab infrastructure, curriculum support, and increasing institutional funding.

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1. INTRODUCTION

Chemistry is tied to Sustainable Development Goals (SDGs) as a solution for global sustainability. However, in many developing countries, chemistry education lacks focus on the environmental impact of chemical production. This oversight hinders awareness of the consequences of creating chemicals and their environmental impact throughout their life cycle (Ogodo & Abosede,2025). While there is not a universal curriculum standard for advancing chemistry education in both emerging and developed nations, valuable insights can be gleaned from diverse cultures and societies. These lessons offer opportunities for enhancing chemistry education and informing future educational reforms (Chiu, 2023).

In addition, chemistry is often perceived as challenging due to its need for a strong grasp of fundamental concepts, incorporation of mathematical calculations, reliance on a progressive learning structure, and integration of both logical and abstract thinking (Sevian & Talanquer, 2014). Chemistry is a fundamental subject in science education, and it is essential for students pursuing careers in science, technology, engineering, and mathematics (STEM) fields. However, recent research from the University of Washington reveals that general chemistry, a crucial introductory course series for numerous STEM degrees, poses a significant obstacle for underrepresented students (Harris *et al*., 2020).

The chemistry performance of Asian countries surpassed global achievement levels significantly. Successful Asian students generally appreciate their school environment, teaching methods, and student emotions. To enhance Chemistry learning outcomes in the Philippines, the focus should be on key factors, like students' past Science performance and the availability of resources (Sanchez, 2019).

Chemistry education in the Philippines has big problems, like being second to last out of 78 countries in a test called PISA in 2018. This shows it's important to make students better at chemistry. Doing well in chemistry is important because it helps us understand science better and come up with new ideas. We need to fix these problems so that our country can be better at chemistry and compete with others (Bernardo *et al*., 2023).

Filipino students say that how well they do in chemistry is affected by things like the mood in class, having a supportive place to learn, thinking about how much money they can make, how they study, if their chosen classes match what they want to learn, and how good their teacher is. They believe these things play a big role in how they perform in chemistry. It is important for them to have a positive environment and good teachers to do well. They also consider how their study habits and the subjects they choose in school impact their success in chemistry (Mangubat, 2023).

The implementation of the STEM curriculum in Sultan Kudarat faces mixed success, with strengths in teacher qualifications and parental involvement, but notable weaknesses in resources, facilities, and curriculum elements. Gaps include lab shortages, poor internet access, insufficient library resources, and inadequate infrastructure, emphasizing the need for comprehensive reforms to improve STEM education quality in the region (Dacles, 2024).

The fundamental purpose of this study is to dive into the complicated network of issues that STEM and non-STEM students face during their chemistry education, as well as to highlight the coping techniques they use to overcome these hurdles. This phenomenological study intends to shed light on individual students' varied experiences, providing a more granular knowledge of the chemical learning process (Al-Zohbi *et al*., 2022).

The outcomes of this study are intended to give useful insights for curriculum development, teaching techniques, and student support services in Bachelor of Secondary Education major in Science (BSEd-Science) programs. It can also help to create a more

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inclusive and fair learning environment by meeting the different requirements of STEM and non-STEM students. Furthermore, this study may be used to guide future research in the field of scientific education, emphasizing the need to take into account students' specific problems and tactics within the context of their academic programs (Zohar & Brazilai, 2013).

This study generally aims to explore the Learning Challenges and coping strategies in Chemistry among STEM and non-STEM students in a BSED-Science program. This research seeks to answer the following question:

(i) What is the socio-demographic of participants in terms of Age, Gender, Senior high school Strand, and Type of Academic Institution?
(ii) What are the specific learning challenges faced by STEM and Non-STEM students in Chemistry subjects (Organic and Inorganic chemistry) within the BSED Science program?
(iii) What coping strategies do these students employ to overcome these challenges?
(iv) What strategic outcomes or desired interventions do these STEM and Non-STEM students suggest to enhance their learning in Chemistry subjects in the BSED-Science program?

2. METHODS

This study employed a phenomenological approach to explore the learning difficulties and coping strategies of 7 STEM and 7 non-STEM students. Phenomenology, a qualitative research method, delves into individuals' experiences to understand their perceptions of the world. We selected this method to investigate the challenges faced by students in the BSED-Science program. Semi-structured interviews facilitated participants in articulating their learning obstacles and the effectiveness of their coping mechanisms in studying chemistry.

The instrument used in this phenomenological study, exploring the learning challenges and coping strategies in Chemistry among STEM and Non-STEM students in a BSED-SCIENCE program to gather the needed information from the participants. We prepared 5 major questions; the first question focused on students' background information. The second question focused on their learning experiences in chemistry, and the third question is about participants' coping strategies. The fourth question focused on STEM and non-STEM perspectives, and the fifth on their future recommendations. These five general questions will only serve as a guide for us.

We also used an Android phone for video and audio recording to make sure that no significant information from the interview would be missed.

3. RESULTS AND DISCUSSION

This chapter outlines the findings of the study, derived from the first-hand experiences shared by the participants. We meticulously analyzed the data, developing themes that are discussed individually. This chapter also details the process used to scrutinize transcripts from the 2 separate focus group discussions conducted, revealing codes and themes described.

3.1. Challenges Faced by STEM Students in Chemistry

3.1.1. Theme 1: Laboratory resources insufficiency and management inefficiency

Thematic analysis was used to examine the data about the difficulties faced by STEM students in chemistry courses under the BSED-Science program. Laboratory resources insufficiency and management inefficiency were the themes that emerged from the data that the participants provided. Based on the data gathered, most of the participants answered

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that the laboratory resources are limited, and some laboratory chemicals that are needed for their experiments are unavailable. Thus, learning chemistry for them becomes more challenging due to a lack of exposure to practical experimentation and laboratory activities (Alema *et al*., 2024).

In the focused group discussion, participants revealed that the major challenge of STEM in learning chemistry in the BSED Science program is the insufficient laboratory equipment and delayed access to laboratory resources. Based on the data provided by the participants, the inefficiency of laboratory equipment affects their learning of chemistry concepts because they cannot perform the necessary laboratory tasks, as it has limitations in terms of laboratory equipment.

Based on the study of (Putri *et al*., 2021), practical laboratory works and activities bolster students' scientific literacy and enhance motivation skills. Therefore, almost all the participants often have a tough time mastering chemistry concepts.

3.1.2. Theme 2: Curriculum-related challenges in chemistry education

About the learning challenges faced by STEM students in learning chemistry in the BSED-Science program, thematic analysis was used to analyze the data. Emerging codes were systematically coded through this analysis, exposing a recurring theme focused on curriculum-related challenges in Chemistry education. Based on the data provided by the participants, STEM students have trouble grasping chemistry concepts because of their complexity. Some of the participants highlighted that they are having confusion with compound numbering, naming rules, and stereochemistry. As a result of the complexity of topics, STEM students identified this as one of their challenges in learning Chemistry in the program.

Based on the data gathered from the focused group discussion, participants revealed that one of their struggles in learning Chemistry in the BSED-Science program is the complexity of Chemistry topics like the naming of functional groups, balancing of equations, numbering of compounds, and rules to follow in inorganic chemistry. Most of the STEM participants highlighted that they are having difficulty understanding Chemistry concepts due to their complexity, and they often get confused about understanding the topic because of the many rules to follow and consider, especially in naming and numbering compounds, as these concepts need a strong foundation in Chemistry topics and in-depth analysis.

It is a proof that Chemistry education is more challenging in the program since Chemistry is often perceived as challenging due to its need for a strong grasp of fundamental concepts, incorporation of mathematical calculations, reliance on a progressive learning structure, and integration of both logical and abstract thinking (Sevian & Talanquer, 2014).

3.1.3. Theme 3: Academic pressure

In connection with identifying the learning challenges of STEM students in chemistry education, thematic analysis was employed, and emerging codes were identified, resulting in a common theme focusing on the Academic pressure of STEM students in learning chemistry. Based on the data gathered and provided by the participants, STEM students often experience academic pressure when it comes to chemistry courses, as they are perceived by non-STEM students as knowing everything related to chemistry. As a result, these experiences become a challenge for STEM students because of the non-STEM expectations of them to excel in Chemistry classes.

Based on the findings, participants revealed during the focused group discussion that STEM students often felt pressured in their chemistry classes because of their classmates'

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expectations of them to know all the topics about chemistry, and if non-STEM students understood chemistry concepts more than they did. It puts pressure on STEM students to excel in chemistry classes because it is believed that Chemistry is already embedded in their curriculum during their senior year of high school as their specialized subject. As a result of this, participants take this as their challenge in chemistry education.

This challenge can be supported by the study of (Firmansyah & Saepuloh, 2022). He cited that Albert Bandura's Social Cognitive Theory emphasizes the role of observational learning, social influence, and self-efficacy in shaping individuals' behaviors and attitudes. This also supports students' perceptions of learning challenges in chemistry, which might be influenced by their observations of others, such as teachers and classmates, as well as their beliefs in their capabilities to succeed in chemistry.

3.2. Challenges Faced by Non-STEM Students in Chemistry.

3.2.1. Theme 1: Weak Foundation of concepts in Chemistry

About the challenges encountered by non-STEM students in chemistry subjects under the BSED-Science program, thematic analysis was used to analyze the data. There are emerging codes that are systematically coded, and the theme-based data provided by participants was a weak foundation for concepts in Chemistry. Based on participants' data, they find challenges for non-STEM students taking the BSED-Science program compared to STEM students. Students from the TVL (Technical-Vocational-Livelihood) and HUMSS (Humanities and Social Sciences) strands often struggle with chemistry because their academic backgrounds do not include much, if any, prior exposure to the subject. Their studies typically focus on practical skills and social sciences, respectively, which are unrelated to the principles of chemistry. As a result, these students find it challenging to grasp chemical concepts, as they lack the foundational knowledge that students from science-focused tracks might have.

Students in the TVL and HUMSS strands struggle with chemistry because their educational paths do not typically cover it. These strands focus on practical skills, the humanities, and the social sciences, therefore, chemistry concepts are unfamiliar. Without prior exposure, they find it hard to grasp new topics. This gap leads to frustration and difficulty keeping up with lessons.

The choice of a high school specialization can influence which college program a student selects. Students who pick a high school focus that matches their intended college major usually perform better academically and are more effective at managing their learning (Meyer *et al*., 2021).

Students who choose courses that do not match their talents may struggle to keep up with their classmates. Furthermore, students may face pressure from both their parents and society norms (Bin Sidek, 2023).

3.2.2. Theme 2: Tailored study methods

In terms of these coping methods for overcoming these problems, we used theme analysis to investigate the data, which they used to overcome the difficulties they encountered in the chemistry (organic and inorganic) courses of the BSED Science program. The data supplied by participants yielded themes connected to specific study procedures, which were carefully categorized and identified as codes (Schaller *et al*., 2016).

According to the participants, they employed specialized study approaches to overcome the coping mechanisms they encountered while learning chemistry. One critical component of personalized study methods is determining the most successful learning style for each

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individual. They were able to better cope with the problems and comprehend the material by adapting their approach to their specific requirements. Taking into account their diverse learning styles and preferences, they were able to devise successful tactics that assisted participants in grasping the concepts more thoroughly.

The information supplied by participants enables them to customize their study techniques by adding active learning methodologies. They concentrated on their academics, such as taking notes or completing chemical problems. Participants can increase their grasp of chemistry by actively applying what they've learned. Participants can also adjust their study strategies to their specific chemical strengths and limitations. For areas where they excel, they can devote less time and concentrate more on reinforcing their understanding via practice. On the other side, if there are more difficult topics or concepts, participants can devote more time to in-depth study, seek extra resources, or seek clarification from professors or classmates (Chen & Chen, 2015).

Several points are in the following:

(i) Personal Development. Personal growth has a significant impact on participants' coping methods when studying chemistry. Personal development is another intervention that participants feel will help them enhance their capacity to participate in successful problem-solving processes and study chemistry. Creating a focused growth perspective is a key part of personal development when learning chemistry. The participants were taught self-reflection and metacognitive skills. Self-reflection entails assessing one's learning process, recognizing strengths and flaws, and establishing objectives for growth. Metacognitive skills entail observing one's own mental processes and learning tactics. Participants can reflect on their learning experiences, measure their grasp of chemical principles, and alter their tactics as needed. Participants improve their learning effectiveness and efficiency by increasing their self-awareness and metacognition. This personal development helps individuals build the tools and mentality needed to overcome obstacles and achieve in their chemistry studies. Based on the research of (Pelekh *et al*., 2020), the rational ego recognizes the benefits of education for opportunity and personal growth. In a similar vein, the superego, influenced by societal standards, instills a sense of duty to study and develop oneself.

(ii) Utilizing Digital Learning Resources. Digital learning tools give users convenient access to a wide range of instructional materials. The use of digital resources as a coping strategy has the potential to improve participants' grasp of the themes presented by their peers and professors in chemistry. These resources may include online platforms such as the internet, multimedia, video lectures, instructional websites, and mobile apps. Students may study chemical themes, issues, and views at their own pace, selecting materials based on their interests, learning styles, and ability level to tailor their education to their unique requirements. Participants also have the option of studying at their speed and reviewing lessons as required. They may pause, rewind, and study information to ensure they completely understand the issues being addressed, as well as use YouTube videos relating to the topic to overcome learning problems and enhance their academic achievement. According to (Qian, 2022) research, digital learning resources are created and made available using several technologies, such as virtual reality, application development, multimedia, the Internet, and artificial intelligence. This helps in understanding students in learning through inquiry-based learning, hybrid learning, independent learning, and participation in collaborative learning.

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3.2.3. Theme 3: Learning adaptability

About this, we used thematic analysis to analyze the data on the coping strategies they used to overcome the challenges they encountered in Chemistry subjects (Organic and Inorganic Chemistry) in the BSED Science program. There is an emerging code adaptability that has been systematically coded, and the themes generated from the data provided by participants are Learning Adaptability. Learning adaptability is an important skill that can greatly enhance participants' coping strategies when it comes to learning chemistry. Adaptability refers to the ability to adjust and thrive in new or changing situations (Ochieng *et al*., 2019).

Based on the participants' statement that learning adaptability serves as a coping mechanism to overcome the challenges they faced in learning Chemistry. They focused on their specific goals and developed a study plan that included regular practice, review, and self-reflection. This helps the participants to stay organized, focused, and motivated by non-stem and with their peers to cope with the learning in Chemistry. The data provided by participants with adaptability is open to exploring the different approaches to find what works best for them. Participants who are versatile and willing to receive comments from their peers or even self-assessment. The participants utilize this feedback to discover areas for growth, modify their learning tactics, and assist one another. By being open to criticism, participants may constantly improve their grasp of chemistry and their entire learning experience.

Academic resilience in chemistry entails devising coping methods to address subject-specific problems. Academic resilience is an individual's capacity to overcome hurdles, adapt to challenges, and remain motivated and interested in what they are learning. Participants with high levels of academic resilience in chemistry are more likely to persevere in the face of obstacles and disappointments. The statistics supplied by the participants suggest that they are interested in development viewpoints. They feel that with work and practice, they may improve their skills and intellect. When confronted with difficulties in studying chemistry, they see them as chances to learn and better, rather than failures. This approach enables participants to accept their mistakes as part of the learning process and persevere in their efforts to master the subject of studying Chemistry.

According to the study of (Ononye *et al*., 2022), academic resilience and emotional intelligence are considered important personal resources for furthering students' academic performance. However, many educational organizations seem to trivialize the performance implications of these constructs in teaching and curriculum.

3.2.4. Theme 4: Collaborative problem-solving strategies

In this regard, we employed theme analysis to examine the data on the coping methods students used to overcome problems in Chemistry disciplines (Organic and Inorganic Chemistry) in the BSED Science program. There is emergent code that has been systematically coded, as well as themes derived from data contributed by participants in collaborative problem-solving procedures. Based on the participants' collaborative problem-solving skills, this acts as a coping mechanism for overcoming the difficulties they encountered while learning Chemistry. Collaborative problem-solving can help students cope with studying chemistry by creating a supportive environment. Participants can share their challenges, doubts, and solutions with their peers. The data supplied by participants demonstrates that when people collaborate, they are more likely to actively share ideas, ask questions, and seek explanations. This active engagement keeps people engaged, motivated, and accountable for their learning. Furthermore, the participants engage in collaborative problem-solving, which

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allows them to not only work together to solve difficult chemical issues but also benefit from their peers' pooled expertise and assistance (Graesser *et al*., 2018).

Learning support systems are critical for helping students overcome obstacles in their educational experiences. According to the participants' statements, the learning support system helps as a coping strategy to overcome the difficulties they encountered while learning Chemistry. Participants submitted the data with the required assistance, advice, resources, and support from their peers, including teachers. Teachers who provide a pleasant and inclusive learning atmosphere can help learners gain confidence and drive to overcome obstacles. Collaborative learning features enable participants to communicate with classmates, exchange ideas, and receive peer help. According to (Perron, 2017) research, Urie Bronfenbrenner's Ecological Systems Theory provides a framework for studying how distinct ecological systems impact students' coping strategies when confronted with educational problems. When developing an effective learning support system, consider the microsystem, mesosystem, exosystem, macrosystem, and chronosystem.

3.3. Coping Strategies Non-STEM Students Employ

3.3.1. Theme 1: Independent learning skills and Utilizing Digital-Traditional Learning Resources

In terms of coping techniques, students employed to overcome the problems they faced in Chemistry disciplines (organic and inorganic chemistry) within the BSED Science curriculum. The data was evaluated using thematic analysis, which led to the discovery of a strong theme: independent learning skills. This subject originated from the participants' experiences and emphasized their approach to overcoming learning barriers in chemistry.

Most non-STEM participants relied heavily on Independent Learning Skills as a coping strategy. This included actively participating in self-study and accepting responsibility for their learning. By using this technique, students were able to better understand the topics given by their professors and set aside time for independent study. Furthermore, these abilities allowed students to judge their development and understand the material at their own speed.

Given the generally acknowledged difficulties of chemistry, Independent Learning Skills can be an effective coping tool for scientific students. It gives individuals the ability to take control of their education and actively engage in the learning process. This not only helps students understand hard chemical concepts, but it also promotes personal growth and development as autonomous learners (Sandi-Urena *et al*., 2011).

Digital resources in education are described as the use of the internet and multimedia for educational purposes. According to the participants' statements, using digital resources as a coping technique allows them to improve their grasp of the topics covered by their peers and professors. This better comprehension enables individuals to overcome the learning hurdles presented by chemistry disciplines, eventually leading to higher academic achievement.

According to research by (Qian, 2022). Digital tools such as simulations, YouTube videos, and online activities serve as coping techniques for chemistry students. These accommodate various learning styles, increase engagement, and enhance comprehension of complicated subjects, resulting in improved academic achievement.

Metacognition is an approach that enables students to actively participate in their education. Some participants in the research adopted this method as a coping mechanism to overcome difficulties in studying chemistry. They used a variety of approaches, including asking themselves questions about the subject, undertaking advanced research, and engaging in self-debate. Even non-STEM participants found metacognition to be an effective method for studying chemistry.

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Flavell's metacognition theory refers to the interconnection between an individual's ability to monitor, regulate, and orchestrate their thinking processes to achieve a specific goal. Metacognitive strategies are often associated with the term "metacognitive" and are used by students as coping mechanisms in the context of learning chemistry. These strategies involve the students' awareness and control of their learning processes, allowing them to effectively plan, monitor, and evaluate their learning experiences in chemistry. By employing metacognitive strategies, students can enhance their understanding and performance in the subject (Dike *et al*., 2017).

3.3.2. Theme 2: Support system

About the Coping strategies, they used to overcome the challenges they encountered in Chemistry subjects (Organic and Inorganic chemistry) within the BSED Science program, we used thematic analysis to analyze the data. There is emerging code and systematically coded; the themes generated from the data provided by participants were Support systems. Most of the participants in the study expressed that having a support system played a crucial role in helping them overcome the challenges they faced in learning Chemistry. They highlighted the importance of having a support system that provides guidance, assistance, and encouragement throughout their learning journey (Mannay & Wilcock, 2015).

Based on the statement gathered from the participants, the support system proved to be important in their coping strategies as non-STEM students. It offers the students guidance, resources, and also gives advice when having difficulty. This support system enables students to ask questions and get guidance from professors, classmates, family members, and friends. This support system assists students in overcoming problems and remaining motivated, resulting in the successful completion of their Chemistry courses. It also serves as a source of resolve, motivation, and a reminder to continue their education.

Learning support systems provide support, advice, resources, and locations that encourage students to participate in the learning process. These systems act as coping strategies for participants, providing additional support and advice to help them overcome obstacles and achieve academic success. As a consequence, participants become more motivated and do better academically in the chemistry topic.

According to Urie Bronfenbrenner's Ecological Systems Theory (Dike *et al*., 2017), it can provide a framework for understanding how diverse ecological systems influence students' coping methods throughout learning obstacles. A good learning support system may be designed by taking into account the microsystem, mesosystem, exosystem, macrosystem, and chronosystem. This will enable the system to deliver the resources, advice, and atmosphere that students need to effectively cope with a wide range of issues.

3.3.3. Theme 3: Motivation

In terms of coping techniques, students employed to overcome the problems they faced in Chemistry disciplines (organic and inorganic chemistry) within the BSED Science curriculum. The data was evaluated using thematic analysis, which revealed a dominant theme: motivation. This subject came from the participants' learning experiences and emphasized their approach to overcoming learning barriers in chemistry.

According to the participants' statements, motivation acts as a crucial coping technique for overcoming problems and positively changing their attitudes about learning. The results presented by the participants suggest that being inspired while studying Chemistry has a

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significant impact on students' motivation and drive to achieve success. Students who are driven perform well academically and actively participate in their studies.

The importance of motivation in increasing students' involvement in any given topic. When students feel driven, their resolve grows, resulting in a greater inclination to put up effort and devote time to their studies. This increased engagement leads to a better grasp and mastery of the subject (Rodriguez-Largacha *et al*., 2015).

Self-efficacy, or a student's conviction in their capacity to effectively accomplish activities and achieve desired goals, is an important component of motivation that impacts a student's decision-making process and ability to overcome obstacles (Artino, 2012; Martini *et al*., 2023; Silain *et al*., 2024). It has a substantial impact on many elements of a student's life, including school, employment, and personal development. When it came to learning chemistry, the study's participants discovered that self-efficacy was an excellent coping method. Participants responded that having a strong sense of self-efficacy allows pupils to maintain self-determination and focus on achieving their objectives despite setbacks. This conviction in their talents enables them to address difficult chemical topics with confidence and resilience.

According to Bandura's hypothesis, students' views about their potential to succeed in a specific activity or topic can impact their motivation, engagement, and performance. Students with strong self-efficacy in chemistry are more likely to persevere in the face of obstacles and seek assistance when necessary (Artino, 2012). In response to this statement, students with strong self-efficacy in Chemistry are more inclined to actively seek assistance when necessary. Rather than being frustrated or giving up, they see problems as chances for development and learning. They recognize that requesting help is not a sign of weakness, but rather an opportunity to better their comprehension and performance. Self-efficacy serves as a useful coping technique for pupils who are struggling to understand chemistry.

3.4. STEM Strategic Outcomes or Desired Interventions

3.4.1. Theme 1: Effective learning strategies and habits

Thematic analysis was used to investigate STEM participants' strategic outcomes and requested interventions in the BSED-Science program to improve their Chemistry learning. This investigation systematically discovered developing codes, demonstrating a common pattern focusing on successful learning techniques and habits. Participants emphasized the necessity of cultivating independence and resilience in overcoming obstacles, highlighting the need to rely less on external help and instead create personal learning habits and good time management abilities. They emphasized that accomplishing their objectives necessitates self-reliance and rigorous methods of studying, calling for a proactive perspective in overcoming academic challenges.

Several points are in the following:

(i) Practice independent learning. Independent learning is a system in which students accept complete responsibility for their own educational experience. This includes establishing their learning objectives, making educated decisions on how to accomplish these objectives, and taking ownership of implementing their learning strategy. They are also in charge of measuring their progress towards their objectives and evaluating their results. In essence, autonomous learning enables students to be proactive and self-directed in their education (Morris, 2019). STEM participants commonly stress the relevance of self-directed learning when discussing strategic goals or desired interventions to improve their chemistry education (Balo & Sanchez, 2025; Iqbal & Campbell, 2023). They argue that students should not rely primarily on others for their success, since self-reliance is essential for future efforts. They promote the

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development of individual abilities and knowledge, emphasizing that one's career path cannot be maintained only by others. This demonstrates their dedication to personal development and perseverance when facing academic and professional obstacles. According to (Lim & Park, 2023) findings, the self-study group did better than the lecture group among the two discussion groups. Analysis of the interactions shows that self-study encouraged students to participate in more dynamic and fruitful debates than lectures, resulting in greater academic achievements. This emphasizes the idea that students are more likely to improve their learning when they actively participate in self-study activities.

(ii) Effective Time Management and Study Habits. In addition to encouraging individual learning, participants stress the need for excellent time management and study habits as critical strategies for improving chemistry education. They argue that students must build disciplined ways of studying and set boundaries, particularly in the face of distractions such as social media and cell phones. Participants advocate for the implementation of regular routines and mindful activities to improve study sessions and learning results. This demonstrates their understanding of how important proactive time management and concentrated study habits are in obtaining academic success in chemistry. According to Pelekh's view, the rational ego realizes the value of education for personal progress and opportunity. Similarly, the superego, formed by cultural ideals, instills a sense of responsibility to study and develop oneself via learning (Pelekh *et al*., 2020).

3.4.2. Theme 2: Development of Educational Resources and Teaching Pedagogy

STEM students underline the need to develop instructional resources and teaching methods for grasping complex chemical subjects. They argue that access to extensive learning materials and excellent pedagogical techniques is critical to obtaining academic success. Furthermore, they believe that colleges should provide enough laboratory equipment, much exceeding the resources given in high schools, to improve their learning experience.

In the field of expanding educational resources and teaching procedures, there is a dual emphasis on improving laboratory facilities and refining instructional methods. Participants believe that having access to well-equipped laboratories is critical to improving their chemical education. Furthermore, they emphasize the importance of teachers teaching, seeing educators as the major source of information inside the classroom. The importance of school type in students' chemistry learning, which is impacted by elements such as classroom dynamics, atmosphere, study habits, teacher quality, and academic track alignment (Mangubat, 2023). To improve performance, schools should prioritize initiatives such as improving laboratory equipment, offering PowerPoint (PPT) materials, and promoting teacher-led discussions to create an environment favorable to academic achievement in chemistry.

According to Maslow's hierarchy of needs, to reach the highest level of self-actualization, a person must first address their most basic, lower-level needs. The most fundamental necessity is physical survival, which includes food, water, and shelter. Once these physiological needs have been met, the next level of safety criteria becomes the driving force. After safety prerequisites are fulfilled, the desire for love, belonging, and social connection arises (Baumeister, 2012).

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3.5. Non-STEM Strategic outcomes or desired interventions

3.5.1. Theme 1: Improvement of educational resources and teaching pedagogy

This theme analysis of the data on non-STEM participants' hopes for better learning outcomes in Chemistry indicated a theme focused on improving educational resources and teaching methods. Emerging codes were identified through systematic coding, highlighting the participants' attention on improving facilities and laboratories, notably the supply of adequate laboratory equipment. In addition, teachers were instructed to provide scaffolding in instructional delivery to effectively aid students' comprehension and learning process (Enyew & Yigzaw, 2015).

Non-STEM students, like their STEM counterparts, believe that having access to a variety of learning tools and media is critical to expanding their grasp of chemistry. They argue that traditional teaching techniques are insufficient, emphasizing the need for educators to augment lessons using PowerPoint presentations and other interactive materials to enable prolonged learning possibilities.

A study indicated that laboratory activities increased learning outcomes in Chemistry, as seen by the experimental groups' much better post-test scores. To fully realize the benefits of laboratory work in Chemistry education, it is critical to address issues such as instructor burden and competency. This supports the notion that having access to a laboratory may significantly improve student performance, particularly in grasping Chemistry topics (Gurung & Gurung, 2023).

3.5.2. Theme 2: Social learning

Classroom bullying remains a concern, and non-STEM students seek intervention to improve their chemistry experience by having supportive peers. They find chemistry tough and feel that having peers who can provide emotional support is essential for coping with these challenges. They understand that intelligence alone is insufficient; having partners and a support system both inside and outside of class is as crucial in overcoming the obstacles given by the topic (Saarento *et al*., 2015).

In addition to the availability of equipment and laboratories, participants highlight the importance of peer support and cooperation in improving their chemistry learning experience. They advocate for the establishment of a secure atmosphere free of judgment and bullying, acknowledging the possible psychological and social consequences of such bad experiences. Instead, they advocate for building good relationships via cooperation and mutual aid, thinking that this method fosters resilience in dealing with problems and overcoming learning issues efficiently.

Bronfenbrenner's Ecological Systems Theory emphasizes the importance of peer interactions for students' development and academic success. In Chemistry, positive peer relationships promote interest, engagement, and support, which improve learning outcomes. Alignment between peer and classroom contexts improves motivation and knowledge of Chemistry (Perron, 2017).

3.5.3. Theme 3: Teaching pedagogy

These non-STEM students are proposing to enhance their Chemistry learning about strategic outcomes or desired interventions. We analyzed the data using thematic analysis, identifying emerging codes and organizing them systematically. The data provided by participants predominantly highlighted the theme of teaching pedagogy. They believe that

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teachers' teaching style should also be an important matter to discuss because a teacher's way of teaching could greatly affect students' performance and learning. Knowing where your students are capable of and adjusting your strategies to accommodate all types of learners (Walkington, 2013).

Participants believe that to elevate teaching pedagogy, teachers must refine their instructional methods to enrich students' learning experiences in chemistry.

According to (Adeniyi *et al*., 2024), using diverse teaching methods in chemistry education is more effective than traditional approaches. Incorporating innovative strategies improves academic performance, offering insights for future educational reforms.

3.5.4. Theme 4: Academic success strategies

Participants underscore self-regulation as a crucial strategy for academic success, alongside peer support and improvements in teaching style. They advocate for allocating sufficient time to study and understand difficult topics, limiting cell phone use, and maintaining focus during class. They emphasize that distractions can impede learning progress and stress the importance of awareness to mitigate them (Khasawneh & Jadallah, 2023).

Participants believe that understanding their limitations regarding exposure to distractions is crucial for enhancing their experience in a chemistry subject. They attribute difficulty grasping chemistry topics to uncontrollable gadget use and social media distractions, leading some to fall asleep during class. They advocate for self-regulation to improve their learning experiences and performance.

Research discovered that self-regulation had a significant impact on students' engagement in learning. This emphasizes the importance of developing and strengthening students' self-regulation skills to enhance their focus and ultimately achieve their goals (Guven & Babayıgıt, 2020).

3.5.5. Theme 5: Academic planning and enrichment initiatives

Non-STEM students are advocating for enhancements in their Chemistry education to align with strategic goals or desired interventions. Through thematic analysis, which involved identifying emerging codes and organizing them systematically, participants primarily emphasized the theme of academic planning and enrichment initiatives. They believe that mapping out academic pathways and implementing enrichment programs can assist students in identifying suitable courses based on their capabilities, thereby offering a more effective intervention to enhance their learning experiences in chemistry.

Several points are in the following:

(i) Course and Strand alignment. In academic planning, connecting courses with specific strands is critical for improving students' chemistry performance and experience. When students take classes that are closely relevant to their strand, they are more likely to understand the material. This correlation guarantees that the information is appropriate for their educational background and interests, resulting in a more interesting and successful learning experience. Educational institutions can improve student achievement in chemistry and other topics by recognizing and addressing the varying needs and interests of students from various strands. According to the Atkinson Worth-Expectancy Theory, people's decisions are influenced by their appraisal of the worth of a desired goal and their likelihood of obtaining it (So, 2021). This implies that students should choose courses that are relevant to their talents and interests. For

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example, ambitious BSED students with a scientific concentration benefit from prior experience in STEM topics.

(ii) Summer Bridging Programs. A non-STEM participant stated that, while aligning courses with strands is good, schools might also offer bridge programs. These initiatives would allow students to take the courses they choose, eliminating the hurdles associated with topic changes. They see bridging programs as a viable intervention to improve non-STEM students' experiences in chemistry. A meta-analysis of 16 university STEM summer bridge programs showed that they improve first-year GPA (d = 0.34) and enhance the likelihood of first-year retention (OR = 1.747) by offering additional coursework and preparation to incoming STEM students (Sadler *et al*., 2014).

4. CONCLUSION

Based on the thorough findings of the study, several important conclusions were identified about the learning challenges and coping strategies of STEM and non-STEM students in chemistry education under the BSED-Science program of Sultan Kudarat State University.

A study revealed that STEM students under the program commonly have difficulty learning chemistry due to an insufficiency of Laboratory resources, which leads to the delay of laboratory experiments, the complexity of chemistry learning, and academic pressure. On the other hand, non-STEM students struggled in grasping Chemistry education for the reason that they have a weak foundation of concepts in chemistry.

Additionally, the study also highlighted several coping strategies of participants in dealing with their learning challenges in Chemistry courses. Based on the data gathered, STEM students employed utilization of digital learning resources, Academic Resilience, and Collaborative problem-solving strategies to overcome their learning difficulties in Chemistry Education, while non-STEM participants employed independent learning skills, Intrinsic motivation, and also utilized digital and traditional learning resources.

Furthermore, effective learning strategies and habits, which as collaborative learning and effective time management, the development of educational resources and teaching pedagogy, like laboratory and teaching improvement, are the desired interventions that STEM recommends to enhance their learning in Chemistry courses. While Non-STEM suggests that improvement of laboratory resources and teaching pedagogy, peer support learning, Strand alignment, and bridging programs for non-STEM students are essential for them to enhance their learning in Chemistry.

In line with the findings of the study, participants revealed that despite their Strand differences, they still experience difficulties in learning Chemistry education. As a result, providing a well-equipped Chemistry laboratory, enhancing teaching pedagogy, and employing effective learning habits are very essential to support learning and provide quality chemistry education in the program.

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6. AUTHORS' NOTE

The authors guarantee that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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