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Using Everyday Life Experiences to Teach Chemistry Concepts in Secondary Schools: A Catalyst for Sustainable Global Development

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Abstract
Secondary school teachers frequently face great difficulty when it comes to teaching chemistry concepts because their students find it difficult to make the connection between abstract theories and practical situations, which erodes their motivation and comprehension. This study addresses the problem by exploring the effectiveness of using students' everyday life experiences as a catalyst for teaching chemistry concepts and promoting sustainable global development. This study explores the integration of everyday life experiences into chemistry education as a means to foster deeper understanding and engagement among learners. This pedagogical strategy emphasizes the importance of understanding everyday chemistry by linking core chemistry concepts to real-world scenarios, making the subject more relatable and engaging, and employing strategies that place students at the centre of learning. By utilizing students' everyday experiences, educators can contextualise chemistry concepts within a familiar scenario, which not only enhances comprehension but also illustrates the relevance of chemistry in daily life. This approach will serve as a catalyst for promoting sustainable global development, as it empowers students with the knowledge and critical thinking skills necessary to address environmental and societal challenges. Therefore, employing an adequate chemistry teaching strategy that leverages students' lived experiences is essential for creating meaningful and lasting educational outcomes that contribute to the broader goals of sustainability and global development. It was recommended that there should be adequate provision of resources for practical and teacher development programs.

Keywords: Chemistry education, Contextualized learning, Everyday life experiences, Secondary school, Sustainable development.

Introduction

Teaching chemistry in senior secondary schools is extremely important in shaping students' perspectives of the natural world and their engagement with global sustainability challenges. Unfortunately, conventional chemistry teaching approaches sometimes fall short of connecting with students' real-world experiences, which causes detachment in learning science. It has long been believed that a country's rate of development is correlated with the degree of scientific literacy and proficiency among its people in science process skills (Agogo, 2017). This gap can be filled by incorporating real-world experiences into chemistry instruction, giving learners a more practical and meaningful understanding of abstract concepts.

Chemistry is a discipline of science that focuses on the investigation of nature, including the structure and application of matter, as well as understanding how matter can change under various conditions (Adeyemo, 2010). This implies that it is very difficult, if not impossible, to differentiate between chemistry and other processes that occur naturally, including all of our daily activities. One promising approach is to incorporate students' everyday life experiences into the teaching of chemistry concepts. According to Helmestine (2010), real science is not just for the classroom but is part of everyday life. Real science develops skills, ability, and capacity, not just knowledge. Recently, a place of chemistry education has been identified as accessible to students and aware of its significance in society. This strategy will not only guide students to see the relevance of chemistry in their daily lives but also as a catalyst for promoting sustainable global development. Falnmy (2000) specified that the fascinating aspect of chemistry is when it is applied to our daily activities. Thus, purposeful chemistry cannot be accomplished in an environment lacking learners' everyday activities. Today, researchers have found out that there are concepts of chemistry or topics that students find tough to attempt

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(Igdoegwu, 2010). To enable comprehension of Chemistry concepts among students, the teachers must engage them in activities based on teaching strategy, relating chemistry concepts to activities they do at home in the kitchen.

Chemistry should be taught in such a way that students relate some of the activities they are involved in at home to their scientific background in chemistry and then follow through and invest in newly introduced concepts to enable them to contribute to global sustainability. Chemistry has been taking a central role in promoting sustainable development through basic research skills, chemical innovations, and technology. Chemistry has a significant and diverse influence on the sustainable development of the world. The field of chemistry offers vital instruments and insights that propel advancements towards a more sustainable future, spanning from green chemistry and renewable energy to sustainable agriculture and healthcare. Also, Anastas and Zimmerman (2018) stressed that the chemical sciences must continue to innovate if we are to overcome the obstacles that threaten global sustainability.

Chemistry and Sustainable Development

The dynamic approach to teaching that is provided by incorporating students' real-world experiences into chemistry classes can greatly improve students' comprehension and memory of difficult ideas. In addition to making learning more relatable and interesting, this approach develops the critical thinking and problem-solving abilities necessary for long-term sustainable global growth. Chemistry education serves as the bedrock for understanding the composition and behaviour of matter, providing crucial insights into chemical reactions, atomic structures, and the periodic table.

Chemistry is a cornerstone in conciseness sustainable development, providing the scientific foundation necessary for innovation in areas such as energy, environmental protection and health. Others include waste management, effective resource use, sustainable agriculture, and the creation of green technologies. Through these advancements, chemistry helps to address some of the Sustainable Development Goals (SDGs) of the United Nations, including climate action, responsible consumption, and renewable energy. Sustainable development depends on green chemistry, which seeks to create goods and procedures with the least possible negative effects on the environment and with the fewest possible uses of dangerous materials. Recent advancements in green chemistry include the development of biodegradable plastics that are made to decompose more quickly in the environment, plummeting pollution (Yadav & Biswas, 2018). The fundamentals of green chemistry stress the significance of waste prevention, safer chemical design, and the use of renewable feedstocks. These guidelines direct the chemical sector towards economically feasible and environmentally friendly methods (Anastas & Warner, 2018).

The development of renewable energy technologies, which are necessary to lessen dependency on fossil fuels and mitigate climate change, depends heavily on chemistry. Advances in photovoltaic materials, such as perovskite solar cells, have significantly increased the efficiency of solar energy conversion. These advancements enhance energy storage capabilities, which are crucial for the usage of renewable energy sources, such as wind and solar power. Chemistry applications directly lower greenhouse gas emissions by enhancing the sustainability and efficiency of energy storage. (Goodenough & Kim, 2023). In agriculture, chemistry plays a critical role in maximizing food production and reducing environmental damage. The development of slow-release fertilizers and biodegradable pesticides has led to more efficient resource use and reduced pollution (Jacobsen et al., 2017). These innovations support sustainable agriculture by increasing crop yields and reducing the need for harmful chemical inputs. In the circular economy, where the objective is to reduce waste and maximize resource reuse, chemistry is at the forefront of developments in waste management. Chemical recycling methods, such as depolymerisation, allow plastics to be broken down into their constituent monomers and reused, reducing the need for virgin materials and decreasing environmental pollution (Hahladakis et al., 2020). Furthermore, the creation of more effective techniques for removing valuable metals from electronic garbage or e-waste encourages the sustainable use of resources and lessens the negative effects of mining on the environment.

Application of Chemistry to Students Everyday Experiences

By demonstrating the real-world applications of chemistry, we can ignite their curiosity and make our classes more engaging and memorable. In light of this, Ellier (2023) identified the following practical ways to apply chemistry to everyday life, transforming the classroom experience into a fun and exciting journey of discovery. He further identified the following applications of chemistry.

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i. **Chemistry in the Kitchen:** The kitchen is an intriguing space where regular cooking and food preparation bring chemistry to life. Cooking causes a variety of chemical reactions, including fermentation, caramelisation and Maillard reactions. For example, the Maillard reaction gives bread and meats their distinctive browning as well as their rich flavours and fragrances. When heated, this interaction between reducing sugars and amino acids produces a wide range of flavour chemicals (Smith et al., 2022). Another significant chemical process that occurs in the kitchen is when sugars are cooked and break down into smaller molecules that give roasted vegetables and caramel their colour and flavour is called caramelisation (Jones & Patel, 2021). Yeast and bacteria are two examples of micro-organisms that convert sugars into acids, gases, or alcohol during the fermentation process, which is frequently used to make bread, yoghurt, and pickles. This procedure improves the nutritional value of food while also preserving it (Liu et al., 2023). Everyday cooking processes provide excellent opportunities to discuss chemical reactions and their importance in our lives. Chemistry in the Kitchen aims to alter all of this by providing all of the tools and information needed to carry out experiments in the classroom (Helmestine, 2010).

ii. **Environmental Chemistry:** The study of environmental chemistry opens the door to critical discussions about global issues like climate change, pollution, and sustainability. This field is essential for developing sustainable solutions to environmental problems such as pollution, climate change, and resource depletion. For instance, industrial processes discharge a range of hazardous substances into waterways, including heavy metals like lead and mercury. These contaminants pose major health dangers to both humans and wildlife because they can build up in the food chain (Gupta et al., 2021). Another major worry is climate change, which is brought on by the atmosphere's growing concentration of greenhouse gases, including carbon dioxide (CO_2) and methane (CH_4). These gases cause global warming and the accompanying environmental changes, including rising sea levels, changing weather patterns, and a decline in biodiversity. They do this by trapping heat in the atmosphere. Research in environmental chemistry is focused on understanding these processes and finding ways to mitigate their effects, such as developing carbon capture and storage technologies (Zhang & Li, 2022). Engaging students in discussing topics such as greenhouse gases, acid rain, or water purification methods encourages students to brainstorm eco-friendly solutions to foster a sense of responsibility towards the environment.

iii. **Cleaning Agents:** Cleaning agent manufacture and use are essential to modern living and play a vital role in public health and hygiene. However, in the context of global sustainability, these items' environmental impact has grown to be a major problem. Every phase of a cleaning agent's life cycle, from the extraction of raw materials to the disposal of finished goods, may have an impact on the environment. Detergent phosphates have the potential to cause eutrophication in water bodies, which negatively affects aquatic life by causing an overabundance of algae growth and oxygen depletion (Hoffmann & Wagner, 2021). To meet the global sustainability targets, the cleaning industry will need to maintain its current level of innovation and ethical business practices.

iv. **Chemistry in Health and Medicine:** Chemistry plays a vital role in the field of medicine and human health. When students are exposed to the chemistry of medicine by discussing drug development, the interactions between chemicals and the human body, and the role of pH in maintaining physiological balance. Other topics such as nutrition and metabolism, explore chemical reactions that occur during digestion, and pharmaceutical waste, which includes medication errors and environmental leakage of active pharmaceutical ingredients (APIs). These compounds can linger in soil and water sources, which could upset ecosystems and result in antibiotic resistance. To minimize environmental contamination, sustainable practices in medicine include the creation of biodegradable medications and the application of appropriate disposal techniques (Kümmerer et al., 2022).

v. **Chemistry of fireworks:** As something burns, heat and light are given off. Metal salts burn to produce the vivid colours seen in fireworks. For instance, compounds containing strontium produce red, compounds including copper produce blue, and compounds containing barium produce green. These metals can harm the environment even if they are necessary for the visual spectacle. These metals can land on land or in water after being released into the atmosphere, where they may enter the food chain and endanger both humans and wildlife (Giri et al., 2021). Fire can be devastating but it can also be spellbound. These resources help students to understand the combustion reaction and provide insight into how fireworks work. (Smith, 2018).

Teachers' Role in Facilitating Everyday Life-Based Chemistry Learning

Integrating real-world experiences into chemistry education requires the teachers to be able to draw connections between the content covered in class and the experiences of the students. The teachers have the primary

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responsibility for the effectiveness of this pedagogical strategy, as its successful implementation demands substantial training and continuous professional growth. These elements are necessary to ensure that teachers have the skills and knowledge necessary to bridge the knowledge gap between theoretical chemical concepts and practical applications. Training for teachers is essential to provide educators with the information and abilities needed to implement application-based, real-world learning in chemistry. Effective teacher preparation programs, according to Van Driel et al. (2019), should concentrate on contextual learning techniques that help instructors connect abstract chemical principles to practical circumstances. These programs must have a strong emphasis on active learning, in which instructors actively participate in the development of transferable abilities that they can use in the classroom rather than just acting as passive consumers of knowledge.

Furthermore, Luft et al. (2018) highlighted the importance of supporting newly hired teachers through targeted training that focuses on connecting chemistry education to students' daily lives. They contend that professional development activities that involve mentorship and collaborative learning are especially beneficial for early-career educators. This aids the development of skills and confidence in using cutting-edge teaching strategies that increase students' understanding of con and interest in chemistry. Moreover, Jarret (2019) defined pedagogical tools as a skillful act of making teaching and learning easier. By linking chemistry concepts to real-life problems, teachers can encourage students to think critically and creatively about the applications of chemistry in addressing global challenges. Professional development programs that focus on sustainability and global development are particularly valuable, as they equip teachers with the tools to integrate these themes into their lessons effectively.

Strategies of Teaching Chemistry Using Students Everyday Life Experience

It is recommended that teachers use instructional strategies that place science learning within the context of students' daily experiences in order to help students bridge the gap between science learning and their everyday lives (Tsurusaki et al., 2012). The absence of a link between scientific knowledge and everyday experience is a key obstacle to science education, according to a phenomenological perspective (Roth, 2015). For science education to be applicable and aid in the development of the individual as well as the country, teachers must acknowledge that science is more than just a subject taught in the classroom; it is a component of daily life. Thus, instead of using the standard "chalk and talk" approach, teachers should start focusing students' attention on local phenomena that have scientific implications.

1. **Context-Based Learning**: According to this approach, learning is most successful when students are able to connect new material to what they already know and have experienced, which gives the process of learning greater significance and real-world application. Students who learnt chemistry using a context-based approach will be able to understand how the material related to events they would meet in everyday life. The emphasis contextual learning places on the learner's environment and cultural background is one of its main features. Constructivist ideas, which support active participation and the development of knowledge via experience, serve as the theoretical foundation for contextual learning (Yani et al., 2021). Connecting chemical concepts to everyday products and phenomena, such as cleaning agents, cooking, and environmental issues. For instance, discussing the chemistry of cooking can explain concepts like Maillard reactions and emulsification. This approach to teaching chemistry places a strong emphasis on chemistry and its linkages to real-world problems (King, 2012).
2. **Problem-Based Learning** (**PBL**): To completely understand chemistry, students need to learn how to solve issues in the real world. Since problem-solving techniques are useful in many facets of life, they are essential in the twenty-first century. PBL has been demonstrated to improve students' comprehension of important ideas in the context of chemistry by challenging them to apply their theoretical knowledge to real-world scenarios. Students might be required, for instance, to come up with a solution for a chemical problem that exists in the real world, like lowering industrial emissions or developing sustainable materials. This methodology not only enhances their intellectual comprehension but also cultivates abilities in research, collaboration, and communication (Strobel & van Barneveld, 2015).
3. **Inquiry-Based Learning**: This approach gives students the freedom to actively investigate the material, establish links between theory and real-world applications, and actively study the area of chemistry. In an inquiry-based learning environment, students are curious about how knowledge is created and shared as well as how they might get the information and abilities needed to become lifelong learners (Ismail, 2014). Encouraging students to ask questions about their environment and conduct experiments to find answers. For instance, analysing the effect of different cleaning products on bacteria can introduce concepts of acidity, alkalinity, and disinfection.

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4. **Project-Based Learning**: Engaging students in projects that relate to their daily lives, such as creating eco-friendly products. It has a lot of potential to enhance 21st-century skills and engage students in real-world tasks (Han et al., 2015; Kingston, 2018). For instance, developing homemade cosmetics or detergents using safe chemical processes.
5. **Use of Technology**: Integrating digital tools and simulations that mimic everyday chemical processes. For example, virtual labs on tablet devices allow students simulate to chemical reactions related to household substances. This helps the students to work on specific problems that might not be possible in a physical laboratory, which broadens their comprehension of thermodynamics and improves their ability to solve difficulties. (Naukkarinen & Sainio, 2018). Also, the use of digital technology created a more conducive learning environment for the students. According to Hillmayr et al. (2020), digital tools can also help improve students' understanding through interactive, multimedia learning content.

Conclusion

The integration of students' everyday life experiences into the teaching of chemistry concepts in Senior Secondary Schools is a powerful strategy that enhances students' understanding and interest in the subject. Connecting abstract chemistry theories to real-life scenarios, makes learning more engaging and relatable. It enables students to see the relevance of chemistry in their daily lives and also improves academic comprehension. Also, it empowers students with the critical thinking skills necessary to address environmental and societal challenges, thereby contributing to sustainable global development. Ultimately, utilising students' lived experiences as a foundation for teaching chemistry creates a meaningful and lasting educational impact, aligning with broader goals of sustainability and global development. This teaching strategy contributes to the larger goals of sustainable development by bridging the gap between theoretical understanding and real-world application, making chemistry relevant and transforming for students.

Recommendations

i. Educational policymakers should review the chemistry curriculum to include more real-life examples and practical applications that relate to students' everyday experiences. This will help bridge the gap between theory and practice, making chemistry more accessible and relevant.
ii. The government should fund programs for professional development that provide chemistry instructors with the abilities and information required to successfully integrate real-world experiences into their lessons.
iii. Schools should be provided with the necessary resources, such as teaching materials, laboratory equipment, and access to community resources, to facilitate the integration of real-life experiences into chemistry education.
iv. Adapt assessment techniques to gauge students' comprehension of chemical principles as well as their capacity to apply them in practical contexts.
v. The government should go into partnerships with local communities, industries, and organizations to provide students with real-world exposure to chemistry. Field trips, internships, and guest lectures from professionals in the field can offer students valuable insights into how chemistry is applied in various industries and its role in sustainable development.
vi. Group projects, peer discussions, and community-based activities should be organized to enhance learning by connecting chemistry to real-world contexts.

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