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BREAKING BARRIERS: INTEGRATING INCLUSIVE PRACTICES IN CHEMISTRY EDUCATION

Abstract. This article examines the issues of inclusive pedagogy in the field of chemistry. It analyzes the barriers faced by students with disabilities in the process of learning chemistry and proposes methods for integrating inclusive practices into the educational process. The paper discusses the importance of creating an accessible and supportive environment for all students and considers practical examples of successful implementation of inclusive approaches in teaching chemistry.

Keywords: inclusive education, chemistry, pedagogy, accessibility, students with disabilities.

Introduction

The process of acquiring the knowledge, abilities, and positive attitudes necessary for a fulfilling existence is called education, and it takes a lifetime. This ought to be, regardless of the limitations exhibited by the special needs children protected under the Inclusive Education Policy (IEP). Every school was required by the inclusive education policy to treat every student equally in the classroom and at school. This rule cannot be ignored in chemistry lessons.

In the current educational environment, the idea of inclusion has grown in significance. It comprises setting up a setting where all students have an equal chance to learn and achieve, regardless of their background, skills, or limitations. This idea applies to all academic fields, including chemistry, where implementing inclusive practices is essential to creating a welcoming and inclusive learning environment.

Practical work in the lab is an obligatory component of most medical and chemical courses, including pharmacy and pharmaceutical sciences, in order for students to receive their degree. Theoretical or online instruction cannot replace this work. Despite the physical accessibility of the site and the requirement for manual manipulation of equipment, practical lessons regrettably present several challenges for students with disabilities. Students must read and listen quickly in hands-on learning environments, retain information and take brief notes, use time management skills, and make a range of quick decisions. Any of these might be challenging for students with impairments.

Literature review

The article “From barriers to boosters: initial teacher education for inclusive education” by Silvia Frankel, Moritz Sterken, Lisa Stinken-Rosner (2023) presents The viewpoints of inclusive pedagogy and scientific education must be integrated in order to achieve effective and inclusive science education (ISE) (Stinken-Rösner et al., 2020). This calls for the meticulous formulation and differentiation of inclusive pedagogical elements in science education, which places particular requirements on science teachers. It is imperative that they have the requisite knowledge and abilities to integrate science-specific content with inclusive teaching approaches. The authors highlighted that, to do this, though, a few obstacles in teacher education must be removed. Firstly, opinions on what should be covered in science teacher education and professional development programs for inclusion are divided. It is essential to create an

open and clear understanding of what ISE should entail in order to advance the foundation of best practices. Second, there are structural obstacles that make it challenging to integrate the elements of subject-specific knowledge and IE, such as the different study plans for regular and special education teachers. Thirdly, as a result, prospective teachers' teacher education seldom incorporates blended techniques. They emphasized capabilities like identifying and assessing learning deficits, differentiating instruction, or individualizing instruction are seldom ever included in science teacher education.

The article "Teaching energy in living systems to a blind student in an inclusive classroom environment" by Dilek Teke, Mustafa Sozbilir (2019) shows that it is crucial to change educational environments based on the needs of students with disabilities. The authors present two methods to education: offering special education classes to learners who need them apart from their peers and educating them in inclusive classrooms. Students with special needs are integrated into general education courses in inclusion classes, which have grown increasingly common in recent years. However, integrated education is the act of removing obstacles from learning environments in order to boost student engagement and lesson discrimination in the classroom. In actuality, integrated education refers to a broad range of methods, initiatives, and procedures meant to fulfill everyone's right to receive education. Integration is a right to education for all children who are disadvantaged for various reasons, even though it is strongly linked to the right of children with disabilities to an education.

The authors highlighted that for those who have low vision or are blind, understanding chemistry is crucial to their everyday existence. There is still a dearth of research, although recent efforts to eliminate barriers and make chemistry more accessible for these students have focused on conceptual comprehension studies and teaching symbolic representations in chemistry. The majority of research has concentrated on creating accessible laboratory settings, modifying current technologies to make chemistry more approachable, and using conceptual knowledge to teach symbolic representations in chemistry.

Based on the research BLV pupils have low interest in science and mathematics because of the barriers in school learning spaces. Three categories can be used to categorize barriers to science access. They are: (i) insufficient teacher preparation; (ii) restricted access to resources and tools; and (iii) educators' acceptance.

The article "Teaching Chemistry to Students with Disabilities: A Manual for High Schools, Colleges, and Graduate Programs 4th Edition." (2001) by Miner, Dorothy L discusses mentoring pupils with impairments similar to mentoring other students to mentor a kid with a disability. Teachers and mentors need to be aware that people with impairments may have low expectations and low self-esteem. Activities that take place outside of the classroom allow students to recognize, use, and record their special talents. Typically, their strong points include their capacity for problem-solving, tenacity, familiarity with negotiation techniques, and ability to forge agreement. Teachers and mentors should encourage students with disabilities to engage in extracurricular activities.

These include: undergraduate research projects; campus organizations or interest groups that cater to the needs of students with disabilities; membership in scientific societies, such as the ACS Student Affiliates program; work-based learning opportunities;

In the article, it is written that some learning-disabled students perform better in the lab than in the classroom. This is largely due to the lab's multimodal training, which blends written content from the lab manual and notebook, hands-on exercises, and verbal presentations from the teacher. Depending on

the nature of a given lab exercise, adjustments in the lab may be necessary for some students. Students who suffer from impairments related to auditory processing or sequencing, for instance, could find it challenging to follow detailed instructions unless they are accompanied by written instructions.

For instance, investigation based learning laboratory exercises are more beneficial to all students than activities or demonstrations with preset results. As a result, laboratory exercises can be changed such that students must come up with their own methods for answering a particular subject.

The article "Three steps for gaining access to the general education curriculum for learners with disabilities" by King-Sears, Margaret E. offers three steps to assist teachers in assessing how accessible their general education curriculum is for students with disabilities. There are also recommendations for improving the curriculum and thinking of original ways to change it. In addition to improving learning for students with mild to moderate disabilities as well as typical students and students at risk of failing their classes, special educators who use this process and work with general educators to improve weak curriculum attributes also reap two main benefits: Students with mild to moderate disabilities, typical students, and students at risk of failing school all benefit from (a) improved learning and (b) more methodical, individualized placement decisions for students with disabilities, which may lead to the least restrictive environment being the general education setting.

The article "Inclusion by design: Embedding inclusive teaching practice into design and preparation of laboratory classes." Hackl, Ellen, and Irina Ermolina present that Higher education providers are responsible for providing individual adjustments and for creating an inclusive learning environment. Numerous assessments from the past few years have concentrated on the institutional commitment to inclusive teaching and learning as well as the development, implementation, and evaluation of inclusive curricula. But, particularly in lab settings, inclusive learning environments aren't frequently integrated into the broader requirements of the university. The majority of science and medical courses, including pharmacy and pharmaceutical sciences, require students to complete practical work in the lab as a required component of their education. This work cannot be substituted with theoretical or online instruction.

The article "Inclusion in chemistry education in secondary school." (2018) by Michna, Dagmar, and Insa Melle discuss that as an evidence-based strategy to make schools and learning accessible for all learners, the Universal creation for Learning (UDL) framework has been developed in the US for the creation of inclusive learning environments. The main thesis is that universal access to the learning materials may be necessary for effective learning for all pupils. To be more specific, the UDL framework is made up of teaching strategies that allow students options and choices with regard to the resources, settings, subjects, etc. A productive learning environment reduces obstacles while providing students with support and challenge. The authors believe that flexible teaching strategies and resources are necessary to minimize barriers. And as a result, according to CAST (2011), the UDL framework has three main principles:

Principle I: Provide Various Representation Methods (the "what" of education)"

Principle II: Provide Multiple Means of Action and Expression (the "how" of learning)

Principle III: Provide Multiple Means of Engagement (the "why" of learning)"

The purpose of this research is to determine the topics mentioned in order to integrate science-specific content with inclusive teaching approaches. The research question is How significant topics are found out to integrate subject content with inclusive teaching approaches.

Methodology

A comprehensive review of more than 20 academic articles fulfilling the frameworks or principles of the Integrative content and inclusive teaching for the study of chemistry was carried out, 9 of which were analyzed, special attention was paid to aspects of the structure of the Integration for the school in Chemistry Lessons. Working with keywords such as "inclusive practices in chemistry teaching" made it possible to identify relevant research and articles for inclusion in the analysis. The study of articles and their comparison made it possible to identify the main frameworks and principles of the methods of implementing the Integrative inclusive teaching for school used in the context of teaching chemistry.

Sampling

In order to accomplish the goal, we examined 9 scientific publications, including methodological books, essays, and scientific journals.

Article name (author, year of publication)	Description
“From barriers to boosters initial teacher education for inclusive science education”Frankel,Silvia (2023)	Offers informative analysis and suggestions for improving initial science teacher education programs in the context of inclusion. Discusses current obstacles and supporters in the context of initial science teacher education for inclusion.
“Teaching energy in living systems to a blind student in an inclusive classroom environment.”Teke Dilek and Mustafa Sozbilir (2019)	Adapting learning settings to the requirements of students with impairments is crucial. The authors provide two approaches to education: educating students in inclusive classrooms and providing special education programs to those who require them separately from their peers.
“Teaching chemistry to students with disabilities: A manual for high schools,colleges,and graduate programs 4th edition” Miner,Dorothy L (2001)	Ways of teaching chemistry to students with disabilities. Recommended to encourage students with disabilities to engage in extracurricular activities.
“Three steps for gaining access to the general education curriculum for learners with disabilities” King-Sears, Margaret E (2002)	provides instructors with three steps to help them determine whether their general education curriculum is accessible to students with disabilities. Additionally, suggestions for enhancing the curriculum and coming up with novel modifications are included.

<p>“Inclusion by design:Embedding inclusive teaching practice into design and preparation of laboratory classes” Hacki, Ellen and Irina Emollina (2019)</p>	<p>For learners with disabilities, lab lessons can pose numerous challenges. Making proactive changes to the planning and organization of laboratory classes can help to ensure that lab-based learning is as inclusive and accessible as feasible.</p>
<p>“Inclusion in chemistry education in secondary school” Michna, Dagmar and Insa Melle (2018)</p>	<p>Explore examples, principles to integrate science-specific content with inclusive teaching approaches. A conducive learning environment lessens barriers while offering students challenge and support.</p>
<p>“The future of laboratory chemistry learning and teaching must be accessible” Egambaram, Orielia (2022)</p>	<p>About making laboratory-based chemistry learning environments, teaching, assessment, and resources accessible to all students and staff.</p>
<p>“An exploratory study of universal design for teaching chemistry to students with and without disabilities” King-Sears, Margaret E (2015)</p>	<p>Conducted a survey between students with and without disabilities while teaching chemistry. For the post-tests, there was an interaction effect between students with and without disabilities, but there were no significant differences between the conditions.</p>
<p>“Conflicting demands of Chemistry and Inclusive Teaching” Abel Simone, Brigitte Koliander and Thomas Plotz(2020)</p>	<p>Examines the problems that a teacher may encounter when instructing a so-called "hard science," such as chemistry, in an inclusive classroom. It is believed that all students should be able to participate in science-specific learning processes thanks to inclusive science education.</p>

Data collection

During my research work, I searched for articles on the topic "**INTEGRATING INCLUSIVE PRACTICES IN CHEMISTRY EDUCATION**" in Google Scholar, especially paying attention to the keywords about topic related to inclusive practices in chemistry education. I studied various academic databases to find relevant literature and critically evaluated the ways in which each article addressed the research objectives. This process helped to ensure that relevant and high-quality articles were included in the analysis on the topic.

Data analysis

After carefully examining each article, I discovered that nine of them fully addressed the study's frameworks and principles and provided insightful details about the usefulness and real-world applications of inclusive teaching and learning when implementing the integrated subject content and inclusive pedagogy in the chemistry classroom.

Result

Article name	Related topic	Frequency	Percentage
Frankel et al. (2023) Kings-Sears, Margaret E et al.(2015)	The add-on approach and subject-specific elaboration	2	22.2%
Michna, Dagmar, and Insa Melle (2018) Teke Dilek and Mustafa Sozbilir (2019) Miner, Dorothy L et al(2001)	Design of Inclusive classrooms	3	33.3%
Abele Simone, Brigitte Koliander et al. (2020)	Documentary method	1	11.1%
Frankel et al. (2023) Hacki, Ellen and Irina Emollina (2019) Egambaram, Orielia (2022) Miner, Dorothy L et al (2001)	open educational resources	4	44.4%
Kings-Sears, Margaret E et al. (2015) Frankel et al. (2023)	Universal Design for Learning (UDL)	2	22.2%

At the end of the study, 9 different articles on "inclusive practices in chemistry teaching" were analyzed, identifying five types of topics. The main topics include the importance of creating a supportive and accessible learning environment for all students, regardless of their backgrounds or abilities (open educational resources)-44.4% and design of inclusive classrooms-33.3%.

Conclusion

In conclusion, the article explores the critical necessity of integrating inclusive approaches into chemistry education at its conclusion. After a thorough examination of the scholarly literature and a thorough analysis of pertinent studies, it is clear that creating an inclusive learning environment requires tackling the obstacles faced by students with disabilities. The research emphasizes the significance of developing welcoming and accommodating learning environments for all students by highlighting several frameworks and concepts for applying inclusive teaching approaches in chemistry classrooms.

The importance of proactive approaches, like using universal design for learning (UDL) principles, making use of free educational materials, and creating inclusive classrooms, is highlighted by key findings. These techniques seek to improve chemistry education equity, accommodate a range of learning demands, and increase student engagement. By using inclusive approaches, teachers may help all students succeed and make valuable contributions to the area of chemistry, which will improve learning outcomes for each student and the discipline as a whole.

References

1. Fränkel, Silvia, Moritz Sterken, and Lisa Stinken-Rösner. "From barriers to boosters: initial teacher education for inclusive science education." *Frontiers in Education*. Vol. 8. Frontiers Media SA, 2023.
2. Teke Dilek, and Mustafa Sozbilir. "Teaching energy in living systems to a blind student in an inclusive classroom environment." *Chemistry Education Research and Practice* 20.4 (2019): 890-901.
3. Miner, Dorothy L., et al. "Teaching Chemistry to Students with Disabilities: A Manual for High Schools, Colleges, and Graduate Programs 4th Edition." (2001).
4. King-Sears, Margaret E. "Three steps for gaining access to the general education curriculum for learners with disabilities." *Intervention in School and Clinic* 37.2 (2001): 67-76.
5. Hackl, Ellen, and Irina Ermolina. "Inclusion by design: Embedding inclusive teaching practice into design and preparation of laboratory classes." *Currents in Pharmacy Teaching and Learning* 11.12 (2019): 1323-1334.
6. Michna, Dagmar, and Insa Melle. "Inclusion in chemistry education in secondary school." *PART 11: STRAND 11* (2018): 1433.
7. Egambaram, Orielia, et al. "The future of laboratory chemistry learning and teaching must be accessible." *Journal of chemical education* 99.12 (2022): 3814-3821.
8. King-Sears, Margaret E., et al. "An exploratory study of universal design for teaching chemistry to students with and without disabilities." *Learning disability quarterly* 38.2 (2015): 84-96.
9. Abels, Simone, Brigitte Koliander, and Thomas Plotz. "Conflicting Demands of Chemistry and Inclusive Teaching—A Video-Based Case Study." *Education sciences* 10.3 (2020): 50.

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PISA ХАЛЫҚАРАЛЫҚ САЛЫСТЫРМАЛЫ ЗЕРТТЕУІ БАРЫСЫНДАҒЫ ҰСЫНЫЛҒАН ТАПСЫРМАЛАРДЫҢ СИПАТТАМАСЫ

Аңдатпа. Бұл мақала PISA халықаралық салыстырмалы зерттеуі шеңберіндегі математикалық есептерді талдауға арналған. Нақты өмірлік жағдайларда қолданылатын теориялық сұрақтар мен тапсырмалардың жиынтығынан тұратын математикалық есептердің әртүрлі түрлерін сипаттауға ерекше көңіл бөлінеді. Зерттеу барысында оқушылардың функционалдық сауаттылығын