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Curricular and Methodological Adaptations for Teaching Inclusive Chemistry in High School

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Summary

Inclusive education requires pedagogical, structural, and cultural changes to ensure respect and accessibility, and it is important that public policies ensure that teachers have access to initial and continuing education programs that prepare them to deal with diversity in the school environment. Thus, the general objective of this study is to analyze the importance of adaptable curricula and methodologies for teaching inclusive chemistry in high school. The methodology used was bibliographic research. The study concluded that the implementation of assistive technologies must be an ongoing process, involving the constant adaptation of methods and tools to ensure that all students can reach their full potential.

Keywords: Curriculum. Methodology. Chemistry. Inclusion

Abstract

Inclusive education requires pedagogical, structural and cultural changes to ensure respect and accessibility, and it is important that public policies ensure that teachers have access to initial and continuing training programs that prepare them to deal with diversity in the school environment. Thus, this study has the general objective of analyzing the importance of adaptable curriculum and methodologies for inclusive chemistry teaching in high school. Bibliographical research was used as a methodology. The study concluded that the implementation of assistive technologies must be an ongoing process, involving the constant adaptation of methods and tools to ensure that all students can reach their full potential. **Keywords:**CV. Methodology. Chemical. Inclusion

1 Introduction

Educational inclusion is an essential right that must be guaranteed to all. In Chemistry teaching, it involves creating an environment that values diversity, promotes equity and enhances the development of all students. Inclusive education requires

more than curricular adaptations, requiring pedagogical, structural and cultural changes to guarantee respect and accessibility.

Thus, the need for public policies that invest in teacher training is evident in the context of inclusive education. Public policies must ensure that teachers have access to initial and continuing training programs that prepare them to deal with diversity in the school environment, promoting inclusive pedagogical practices and using assistive technologies effectively (Carvalho; Santana; Carvalho, 2025). Through continuing training, teachers will be ready to respond to the challenges of inclusive education and ensure that all students have access to quality education.

This study is justified by the fact that assistive technologies have the potential to democratize the teaching of Chemistry, providing a more inclusive and personalized education for all students, despite their limitations. Tools such as reading software, tactile models, reaction simulators and educational games allow teaching to be adapted to the diverse needs of students, promoting the development of essential skills and knowledge in an equitable manner.

Thus, this study has the general objective of analyzing the importance of adaptable curricula and methodologies for teaching inclusive chemistry in high school. The specific objectives are to identify curriculum strategies for teaching inclusive chemistry; describe the use of assistive technologies in chemistry teaching; and address strategies for teacher training for special education in chemistry.

The methodology used was bibliographic research, based on authors who published studies in the last five years (2020-2025) and who addressed the topic in order to meet the proposed objectives.

2 Theoretical Framework

2.1 Curriculum and Methodology for Teaching Inclusive Chemistry in High School

Inclusive education represents one of the greatest advances in the educational field, proposing teaching-learning environments that consider the diversity of students and eliminate barriers that hinder access to and permanence in school. In the context of secondary education, the area of Natural Sciences, especially Chemistry, presents specific challenges due to the theoretical complexity and experimental nature of its content. Adapting curricula and methodologies is necessary to ensure that students with disabilities have access to

equal access to learning the subject, converting pedagogical practices into real opportunities for inclusion.

The historical evolution of inclusive education in Brazil has undergone significant transformations, marked by the fight for education for students with disabilities. The educational system segregated these children, directing them to specialized institutions and keeping them away from regular education. However, international agreements, such as the Salamanca Declaration in 1994, led to a movement to question this model, advocating the inclusion of students with disabilities in regular education. This process was driven by the 1988 Federal Constitution, which consolidated the right to education for all (Reis; Coutinho, 2024).

Reis and Coutinho (2024) emphasize that this right was reinforced by the Law of Guidelines and Bases of National Education (1996) and the Brazilian Law for the Inclusion of Persons with Disabilities (Law No. 13,146/2015), known as the Statute of Persons with Disabilities, which brought legal and regulatory advances for inclusion. More recently, the National Common Curricular Base (BNCC) established inclusive guidelines for basic education, proposing adaptations of content and methodologies in order to meet the diversity of students.

In science education, especially in chemistry, inclusive policies are important to ensure access to scientific knowledge for all students, overcoming obstacles such as the lack of adapted teaching resources. Accessibility can transform students' lives by combating stigma and promoting a sense of belonging, while enabling a broader understanding of social and environmental issues.

Silva and Amaral (2021) emphasize that inclusive Chemistry teaching faces challenges. Among these, physical issues stand out, such as inadequate school infrastructure, making it difficult to carry out practical experiments essential for learning. In addition, attitudinal barriers manifest themselves, with some teachers' resistance to adopting inclusive practices, often due to lack of training and prejudices regarding the abilities of students with disabilities.

Pedagogical barriers represent significant challenges. For students with hearing impairments, verbal communication in Chemistry teaching can be a challenge, making the presence of sign language interpreters or the use of adapted materials essential. Students with visual impairments face difficulties with graphic representations and experiments, requiring tactile resources and audio description. Students with physical and intellectual disabilities face practical difficulties and difficulties in abstracting chemical concepts,

demanding adaptations in the pace and teaching methodologies, with the use of more concrete and progressive resources (Silva and Amaral, 2021).

Overcoming these challenges requires a structural and cultural transformation in schools, with investments in adequate resources and infrastructure. It is also important to ensure ongoing and specialized training for teachers. Inclusion in Chemistry teaching goes beyond a legal requirement; it is a question of equity, which ensures students with disabilities have equal access to scientific knowledge, thus promoting their academic and social development.

2.2 Curricular Adaptation Strategies

Curricular adaptation strategies are essential to promote inclusive Chemistry teaching, ensuring that all students, regardless of their limitations, have access to knowledge and can develop their skills. Making complex content more flexible and adapting it are important steps, especially when meeting the needs of students with intellectual disabilities. Chemistry, as a science that involves abstract concepts, specific symbols, and practical experiments, can be challenging, but at the same time, it offers opportunities for more accessible teaching (Santos et al., 2024).

In this context, it is important to use simpler and more direct language. Simplifying content, without compromising the essence of scientific knowledge, facilitates understanding and increases student engagement. Concrete and contextualized examples, linked to students' daily lives, help to make concepts tangible, allowing for gradual and meaningful assimilation.

Santos et al. (2024) state that the use of visual resources, such as diagrams, illustrations and explanatory videos make learning attractive. The use of simplified practical activities, adapted to the students' limitations, contributes to a concrete and experiential understanding of chemical specificities. To this end, the pedagogical approach must prioritize the individual pace of learning, creating an environment in which students feel safe and valued, encouraging their active participation in the learning process.

In this scenario, Amato and Ribeiro (2018) report that the concept of Universal Design for Learning (UDL) emerges as an innovative and effective strategy for teaching inclusive Chemistry. UDL proposes the creation of flexible curricula that consider the needs of all students from the beginning, eliminating barriers and offering multiple

forms of learning. This approach is structured around three principles: offering multiple means of representation, action and expression, and engagement. In teaching Chemistry, these principles can be applied in different ways, diversifying teaching strategies and ensuring that the content reaches all students.

When applying UDL, teachers can, for example, present Chemistry content through different resources and languages, such as tactile materials, audio descriptions, subtitled videos, and practical projections (Pereira; Almeida, 2021). For students with visual impairments, the use of relevant materials, such as three-dimensional models of molecules and tactile representations of the periodic table, may be necessary for their understanding. Likewise, students with hearing impairments benefit from videos with subtitles, sign language interpreters, and detailed visual resources that replace oral explanations. For students with intellectual disabilities, playful activities, educational games, and simple experiments, combined with objective and contextualized explanations, are effective tools to facilitate learning (Souza et al., 2023).

Amato and Ribeiro (2018) note that UDL also values diversity in the forms of student expression and assessment, allowing them to demonstrate their learning in a variety of ways. Instead of being limited to written tests, students can be assessed through visual presentations, simplified reports, or participation in experiments and practical activities. This flexibility allows individual potentialities to be explored, while specific difficulties are minimized, ensuring educational progress for all.

By adopting curricular adaptation strategies combined with Universal Design for Learning, teaching Chemistry becomes more accessible, respecting differences and enhancing the abilities of each student. This approach promotes social inclusion and the development of skills that will accompany students throughout their lives.

2.2.1 Methodological Adaptations for Practical Classes

Methodological adaptations in practical Chemistry classes enable inclusive education, allowing all students, including those with disabilities, to participate in the experimental process. Chemistry, due to its practical and investigative nature, can present barriers for students with disabilities, making it necessary to adapt laboratories, experiments and methodologies to ensure that scientific knowledge is accessible to all (Silva et., 2023).

Medeiros et al. (2024) clarify that, for students with visual impairments, the use of tactile materials, such as three-dimensional models of molecules and chemical structures, is an effective strategy, allowing the understanding of abstract concepts such as molecular geometry. Auditory sensors, which detect temperature variations and chemical reactions, and the use of Braille materials, screen reading software and audio instructions complement these adaptations, providing a complete sensory experience.

For students with hearing impairments, according to Silva et al. (2023), the use of educational videos with subtitles, translation into Libras, and visual representations facilitates the understanding of experimental procedures. Virtual experiment simulators are useful, offering a dynamic practical experience without relying on direct auditory communication.

Accessibility in the laboratory allows for the provision of services to students with physical disabilities. Adapting the environment, with adjustable benches, automated devices and adequate organization of spaces, facilitates mobility and provides independence to students with motor difficulties, enabling their active participation in practical activities (Silva et al, 2023).

By adapting methodologies and experiments, teaching Chemistry becomes an inclusive tool, promoting a collaborative environment that respects differences and provides a transformative education for all. These strategies ensure equal participation of students with disabilities and enrich the learning experience, making it more accessible.

2.2.2 Accessible Teaching Resources

The production and use of teaching resources promote inclusive Chemistry teaching, ensuring access to scientific knowledge for students with disabilities. The diversity of available resources, such as adapted materials and innovative technologies, contributes to overcoming learning barriers and makes the teaching process more dynamic and interactive.

Resources such as audiobooks and Braille texts are necessary for students with visual impairments. Audiobooks allow theoretical content to be accessed through hearing, while Braille facilitates the reading of printed materials, allowing an understanding of concepts. These adaptations are applied both in textbooks and in supplementary materials, such as experiment scripts (Santos; Silva Franqueira; Santos, 2024).

Technology enables the use of tools such as screen reading software and 3D visualization applications, which help visually impaired students understand molecular structures and perform virtual experiments. Adapted educational games, both physical and virtual, are another important strategy, making learning stimulating while developing skills such as logical reasoning and teamwork (Carvalho; Santana; Carvalho, 2025).

Therefore, curricular and methodological adaptations are important for the success of inclusive Chemistry teaching. Successful experiences demonstrate that, with the use of appropriate strategies and appropriate resources, it is possible to ensure quality education for all students.

2.3 Use of Assistive Technologies in Chemistry Teaching

The use of Assistive Technologies (ATs) has become an important tool to promote educational inclusion for students with disabilities. In the context of Chemistry teaching, the implementation of these technologies allows students, despite their limitations, to have access to scientific knowledge in an accessible, participatory, and effective way. Since ATs can include a wide range of devices and software, and their applicability goes beyond simple adaptations, they help to personalize the teaching-learning process according to the specific needs of each student (Garcia, 2023).

The use of these technologies in teaching Chemistry helps to overcome barriers that may arise due to sensory, motor or cognitive deficiencies, in addition to facilitating student interaction with complex scientific concepts.

According to Moraes (2023), Assistive Technologies (ATs) are essential tools for promoting accessibility and inclusion for students with disabilities, offering resources that guarantee autonomy and equal opportunities. They can be divided into physical devices, such as prosthetics and wheelchairs, and assistive software, such as screen readers and magnification programs, as well as alternative communication systems, such as Libras and symbol communication.

In Chemistry teaching, ATs allow for the adaptation of experiments, teaching materials and learning methodologies, meeting the diverse needs of students. For visually impaired students, solutions such as 3D tactile models and Braille materials allow abstract concepts, such as molecules and chemical structures, to be accessible.

students with hearing impairments, subtitled videos, materials in Libras and experiment simulators provide inclusive theoretical and practical learning (Moraes, 2023).

For students with physical disabilities, ATs are able to adapt the learning environment, with equipment such as tables and remote control devices for instruments, ensuring their active participation in laboratory activities. In addition, simulation software allows students with mobility difficulties to participate in experiments (Graf et al., 2024).

In addition to adapting the content and environment, ATs promote student autonomy by allowing them to access information in a personalized way, such as expanded texts, interactive audios and videos. This strengthens students' protagonism, encouraging them to participate in the construction of their knowledge and develop greater confidence and responsibility in their learning process.

2.4 Specific Tools and Technologies for Teaching Chemistry

In the context of inclusive education, assistive technologies ensure that all students can access knowledge and participate in the learning process. In Chemistry teaching, these tools offer creative and effective solutions to overcome barriers that arise due to visual, auditory, physical and intellectual disabilities.

Assistive technologies can be applied to benefit students with different types of disabilities in Chemistry teaching. For students with visual impairments, assistive technologies offer tools that facilitate access to content and understanding of chemical concepts. Software such as NVDA (NonVisual Desktop Access) and JAWS (Job Access With Speech) are essential for reading digital texts, allowing students with visual impairments to access teaching materials auditorily. These screen readers convert digital text into speech, ensuring that the student can follow explanations and written information about chemical formulas, experiments, and theories (Martins et al., 2023).

Tactile three-dimensional models, according to Ribeiro (2023), are useful for the study of molecules, atoms and chemical reactions. Through tactile materials, students can “touch” models of molecules and chemical structures, visualizing their shapes, bonds and spatial arrangements in a concrete way. Another innovative resource is auditory sensors, which allow students to identify physical and chemical changes during experiments, such as temperature changes or changes in state. By providing *feedback* auditory about reactions

chemicals, these devices make the laboratory safe for visually impaired students.

In the case of students with hearing impairments, the author emphasizes that the use of assistive technologies facilitates the understanding of audiovisual content, which is essential in the teaching of Chemistry (Carvalho; Santana; Carvalho, 2025). Video classes with interpretation in Libras (Brazilian Sign Language) and subtitles offer an effective means of transmitting information, allowing students with hearing impairments to follow the classes in full. The use of subtitles and translation into Libras makes the content accessible, ensuring full student participation in the activities.

The inclusion of software such as *ChemDraw* and PhET, which provide dynamic visual representations of molecules and chemical reactions, is also useful. The *ChemDraw* allows students to draw and visualize molecular structures, facilitating the understanding of chemical interactions and the properties of compounds. PhET's interactive simulators allow students to perform virtual experiments, understanding complex chemical characteristics without the need for physical equipment. These resources help translate theoretical teaching into tangible experiences for students with hearing impairments (Vidade; Mafuiana, 2024).

Students with physical disabilities can benefit from assistive technologies in the laboratory environment, as these tools ensure their active and safe participation in chemical experiments. The use of adapters for laboratory equipment makes the learning environment more accessible, allowing students with reduced mobility or other physical disabilities to use flasks, glassware, and instruments effectively and independently. These adapters are designed to facilitate the manipulation of equipment, ensuring that students can perform hands-on experiments independently (Graf et al., 2024).

Voice-controlled devices that allow students to operate experiments or laboratory equipment are an excellent solution to overcome physical barriers that could hinder participation in practical activities. According to Graf et al. (2024), these devices allow students to interact with experiments without the need for excessive physical effort, ensuring their active participation in laboratory activities. This ensures that students with physical disabilities can participate in Chemistry classes independently and without the need for constant assistance.

For students with intellectual disabilities, the use of gamified applications can be a tool to facilitate the learning of basic Chemistry concepts. Platforms

such as Quizlet and Kahoot offer gamification features that make learning more interactive and engaging (Pereira; Almeida, 2021). These tools allow students to review content, answer questions, and participate in activities in a playful and challenging way, stimulating interest and motivation (Pinheiro, 2023).

Adapted chemistry games can be used to teach concepts such as chemical reactions, molecular behavior, and material properties in a visual and interactive way. These games simplify the learning of complex processes by using visual representations and interactions that make the content understandable. By transforming education into a fun experience, these tools effectively contribute to student understanding.

2.5 Gamification and Augmented Reality/Virtual Reality

Gamification, augmented reality (AR) and virtual reality (VR) have stood out as innovative resources in teaching Chemistry in inclusive contexts. These resources make learning interactive, benefiting students with different needs (Souza Gomes et al., 2024).

Gamification, by integrating game elements into the educational process, creates a dynamic and motivating environment, with immediate feedback that facilitates knowledge retention. For students with intellectual disabilities, digital games can simplify complex chemistry concepts, making them accessible and promoting active participation and collaborative learning. Platforms such as Kahoot and Quizlet offer a fun way to review and test knowledge (Pinheiro, 2023).

Augmented reality, according to Souza Gomes et al. (2024), allows the visualization of chemical concepts in 3D, such as molecules and chemical reactions, providing a tangible understanding of the content. Using devices such as tablets and smartphones, students can explore molecular structures and interact with them in an immersive way.

Virtual reality offers the opportunity to conduct laboratory experiments in simulated environments, eliminating mobility and accessibility barriers. Students can explore chemical substances and observe reactions without the need for physical equipment, ensuring safe and controlled learning, ideal for complex experiments (Souza Gomes et al., 2024).

These technologies make Chemistry teaching inclusive and stimulate scientific curiosity, promoting student leadership in their learning process. With the

Using gamification and AR/VR, the classroom becomes an interactive space, where all students can learn in an active, practical and engaging way.

2.5.1 Challenges and Limitations in TA Implementation

The implementation of assistive technologies (AT) in Chemistry teaching, although beneficial, faces several challenges and limitations that need to be addressed to ensure effective inclusion. These challenges include costs and access to technologies, teacher training and qualification, and the adaptation of content and resources to students' individual needs.

The high cost of ATs, such as specialized software and Braille reading devices, is one of the biggest challenges in public schools and in regions with limited resources. Inequality in access to technological equipment and the lack of adequate infrastructure compromise the effectiveness of implementation. To overcome this, more government support and resource mobilization are needed (Silva Brito et al., 2023).

Another challenge, according to Silva Brito et al. (2023), is the training and qualification of teachers, who do not have the necessary knowledge to use ATs effectively. The lack of adequate training can affect the quality of teaching. Investing in continuous training programs is essential to ensure that educators can integrate ATs into the curriculum in an inclusive way.

Furthermore, adapting teaching content and resources to the specific needs of students requires personalization. The diversity of disabilities and learning styles requires adapted materials, such as texts in Braille and videos in Libras. The adaptation process must be flexible, as students' needs may change over time. Personalizing teaching in large classes represents a significant barrier.

Overcoming these challenges requires collaboration between schools, governments, teachers, students and the community. Equal access to ATs with appropriate pedagogical training is necessary to ensure that all students, regardless of their disabilities, can learn and develop in Chemistry education.

2.5.2 Challenges and Possibilities in Teacher Training for Special Education in Chemistry

Inclusive education in Chemistry teaching seeks to ensure that all students, regardless of their disabilities or specific educational needs, have access to meaningful learning. However, for this to happen effectively, teachers must be prepared to deal with the diversity present in their classrooms.

Teacher training is therefore essential in building an inclusive environment, as it enables educators to adopt appropriate pedagogical practices adapted to the needs of students with disabilities. This theme discusses the challenges and possibilities involved in teacher training for special education in Chemistry, highlighting the importance of ongoing preparation and the skills necessary for an inclusive and effective educational practice.

The teacher, as a mediator of knowledge, is one of the main agents of transformation in the process of school inclusion. In an inclusive educational context, the educator must act as a facilitator of the active participation of all students, ensuring that everyone has equal opportunities to learn. The role of the teacher in inclusive education, in teaching Chemistry, goes beyond teaching classes. He or she must be able to identify the different needs of his or her students and employ pedagogical strategies that allow for the adaptation of content, activities, and assessments (Santos et al., 2024).

According to the authors, inclusion in Chemistry teaching requires that teachers develop specific skills to deal with the diversity of students in their classrooms. This involves, for example, knowledge about the various disabilities (such as visual, auditory, intellectual, among others), their characteristics, and ways to adapt teaching so that each student has access to the content in a meaningful way. Furthermore, teacher training for special education in Chemistry should address the use of assistive technologies, the adaptation of methodologies, and the creation of a safe and welcoming learning environment.

The teacher must also be able to reflect on their practices, seeking to improve their pedagogical approaches, requiring ongoing training that enables educators to learn new methodologies and tools, such as the use of visual, tactile and technological resources, to ensure that all students can understand chemical concepts in an accessible way.

2.6 Context of Teacher Training in Brazil

Teacher training in Brazil for special education has been shaped by public policies that seek to promote the inclusion of students with disabilities in the education system. Since the 1990s, the country has adopted a series of guidelines and initiatives to ensure equity in access to education, with an emphasis on inclusive education. The National Policy for Special Education from the Perspective of Inclusive Education (PNEEPEI), established by the Ministry of Education (MEC), was an important milestone in this process. This policy seeks to ensure the enrollment of students with disabilities in regular schools, with the support of professionals trained to adapt curricula and teaching methods to the needs of these students (Campelo, 2023).

The PNEEPEI, approved in 2008, reaffirms the right to quality education for all, with a focus on the social and educational inclusion of people with disabilities. It guides teacher training so that they understand the different disabilities and know how to modify pedagogical practices to meet this diversity. The policy also proposes the use of assistive technologies, adaptation of content and the provision of specialized support, ensuring that students with disabilities can enjoy a quality education.

Malta et al. (2024) point out that, despite advances in public policies, teacher training for special education still presents significant gaps. Inclusion policies, although well-designed, sometimes do not translate into concrete practices in classrooms due to gaps in teacher training, both in initial and continuing education. Many teachers enter the teaching profession without adequate preparation to work with students with disabilities, in teaching subjects such as Chemistry, which require more complex adaptations.

Initial teacher training in undergraduate courses still lacks specific content on inclusive education. The authors report that, although some universities offer courses focused on special education, they do not always have a practical focus, aimed at direct application in the classroom. Furthermore, most teacher training courses do not prepare teachers to use assistive technologies or to adapt teaching and assessment methodologies for students with disabilities. This reflects a significant gap in teacher training, which often leaves teachers unprepared to deal with the diversity of students' needs.

Continuing education for teachers is important. The job market, with its constant demands and innovations, requires that educators stay up to date on new

methodologies, assistive technologies and pedagogical tools. Continuing education programs, such as improvement and specialization courses, have been offered to fill these gaps. However, the lack of financial resources and the workload of teachers make it difficult to access and implement these trainings on a broad scale. This creates an additional challenge for the implementation of quality inclusive practices in the teaching of Chemistry and other disciplines (Malta et al., 2024).

In light of the above, teacher training in Brazil for special and inclusive education still faces significant challenges. Although public policies are in place, gaps in initial and continuing teacher training need to be overcome to ensure that teachers are prepared to implement inclusive pedagogical practices in the teaching of Chemistry and other areas of knowledge.

2.6.1 Challenges Faced by Teachers

Teacher training for inclusive education faces several challenges that impact the implementation of appropriate pedagogical practices in Chemistry teaching and other areas. These challenges are related to the lack of specific preparation during initial training, the scarcity of resources and infrastructure in schools, and the workload of educators.

According to Fontenele and Cantero (2024), one of the biggest challenges faced by teachers in Brazil is the lack of specific training in inclusive education during their undergraduate studies. Although national curricular guidelines provide for the inclusion of topics related to diversity and special education, most undergraduate courses still do not offer robust content on how to serve students with disabilities in the classroom. Teachers are often not prepared to deal with the specificities of teaching students with sensory, physical, or intellectual disabilities, and this makes it difficult to adapt the curriculum and teaching methods.

Fontenele and Cantero (2024) highlight the teaching of Chemistry as an example, emphasizing that experimental sciences require a high level of adaptation. This need includes both the use of assistive technologies and the modification of content and pedagogical practices. However, the lack of adequate training can generate insecurity and unpreparedness in teachers, making it difficult to effectively apply these resources and compromising the quality of inclusive teaching. This training gap highlights the lack of a practical and

interdisciplinary, essential for educators to develop the skills and abilities required to work with students with disabilities in scientific disciplines.

The lack of resources and adequate infrastructure in public schools is one of the biggest challenges faced by teachers. Sidor and Strugal (2024) point out that educational institutions still lack the necessary support to promote inclusive practices, whether due to the absence of adapted teaching materials, assistive technologies or accessible environments for students with disabilities. In the case of teaching Chemistry, the availability of adapted laboratories and equipment that allow active participation in these classes is necessary to ensure inclusion in the learning process.

According to the authors, many schools lack teaching tools and pedagogical support that meet the needs of all students, such as reading software, braille materials, audiobooks or tactile models for the study of molecules and chemical reactions (Sidor; Strugal, 2024). The absence of these resources compromises equal opportunities for students with disabilities, making it difficult for them to participate in the teaching-learning process.

According to Martins (2023), teachers' workload is a factor that contributes to the difficulty in implementing inclusive practices effectively. Teachers in public schools often face large classes and a series of responsibilities, such as preparing lessons, correcting activities, and participating in pedagogical meetings. With so many demands, it becomes challenging for teachers to dedicate themselves to adapting content and methodologies for students with special educational needs.

Adapting content and personalizing teaching for each student requires time and effort, as well as knowledge about different disabilities and the best pedagogical strategies to meet these needs. Many teachers face a lack of adapted materials and difficulty planning activities that are meaningful for all students. This workload, combined with a lack of support and specialized training, can lead to demotivation and burnout among educators, hindering the inclusion process (Martins, 2023).

In short, the lack of specific training, the scarcity of resources and the workload are significant challenges for inclusion in Chemistry teaching. Overcoming them requires investments in teacher training and the creation of public policies that guarantee adequate resources and better working conditions, which is necessary to ensure that all students have access to quality education and participate in learning.

2.7 Possibilities and Strategies for Teacher Training

Teacher training is essential to promote inclusive practices in chemistry teaching, ensuring that teachers can meet the needs of students with different disabilities. One effective strategy for this is ongoing training, which allows educators to stay up to date on inclusive practices, assistive technologies, and adapted pedagogical methodologies. Periodic courses and workshops are important for teachers to acquire theoretical and practical skills, such as the use of reading software and three-dimensional models, in addition to enabling the exchange of experiences with other educators (Medeiros et al., 2022).

The incorporation of active learning methodologies, such as blended learning, is an important strategy. Blended learning combines face-to-face learning with the use of digital technologies, allowing students with disabilities to learn at their own pace. Interdisciplinary projects that integrate areas such as biology and physics with chemistry can be a creative way to apply inclusive practices in a collaborative manner (Almeida; Resende; Vieira, 2024).

Partnerships with universities, NGOs and inclusive education centers strengthen teacher training by offering courses, workshops and specialized resources. These partnerships create a support network, allowing teachers to share experiences and access up-to-date and innovative materials.

Furthermore, the inclusion of courses on inclusive education and the use of assistive technologies in the curricula of undergraduate chemistry courses is essential to prepare future teachers. These courses should be practical and interdisciplinary, addressing the needs of students with disabilities and offering tools for adapting teaching.

It is necessary to invest in teacher training to ensure quality inclusive education, providing teachers with the tools and knowledge necessary to meet the diverse needs of students. Strategies such as ongoing training, the use of active methodologies, partnerships with specialized institutions and the inclusion of topics related to inclusive education in undergraduate courses are essential to prepare educators to create an effective learning environment for all.

However, for this training to be effective and capable of ensuring full inclusion, it is essential to adopt a broader and more integrated approach. The multidisciplinary approach, which involves collaboration between different professionals, is a basic factor in this process, as

allows educators to count on the support of specialists from different areas to meet the needs of students with disabilities in a more precise and personalized way.

In this sense, Delgado (2023) states that promoting quality inclusive education in Chemistry teaching requires a collaborative effort between several professionals, such as educators, occupational therapists, psychologists, sign language interpreters and other specialists. The multidisciplinary approach is essential to meet the diverse needs of students with disabilities, providing personalized teaching.

According to the author, collaboration with health professionals, such as occupational therapists and psychologists, allows us to understand the specificities of each student and adapt the learning environment. These professionals provide detailed diagnoses of learning difficulties, motor and sensory issues, allowing teachers to adopt appropriate pedagogical strategies. Sign language interpreters also play a fundamental role in the communication of deaf students, ensuring that they understand the Chemistry content and participate in class.

The collaborative approach should extend to the day-to-day classroom, where interactive pedagogical practices can be developed jointly by teachers and health specialists. This collaboration strengthens the adaptation of experiments and the use of assistive technologies, creating a more inclusive learning environment. The exchange of experiences and the discussion of strategies among professionals contribute to the creation of effective teaching (Carvalho; Santana; Carvalho, 2025).

Partnering with families is vital to ensure that teaching is complemented with the necessary support at home. A multidisciplinary approach allows for an understanding of students' needs and the development of more effective pedagogical strategies, ensuring equal learning opportunities for all. Thus, collaborative practices promote a more inclusive and integrative school environment.

Final Considerations

This study demonstrated that despite the challenges, such as abstract concepts and experimental practices in Chemistry, there are opportunities to create stimulating learning. The success of inclusion depends on the commitment of managers, teachers and institutions. Managers must implement policies that ensure accessible resources and adapt spaces and materials. Teachers discuss ongoing training to adjust pedagogical practices and

use assistive technologies, ensuring active student participation. Institutions should invest in research, inclusive materials and support for educators.

Overcoming these challenges brings significant benefits, valuing diversity and ensuring equal opportunities. With joint efforts, it is possible to build quality education that respects differences and prepares students for the scientific and social future.

Furthermore, it was seen that the recommendations for a more humanized training, include the creation of training courses that are integrated into the realities of schools and students, addressing in a practical and concrete way the strategies and tools necessary for inclusive teaching. It is essential that these courses include components on the use of assistive technologies, the management of diversity in the classroom and the importance of collaborative work with other professionals. Furthermore, it is essential that teacher training be seen as an opportunity for the personal and professional development of educators, promoting a more fair, inclusive and quality education for all.

For assistive technologies to be effective in teaching chemistry, their implementation must be strategic. Schools need to invest in adequate infrastructure and ongoing training programs for teachers, ensuring that they have the necessary skills to use these technologies effectively. Personalizing content should be a priority, adapting it to the specific needs of students, requiring a collaborative environment, with the support of accessibility specialists and pedagogical planning that considers the diversity of students.

Thus, it is concluded that the implementation of assistive technologies must be an ongoing process, involving the constant adaptation of methods and tools to ensure that all students can reach their full potential. By adopting an inclusive approach, schools will be creating a fair educational environment in which science becomes accessible to all.

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