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Literature Review: Universal Design for Learning (UDL) Approach of Chemistry Learning in Inclusion Schools

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Abstract

Inclusive education is a promising way to create an equitable and high-quality education system that accepts all learners, including those with special needs. Universal Design for Learning (UDL) offers a flexible and dynamic approach to meet the various needs of learners, helping them to reach their full potential in education. This literature study aims to discover the application of the universal design for learning approach in chemistry learning. The research method used Narrative Literature Review (NLR), which uses the Google Scholar database to search for journal articles from the last ten years. The results of the literature show that applying the Universal Design for Learning approach in chemistry learning has a major influence in improving the learning experience and learning outcomes of students with special needs. Various interesting teaching materials such as learning videos, interactive games, and the application of E-modules are also used to support the learning process.

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INTRODUCTION

Inclusive education is a learning approach that ensures all students, including those with various needs and backgrounds, have equal access to quality education. Therefore, according to Chumairo et al. (2021) inclusive education is a help for those who have disabilities or different backgrounds to be able to receive a decent education. Inclusive education aims to provide equal access for all students, including those with special needs, in various subjects, including chemistry learning. However, the complexity of chemical materials often becomes a challenge for students with diverse learning needs. Universal Design for Learning (UDL) emerged as a solution with a flexible framework to accommodate differences in students' ways of learning through providing various methods of presenting material, learning activities, and evaluation, as well as providing opportunities to increase creativity and participate effectively during the learning process (Huda, 2024; Salgarayeva & Makhanova, 2024). Therefore, implementing UDL in chemistry learning in inclusive schools is crucial for creating a learning environment that is more enjoyable effective, and supports the success of all students (Hansen et al., 2016).

Previous research has shown that applying UDL in learning can increase students' active participation and understanding, especially in inclusive environments. However, most research still focuses on subjects such as language, mathematics, citizenship education, and physical education, while studies related to the implementation of UDL in chemistry learning still need to be completed. In addition, existing research often has not touched on practical aspects, such

as adapting complex chemical materials to fit the UDL framework. This shows a research gap that needs to be filled to ensure that all students in inclusive schools can access chemistry learning optimally.

This literature review is essential because it can present a systematic review of the mapping of approach research topics Universal Design for Learning (UDL) in chemistry learning at inclusive schools in the last ten years. The focus of this literature review is mapping approach research topics, such as Universal Design for Learning (UDL), that have been implemented and analyzing the implementation of the approach, Universal Design for Learning (UDL), in chemistry learning at inclusive schools. The potential contribution that can result from this review study is that it can provide recommendations regarding approaches to Universal Design for Learning (UDL), which is appropriate to be implemented in chemistry learning in inclusive schools.

METHOD

This literature research uses methods of narrative literature review. The first step is to determine the research topic to be studied so that the aim is to provide general knowledge about the approach to Universal Design for Learning in inclusive schools in chemistry learning. The next step is to search for articles from 2014-2024, which were obtained using Google Scholar in this literature review. In data analysis, articles discussing the universal design for learning approach and those related to learning outcomes in chemistry learning were then arranged into several groups. This grouping is presented in table form containing article metadata consisting of journal name, article title, year of publication, author's name, and research results.

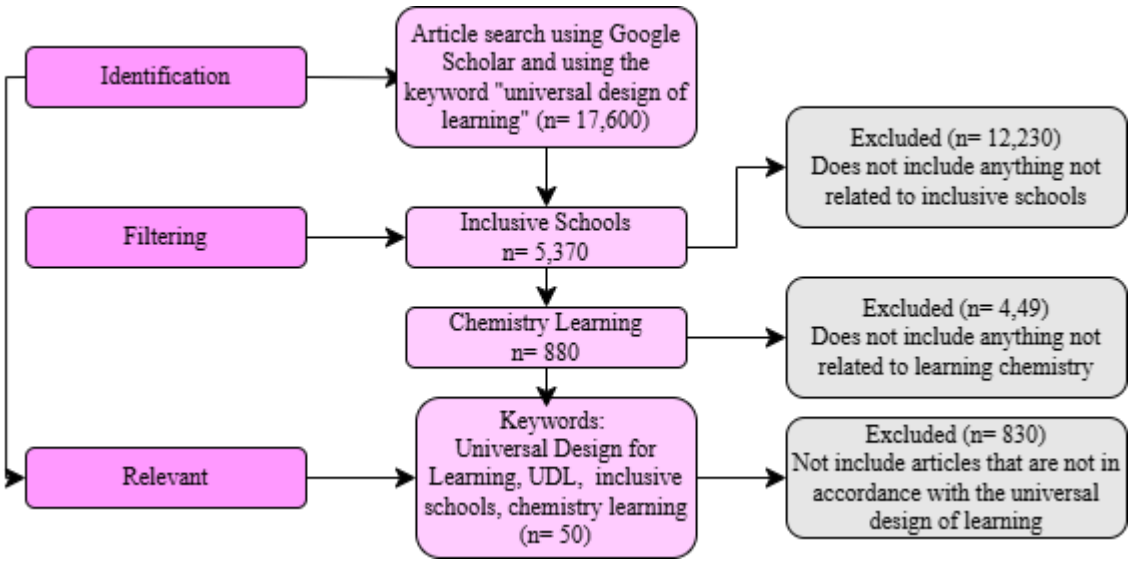

Figure 1. Data search strategy flow chart

A search for research literature relevant to this research topic was carried out with the keywords "universal design for learning" and found 17,600 articles. The obtained articles were then filtered using the keywords "inclusive school" And "Inclusive Education" 5,370 articles, so 12,230 articles were not included because they were not included in the approach to universal learning design. Then filtering was carried out again using the keywords "chemistry learning" and "Chemistry learning"880 articles were obtained, so 4,490 articles were not included because the articles included biology, physics and mathematics learning. In the end, the number of articles selected after sorting according to the subject of discussion was 50 articles. Criteria for articles included include (1) Articles about approaches to universal design for learning in

chemistry learning. (2) The year limit is between 2014 and 2024. (3) Articles from reputable publications with open access. (4) The content of the article must provide concrete data or analysis about the impact of implementing UDL in an educational context, including studies in school, university or informal education environments.

RESULTS AND DISCUSSION

Approach Concept Universal Design for Learning At Inclusive Schools

An education system that is prepared to help students learn to ease all learning obstacles and encourage students to participate more is the meaning of inclusive education (Sword-Chavarria., 2023). According to Tanjung in Marantika et al. (2024), inclusive education is combining children with special needs into regular classes and providing the necessary support in participating in learning together with other students, while according to Dunn in Triana & Supena (2023), inclusive education is generally defined as teaching that involves students in relevant, accessible and meaningful learning. Children with certain conditions who need special handling and attention during the teaching and learning process are called children with special needs. They can be classified as children with physical, cognitive, emotional or social disabilities. In this case, inclusive education is very important for those who fall into this category (Fakhiratunnisa in Marantika et al., 2024).

Inclusive schools are a real manifestation of the implementation of inclusive education; these schools accept various students with special needs in the environment, social interactions, and curriculum (Agustryana in Novianti, 2021). According to Lamport in Novianti (2021), there is a special education system where all children with special needs can join their peers in regular classes. Students with special needs or limitations in the learning process need school, which has an important role and various benefits that students get from school. Students have various advantages and disadvantages, but these differences should not limit them from getting an equal education, following the Regulation of the Minister of National Education of the Republic of Indonesia number 70 of 2009, which states that education for children with special needs is inclusive education (Muslim, 2022).

The solution to dealing with the problems of students who have their strengths and weaknesses with different characters in inclusive classes is to use the principle of approach universal design for learning abbreviated as UDL. One learning approach known as universal design for learning prioritizes access to diversity of learning for all students with various backgrounds (Arnez et al., 2023). According to Meyer in Kusumastuti and Prabawati (2024), Universal Design for Learning (UDL) is education that ensures that students can have all the same actions regardless of their backwardness.

UDL provides a framework for designing learning objectives, methods, materials, and appropriate assessments for each learner. This allows for diverse learning styles and the needs of each learner to be met temporarily. According to Brand & Dalton in Griselda et al. (2022), in the UDL approach, students can improve their literacy understanding, and the learning experience is meaningful, interesting, and tailored to their skills. The UDL approach can create a flexible learning environment because it involves students in learning information presented in various ways, and they have many options to demonstrate their learning. The UDL approach allows teachers as facilitators to change the curriculum so that later, the teaching and learning process and student assessment can be adjusted in any possible way (Alqarni in Rosmi &jauhari, 2023).

The aim of the UDL approach is to ensure that students can have equal opportunities in terms of learning through flexible curriculum and instruction so that it can be accessed by a variety

of students with learning styles, abilities and backgrounds. UDL is evaluated as a learning design that provides for all diversity, especially students who have special needs (Priyadharsini and Mary, 2024; Muslim, 2022).

Basically, the UDL approach was created based on three principles, namely, first principles, multiple engagement or how students can be motivated in learning activities with various methods that can trigger interest and create a supportive environment for students. Second principle, multiple representations or various ways of representation. Students have different learning styles. UDL is able to accommodate differences in different learning styles by ensuring that these differences do not hinder them in learning and that the learning process is adapted to their learning styles. The final principle is, multiple actions and expressions or various ways of acting and expressing. This principle is a stage of student assessment in learning which aims to measure students' abilities and skills in accepting the learning process (Kusumastuti and Prabawati, 2024).

These three principles are very suitable if applied in the learning process, especially in inclusion classes, where students with different characteristics can experience enjoyable learning activities, so that they can be motivated or active in learning activities. If students in inclusive schools use this UDL approach, they will experience the learning process of students in regular education schools. This UDL approach also adapts to the skills that students have, even though they have deficiencies, this does not prevent them from experiencing a pleasant learning process and growing their sense of motivation to learn, therefore this UDL approach is important to implement in inclusive schools.

Universal Design for Learning Approach to Chemistry Learning

Approach universal design for learning (UDL) is an approach to learning that is centered on diversity learning for all students with various backgrounds. This approach is an educational framework that aims to create an inclusive learning environment by enabling a variety of representations, actions, and expressions as well as engagement for each learner, regardless of their learning style, abilities, or deficiencies (Sharma et al., 2023). According to Anggraini (2024) states that when the complex impacts of inclusive education grow and develop, UDL is an ideal framework for achieving the existence of inclusive development. UDL provides a framework that combines inclusive teaching practices to create a more flexible and contextually appropriate learning environment by planning for learner variability and providing better support for each learner (Meyer in Orndoff et al., 2022). The use of UDL in learning activities can provide promising results because it can improve and maximize the learning experience regardless of individual learning abilities (Baybayon, 2021).

Learning chemistry is an educational process that involves understanding basic and advanced concepts regarding substances, their properties, and phenomena. Chemistry studies natural phenomena at macroscopic, microscopic and symbolic levels. Various natural phenomena will later be explained using various concepts, theories and laws (Gabel in Redhana, 2019). Maftuhin & Aisyah in Abrori (2023) say that in order to maximize the role of chemistry teachers in implementing inclusive classes, appropriate preparation and changes are needed. This will ensure that students with special needs can receive inclusive and effective learning. Therefore, chemistry teachers can use a more structured learning approach or more varied learning techniques to help students with different abilities learn well. By using a variety of learning methods and considering students' unique needs, teachers can help understand the material better and improve learning outcomes. Universal design for learning is one approach that is suitable and can be applied in inclusion classes.

UDL teaching methods and adaptive strategies can be implemented in schools which can create an inclusive and supportive learning environment for students. Universal design for learning

offers a flexible and dynamic approach to meet the diverse needs of students by helping them achieve their full potential in education. The main goal of UDL is to ensure equal educational opportunities by encouraging teachers to provide representation, expression, and involvement to all diverse learners (Marantika., et al, 2024; Alqarni, 2022). These UDL principles are suitable for application in chemistry learning because they support various ways of learning, increase engagement, and flexibility in the way students learn and express their understanding. This ensures that students of all kinds and different learning styles can successfully understand the often complex chemistry material.

According to Courtad (2019) Universal Design for Learning (UDL) consists of three principles, namely multiple representations or representation, multiple actions and expressions or action and expression, as well multiple engagement or involvement. Principle First UDL is multiple representations or ensuring a variety of representations, that students have different strategies in accessing information. This supports a variety of learning methods, preferences and competencies for conveying information through auditory, tactile and visual modalities. By presenting accessible materials and formats, such as assistive technology, captions, alternative texts, this principle makes the learning environment more inclusive (Case & Davidson in Sharma et al., 2023).

According to Sewell et al. (2022) the more diverse representations used during the learning process, the more students' learning outcomes will improve. Applying this principle in the chemistry learning process, teachers usually present material in the form of text, images, videos and models, such as atomic models in 3D form. The use of video is closely related to visualization in the form of images. The video format can provide benefits for deaf students because they can rely on other senses, especially sight (Khasawneh in Wulayalin and Suprihatiningrum, 2024). The learning style of deaf students is usually visual and kinesthetic, so apart from videos, teachers use graphics, posters, pictures and writing. According to Wulaningrum in Wulaalin and Suprihatiningrum (2024), chemistry teachers must be able to develop a complete learning design so that abstract chemistry learning concepts can be conveyed to students.

Principle second UDL is multiple actions and expressions or various ways of acting and expressing, with a focus on providing students with various ways to display their competencies. The methods used during learning must also be useful for students in applying and practicing knowledge and skills, accommodate their needs and the learning media used are effective. Ensuring that students are able to demonstrate knowledge according to their abilities (Arnez et al. in Sharma et al., 2023; Frolli et al., 2023).

According to Sharma et al. (2023) the use of technological devices, various forms of response and providing choices for tasks is one form of this principle. develop an inclusive learning environment by acting and communicating well and respecting the various abilities of students and supporting a fair and inclusive learning experience. The application of this principle provides various ways for students to demonstrate their understanding, express skills and actively participate in the learning process. In chemistry learning, this principle can be applied by involving students in carrying out practical acid-base reactions using a virtual laboratory. When students do practicum, they are provided with a virtual lab and maximize group activities to discuss the results of their work. For example, students with special needs observe changes in litmus paper, even though they have limitations in carrying out practical activities, their goals remain the same as other students. This shows that teachers have high expectations for students with disabilities and provide alternative ways for them to access learning (Wulayalin and Suprihatiningrum, 2024).

Principle third UDL is multiple engagement or various modes of engagement, which focus on increasing learner motivation, positive emotional connection to the learning process and active

participation. This principle states that meeting the different preferences, interests and motivation levels of students is very important (Arnez et al. in Sharma et al., 2023). According to Hall in Dalimunthe et al. (2020) stated that this principle provides various options to support and encourage students' desire to learn. An inclusive learning environment allows all learners, regardless of their learning style, background or competencies, to feel valued and fully engaged. This is achieved by recognizing and combining different forms of engagement (Sharma et al., 2023). This UDL principle will facilitate students in involving them in a pleasant learning environment, for example the use of e-learning makes it easier for students to learn flexibly (Yuwono et al., 2023).

The third principle of UDL aims to foster interest and encourage students to participate actively. In chemistry learning, this principle is important to ensure that students feel interested and motivated to learn. The way to apply this principle in chemistry learning is by linking learning to everyday life. For example, in the acid-base material, teachers can relate it to ingredients they have at home such as vinegar, soap, and baking soda. By seeing the real benefits of learning chemistry, they can be more motivated to understand the material. The third principle of UDL is also an assessment stage for students. According to Evenddy in Wulayalin and Suprihatiningrum (2024), an alternative assessment is an assessment given by teachers as a substitute for quizzes and exams. Types of assessment can be portfolio assessments (such as project reports and presentations), self-assessments, and peer assessments. Alternative assessment can also help teachers find the right assessment to apply in the classroom and determine what students need (Alokozay in Wulayalin and Suprihatiningrum, 2024).

Universal design for learning (UDL) significantly impacts students with special needs, including students with disabilities, by providing more inclusive and effective access to chemistry learning (Meyer et al., 2014). One example of the application of UDL in the chemistry learning process is a blind student can understand the concept of molecular structure by using a three-dimensional model that can be touched, which is designed based on UDL principles so that they can imagine the shape of molecules concretely (Rao et al., 2017). Meanwhile, for students with dyslexia, chemical material presented in audio or video lessons helps them understand the topic of chemical reactions without the obstacle of reading long texts (Al-Azawei et al., 2016). With various flexible and inclusive ways of delivering material, UDL provides equal opportunities for students with special needs to gain a deep understanding of chemistry material.

In chemistry learning with the UDL approach, there are supporting tools in the form of learning media. Learning media for students can help students understand the material and provide convenience and effectiveness. From the reviewed articles, several data were obtained related to learning media based on the UDL approach.

Table 1. UDL-based learning media

Instructional Media	Results	Reference
E-module	Using e-modules as an approach-based learning media universal design for learning in increasing learning motivation, understanding concepts, and accommodating students' needs,	(King-Sears dkk., 2015; ebb & Hoover, 2015; Cipto dkk., 2018; Mujiono et al., 2018; Novianti, 2021; Murtadho et al., 2022; Wusqo & Jatiningsih, 2022; Arnez et al., 2023; Holländer & Melle, 2023; Maslahah et al., 2023; Kusumastuti & Prabawati, 2024; Marantika et al., 2024)
Interactive games	Using interactive games as an	(Dewi & Dalimunthe, 2019;

	approach-based learning medium universal design for learning in increasing learning motivation, understanding concepts, accommodating student needs, creativity and collaboration	Chumayro dkk., 2021; Alifian, 2023; Rosmi & Jauhari, 2023)
Learning videos	Using learning videos as an approach-based learning media universal design for learning in increasing understanding of concepts and motivation to learn	(Seok et al., 2018; Muslim, 2022; Orndorf dkk., 2022 Huda, 2024; Istiqomah et al., 2024)

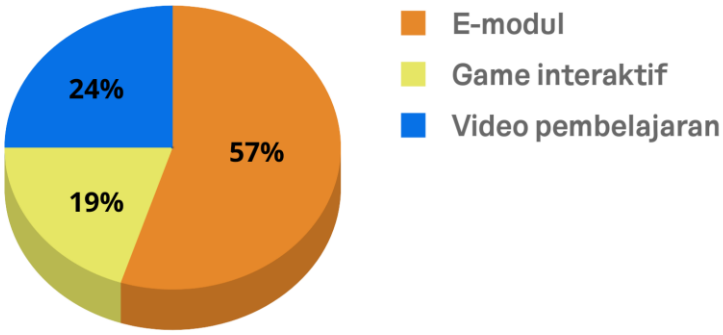

Figure 2. Percentage of use of learning media

Figure 2 shows several types of learning media based on the UDL approach used in learning at inclusive schools. Articles obtained ranged from 2014 to 2024, and modules were used by 57%. In Universal Learning Design (UDL), E-modules provide flexibility in the delivery of material, which allows adjustments to various student learning styles. Using a platform such as Liveworksheets, examples of chemistry material about "Reaction Rates" can be presented in interactive e-modules using a scientific approach. This e-module is intended to increase students' understanding of how reactant and product concentrations change over time. This is done through interactive simulations and practice questions that provide automatic feedback. Therefore, this e-module not only makes chemistry learning more accessible and more interactive but also supports UDL principles by providing students with multiple ways to perform and engage.

E-modules also have disadvantages. For example, making teaching materials takes a long time (Yuliana et al., 2023). The use of learning videos is 24%. In Universal Design for Learning, using video as a learning medium has several advantages. Learning videos can present complex chemistry concepts through animation and simulations, making it easier for students to understand. In addition, learning videos can be accessed flexibly so that students can learn at their own pace and time. For example, chemistry material about "Redox Reactions" can be communicated through videos that display interactive animations showing the transfer of electrons between the substances involved. To support a better understanding of this material, verbal and text explanations may be included. However, learning videos can only be used with computers and require additional devices such as projectors and speakers.

Apart from that, making a video takes a long time and costs a lot of money (Apriansyah, 2020). The use of interactive games is 19%. Using the Universal Design for Learning (UDL) approach, interactive games can increase student motivation and involvement in the learning process, making it more challenging and fun. This game can also be played on smartphones,

allowing students to learn anytime and anywhere. Students can understand complex chemical concepts more easily thanks to the game's attractive and interactive visual display. As an application example, chemistry material about the "Periodic System of Elements" can be delivered through interactive games that encourage students to identify and group elements based on their characteristics. Games like this can help students understand the periodic table's regularities and patterns in fun and interactive ways. However, there are drawbacks associated with using interactive games.

Game development requires time, money, and technical skills, which can hinder achieving it. Additionally, some students need more devices or internet connections to play interactive games, which can hinder their learning. Interactive games can distract students from the main learning objectives if they need to be designed better (Yulian et al., 2023). Thus, each learning media in UDL has its advantages and disadvantages. Educators need to design the right combination of media, such as integrating video, e-modules, simulations, print media, and interactive games, to create a flexible, effective, and inclusive learning environment. This approach is expected to meet the needs of various students, including those with special needs so that chemistry learning becomes easier to understand and more engaging for all students.

UDL can provide opportunities to develop students' abilities in the environment and overcome barriers to their learning (Al Hazmi & Ahmad, 2018). UDL is an approach that has been designed to make learning and curriculum easily accessible to all students regardless of their backwardness (Camedda et al., 2024). The criteria for learning media based on the UDL approach must reach the background of students, especially students with disabilities. Of course, the criteria for selecting learning media must be by UDL principles, namely the way of conveying information, flexibility in activities, and flexibility in assessment (Marantika et al., 2024). The application of learning media that can support students during learning activities is also applied in inclusive schools. According to Widyawan et al. (2023), the use of media as a curriculum development tool in the UDL approach is recommended as the main method for delivering material because it is considered that learning media can adapt. The application of UDL principles focuses on educational efforts to reach students in various ways, for example by reading texts aloud or using videos to convey learning material (Roski et al., 2021).

One of the learning media is an e-module based on the UDL approach which is intended for students who have special needs and various types of character. The reason why e-modules are more widely used as a learning medium in the UDL approach is because e-modules can combine the 3 principles of UDL. The first principle, namely flexibility in conveying information, means that students with disabilities have their learning styles so when providing learning media, it must be provided according to the needs of each student, such as text, audio, and video. In the e-module, these three formats are available, namely material in text form, explanation of the material with audio, and the addition of learning videos in visual form. E-module in text format for deaf students who are unable to receive chemistry learning material in audio or oral form. E-modules in audio format for visually impaired students who are unable to receive chemistry learning material in text or visual form (Mujiono et al., 2018).

There are also e-modules designed for students in categories slow learner. The second principle is flexibility in learning activities, where the e-module has been prepared to suit the needs and learning styles of students, for example in the e-module there are activities for discussions, practice questions, or practicums so that this can make the learning process more active and interesting. The third principle is flexibility in assessment in learning activities. Assessment of students are not assessed when they take written exams, but assessments to measure students' understanding and skills can use various options such as presentations, projects, or portfolios. Therefore, the e-module provides activities for discussion, students will be asked to present the results of their discussions in the class that assessed by teacher (Marantika et al., 2024).

In implementing UDL in learning media, namely e-modules, teachers must design material that is easily accessible and can improve students' learning experience regardless of their learning abilities. E-modules used in chemistry learning by applying UDL principles must be able to explain the chemical concepts obtained to improve student achievement, for example by adding a text-based format by presenting the results of chemical reaction equations (symbolic), a video format by presenting experimental videos regarding acid-base reactions that produce color changes (macroscopic), and animations by presenting 3D animations to show particles moving and interacting in chemical reactions (microscopic), there are also graphs and diagrams. The UDL approach can make abstract chemistry learning concrete because learning activities can provide experiences, materials, and interactions that make them involved in learning through flexible information delivery methods according to student's abilities and needs (Wulayalin & Suprihatiningrum, 2024).

Learning media using learning videos is usually closely related to e-modules because in e-modules there are learning videos as a support. Interactive game learning media can also help students to be active during learning activities, of course, interactive games must be adapted to students' needs. According to Alqarni (2022) and Hanjarwati et al. (2023) one of the principles of UDL, namely how to convey representation and expression by providing video games and supplements such as e-modules, has proven to be effective, flexible, and easy to use to accommodate various characteristics of students. Integration in learning with UDL can produce classrooms that are friendly and centered on students who learn actively and reflect on their own learning (Qazi et al., 2018). The benefits of using approach-based learning media universal design for learning in increasing learning motivation, understanding concepts, accommodating student needs, and learning motivation.

Advantages and Disadvantages of the Universal Design Learning Approach

During the chemistry learning process, especially in inclusive schools, teachers are expected to be able to develop and implement adaptive strategies for students. One framework that can facilitate adaptive learning strategies for children with special needs is Universal Design for Learning (UDL). Chemistry learning is a part of science, which emphasizes scientific skills through practical work in the laboratory (Salame & Casino, 2021). When learning chemistry, students who have unique needs have the same process as other students, only students with special needs need more assistance than other students. the slow learner who needs assistance related to concentration problems, changes in teaching methods, and the content of the material to be taught. According to Rosmi & Jauhari (2022), UDL can provide a flexible learning scope when information is presented in various ways, students can participate in the learning process in various ways, and students can choose how to explain learning to them.

This UDL approach has several advantages and disadvantages that we need to consider first, before applying it when learning chemistry. The advantages of this approach are that it can encourage students to be more creative and active and UDL can accommodate students to pay more attention to learning when they are given something that suits their wishes (Rosmi & Jauhari, 2022). According to Firmansyah et al. (2017), the advantage of UDL is that it can improve student learning outcomes with a learning process that is tailored to student needs so that the learning process runs well. UDL can include all students from various types of education and does not only explain differences in students from aspects of disability (Dewi & Dalimunthe, 2019).

According to Murtadho et al. (2022), UDL can be applied to adaptive module-based learning, during learning you will get pictures, illustrations, and knowledge related to the past to get an emotional impression from these pictures and illustrations, and this module facilitates material preferences that students can use with various learning styles in each lesson. The use of this

adaptive module is suitable when applied to atomic structure materials, chemical elements, substances and their changes, and colloidal systems.

According to Black et al. (2015), the advantages of UDL can be defined as a curriculum that will provide an effective, accessible, and non-discriminatory environment for students who have unique limitations, therefore the existence of this type of UDL curriculum can increase positive student performance and reduce The need for accommodation and the principles of UDL can be applied widely so that all students with disabilities can increase their accessibility. This approach is flexible, so that it is not only beneficial for students with disabilities, but can improve the learning experience of all students, as well as produce an inclusive environment that supports and is more educational for students who have different abilities in understanding chemistry subjects.

The lack of research that discusses this approach makes it a challenge for teachers to apply it in chemistry learning. According to Rosmi & Jauhari (2022), the weakness of this approach is that a teacher needs more experience to apply UDL principles to the chemistry learning process. Without sufficient experience, implementing UDL in the classroom will be less effective so it cannot meet the needs of the diversity of learning styles of students. This needs to be considered before implementing UDL as a learning curriculum, namely that Many educators and parents may still not know much about the principles and practices of UDL so they do not understand the benefits of UDL for learning, especially in chemistry learning (Priyadharsini & Mary, 2024). According to King-Sears et al. (2015) in several studies, explained that UDL interventions were incomplete in explaining clearly the UDL principles and guidelines that were being operationalized. When you want to apply this approach to learning, you need to know that there is only a small amount of material that focuses on learning, so it does not provide satisfaction for students in the learning process. In applying UDL to learning, educators need professional training to be able to meet the needs of their students.

CONCLUSION

Implementation of the approach Universal Design for Learning (UDL) in chemistry learning in inclusive schools is very important to implement because it can ensure that all students, including those with disabilities, can learn inclusively and effectively without any obstacles. UDL emphasizes 3 main principles viz multiple engagement, multiple representations, And multiple actions and expressions. By offering a variety of ways to present information, express understanding, and increase motivation, UDL enables each learner to learn in the way that best suits their learning style. UDL principles, such as providing choices, using a variety of media, and creating a flexible learning environment, help students build a deeper understanding of chemistry concepts that are often considered difficult. Thus, UDL not only increases the accessibility of chemistry learning but also improves the quality of learning.

RECOMMENDATIONS

Based on the article, further research is recommended to develop a universal design for the learning approach to science at the elementary school, junior high school, high school, and college levels.

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