ADDRESSING DIVERSITY IN SCIENCE EDUCATION: TEACHERS' CHALLENGES AND INNOVATIVE SOLUTIONS FOR INCLUSIVE EDUCATION

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Abstract. Inclusive science education requires an approach that is sensitive to student diversity, including differences in gender, culture, social background and learning ability. This process not only reflects social justice values, but also enriches students' learning experiences and prepares them to participate in an increasingly globalized society. However, many challenges are faced by science educators in their efforts to address this diversity in an effective way. This study explores the various challenges faced by teachers in dealing with diversity in the context of science education. Factors such as gender stereotyping, imbalance of cultural representation in teaching materials and inequality of access were highlighted. Teachers also face barriers in establishing a supportive and inclusive classroom environment for all students. Through a literature review and field research, this study explores innovative solutions adopted by science teachers to address these challenges. These initiatives involve inclusive curriculum design, the use of diverse role models, and the integration of technology to improve access and learning. In addition, teacher training focusing on cultural expertise and awareness of unconscious bias were also identified as key factors in creating inclusive learning environments. This research provides an in-depth insight into how science educators can face and overcome the challenges of diversity in the context of science education. Practical implications and policy recommendations will be outlined to support a more inclusive and relevant science education for all students in this global era.

Keywords: *Inclusive Education; Science Education; Diversity Education*

A. INTRODUCTION

Merangkum Summarizes an in-depth review of efforts to address diversity in science learning, with an emphasis on the role of teachers, the challenges they face, and the innovative solutions implemented in creating inclusive education. First, "Addressing Diversity In Science Education" describes a commitment to exploring and responding to diversity in the context of science learning (Hasanah, 2023). This reflects an awareness of the complexity of students' backgrounds in terms of culture, ability and learning styles. This article discusses how diversity can be a valuable resource that can enrich the learning experience, but also a challenge for educators. By understanding and responding to this diversity, this article can provide deep insights into how

science education can better align itself with the needs and characteristics of diverse students.

Then, the focus on "Teachers' Challenges And Innovative Solutions For Inclusive Education" highlights the role of teachers in facing these challenges. The article discusses concrete barriers faced by teachers, such as inequalities in learning accessibility, differences in learning styles, or cross-cultural communication challenges. By exploring these challenges, readers are expected to gain a better understanding of the complexity of teachers' tasks in managing diversity. In addition, this article will provide an in-depth look at innovative solutions implemented by teachers to create an inclusive learning environment. These solutions may include the use of technology, responsive curriculum development or differentiated teaching practices to meet the needs of diverse students. Thus, the title of the article promises a holistic understanding of creating inclusive science education through understanding the challenges and innovative solutions faced by teachers.

Science education is a key element in building a foundation of knowledge and skills to face the challenges of the modern world (Halim, 2022). However, in the face of increasingly complex diversity in the classroom, educators are faced with significant challenges. This article aims to explore the dimensions of diversity in science education and specifically focus on the role of teachers in dealing with these challenges. With the title "Addressing Diversity In Science Education: Teachers' Challenges And Innovative Solutions For Inclusive Education", this article explores the extent to which educators face challenges in creating an inclusive learning environment that takes into account the diversity of students in terms of culture, abilities and learning styles.

The importance of diversity in the context of science education lies not only in recognizing individual differences, but also in the potential that diversity has to enrich students' learning experiences. In line with the dynamic changes in the global society, this article aims to detail the challenges faced by science teachers in responding to student diversity. Through an in-depth literature review, this article seeks to provide insight into the concrete barriers that educators may face, while highlighting the innovative steps that have been taken to create inclusive science education. By understanding and addressing these challenges, it is hoped that this article can positively contribute to our understanding of how to create a science learning environment that integrates diversity into a dynamic and inclusive educational force.

B. METHODS

The literature study method is a research approach that involves collecting, analyzing, and synthesizing literature relevant to a particular research topic (Assyakurrohim, 2023). This method does not involve collecting new data, but rather focuses on researching and understanding previously published works, such as books, journal articles, theses, and other literature sources. The main purpose of the literature study method is to present a comprehensive and detailed overview of existing knowledge in a research field (Kurniawan, 2023).

This literature study is designed to provide an in-depth insight into the role of teachers in addressing the challenges of diversity in science education, focusing on the innovations that have been adopted to create an inclusive learning environment. With the title "Addressing Diversity In Science Education: Teachers' Challenges And Innovative Solutions For Inclusive Education" this article uses the literature study method to investigate the contributions of relevant literature in understanding the context of diversity in science classrooms.

In an effort to holistically understand the challenges faced by science teachers, the selected literature includes empirical, theoretical and best practice research. Through analysis of the literature, several key themes emerged, including cross-cultural communication challenges, differences in student learning styles, and learning accessibility gaps. While the literature presented an overview of these barriers, a number of innovative solutions were also revealed. Some of these

solutions may involve the application of technology in teaching, curriculum development that is responsive to student diversity, and learning differentiation strategies tailored to individual needs.

This article compiles the results of the literature analysis to present a deeper understanding of how science teachers can face diversity challenges and implement innovative solutions to achieve a more inclusive science education. It is hoped that this article will provide guidance for educational practitioners, researchers and policy makers in understanding the framework needed to create science classrooms that integrate diversity as a valuable resource. The conclusion of this article is expected to be a useful contribution to the development of future strategies for inclusive science education.

C. RESULT & DISCUSSION

The results of this literature study illustrate that diversity in the context of science education plays an important and complex role in shaping an inclusive learning environment. The challenges faced by science teachers in addressing diversity include various aspects, such as cross-cultural communication gaps, differences in student learning styles and learning accessibility issues. The literature also highlights that inequalities in teaching approaches can limit students' potential, particularly those who come from different cultural backgrounds or have unique learning styles.

In this context, the innovative solutions proposed in the literature are integral to addressing these challenges. The use of technology in teaching, such as the use of online learning platforms or customizable educational apps, has proven to be one effective approach. In addition, learning differentiation strategies, where teachers tailor teaching methods to students' individual learning styles and needs, have also emerged as a promising solution.

1. Cross-Cultural Communication Challenges.

Science teachers face difficulties in communicating with students who come from different cultural backgrounds (Zahrawati, 2021). Differences in language, cultural norms and values can affect the effectiveness of communication in the classroom. In addressing diversity in science education, educators face a number of cross-cultural communication challenges that require innovative solutions. One of the main barriers is language and communication differences, where students with different cultural backgrounds may face language gaps. Innovative solutions in this case involve developing teaching strategies that take into account language variations, such as the use of technology for translation or the provision of resources in several languages. Different cultural norms and values are also a challenge, with educators needing to understand and respect the diversity of student values. Solutions include involving students in curriculum creation and providing training to teachers to improve their understanding of different cultural values.

Other challenges include low cultural awareness, where a lack of awareness can result in insensitivity to students' needs. Innovative solutions include regular training on cultural awareness for teachers and creating a school environment that supports open dialog about cultural diversity. Lack of representation in the curriculum can also be a barrier, with solutions involving revising the curriculum to reflect the scholarly contributions of different cultures. Educators may also face a lack of resources to support students with different cultural backgrounds, and innovative solutions include building inclusive resource centers. Inequitable assessments, especially those that do not consider cultural context, are also an obstacle that needs to be addressed through the development of assessment methods that take into account the diversity of student understanding. Finally, a lack of community involvement can make it difficult for education to be appropriate to students' cultural contexts, and innovative solutions include building close relationships with local communities and inviting the participation of parents and community members in educational decision-making. By addressing these challenges, a more inclusive science learning environment that is responsive to

students' cultural diversity can be created.

2. Differences in Student Learning Styles.

The literature shows that there is a large variation in students' learning styles. Teachers need to recognize and respond to these differences in order to present learning materials in a more effective way (Azrina, 2023). In addressing diversity in science education, teachers are faced with significant differences in students' learning styles as a major challenge that requires innovative solutions to create truly inclusive learning approaches. Learning styles refer to an individual's preferences and tendencies in receiving, processing and understanding information. Students are unique in the way they acquire knowledge and skills, creating a wide spectrum of learning preferences. Some students may show a tendency to learn better through visual approaches, such as diagrams and graphs, while others may be more responsive to verbal explanations or hands-on experiences through kinesthetic approaches.

The true challenge lies in the need to align teaching methods with this diversity of learning styles. This requires teachers to develop strong skills in designing diverse learning experiences and customizing teaching materials according to students' needs. In addition, the use of innovative learning tools and educational technology can be key in providing accessibility to various learning styles. For example, the use of multimedia, interactive simulations and online learning platforms can help overcome barriers to presenting information in a way that suits diverse learning preferences.

Innovative solutions to creating inclusivity in science education include curriculum development that takes into account different learning styles. This can involve task design that allows for active participation, project-based learning that allows for creative exploration, and the use of evaluations that reflect deep understanding rather than relying solely on written exams. Engaging students in the learning process is also a focus, where teaching can be tailored to their interests and learning styles. Through innovative solutions such as these, teachers can create a science learning environment that considers the diversity of students' learning styles, opens up opportunities for optimal development of each individual, and advances an inclusive approach in science education.

3. Learning Accessibility Gap.

There is unequal accessibility to learning resources, both physical and technological (Nadziroh, 2023). Students from low economic backgrounds may face access barriers to necessary learning materials. The learning accessibility gap refers to the inequality or inability of some students to access and utilize learning resources in an equal way. These challenges can stem from a variety of factors, including economic, technological, geographical, physical and even cultural differences. Financial hardship is one of the main factors leading to the accessibility gap, where students from low economic backgrounds may struggle to access books, learning materials or additional educational resources.

Technological aspects also play an important role in the accessibility gap. Students who do not have access to digital devices or a stable internet connection may be left behind in distance learning or unable to keep up with technological developments in the education process. In addition, geographical gaps may also occur, especially in rural or remote areas where schools may not have adequate infrastructure or educational resources. Physical factors include gaps in accessibility for students with disabilities. Lack of disability-friendly facilities, lack of adapted learning materials, or teaching methods that do not support the different needs of students with disabilities can create significant gaps in learning accessibility.

Solutions to address the learning accessibility gap include building education policies that support inclusivity, empowering communities through participatory approaches, and investing in educational technology that is affordable and accessible to all. Financial aid programs or the provision of devices and internet access for students from low economic backgrounds can help

reduce the financial gap. Meanwhile, a universal design approach to learning can ensure that learning materials are accessible to all students, including those with special needs. By understanding and responding to the factors that cause learning accessibility gaps, education systems can become more inclusive and ensure that every student has equal opportunities to develop their potential.

4. Technology Innovation in Teaching.

The use of technology, such as online platforms and educational apps, is emerging as an innovative solution to overcome accessibility challenges and facilitate customized learning (Mukhid, 2023). In this context, technological innovations play a crucial role in creating learning environments that are inclusive and respond to student diversity. One of the main challenges teachers face is the different learning styles and needs of their students. Technological innovations, such as online learning and educational apps, can provide greater access to a variety of learning methods that can be tailored to individual preferences. The importance of technology in addressing the accessibility gap is becoming more prominent, especially with online learning platforms and game-based curricula that can be accessed from various locations. The application of technologies such as augmented reality (AR) and virtual reality (VR) opens up new opportunities in visualizing science concepts in an engaging and inclusive way, allowing students from different cultural backgrounds to engage more actively in the learning process (Siswati, 2023).

In facing the challenges of cross-cultural communication, technology also plays an important role. Student engagement apps and platforms can support collaboration between students from different backgrounds, creating spaces where cultural understanding can be enriched and shared. Artificial intelligence (AI) technologies can be used to understand individual learning styles and provide customized feedback, ensuring that teaching can be adapted according to each student's unique needs. Nonetheless, it needs to be recognized that not all students have equal access to these technologies, so the challenge of accessibility gaps remains relevant. Innovations in this regard include measures to increase technology access in underprivileged communities, as well as the development of accessible solutions without reliance on high-end devices. This means that while technological innovations promise great advances in inclusive science education, continuous efforts are needed to ensure that these innovations truly reach all students, without exception. Thus, this article will further explore the challenges and innovative solutions involving technology in embracing diversity in science education.

5. Learning Differentiation Strategy.

Learning differentiation strategies, where teaching approaches are tailored to students' individual needs and learning styles (Siswati, 2023), have proven effective in creating inclusive environments. In the face of diversity challenges in science education, learning differentiation strategies are emerging as an innovative approach that can bridge the gap and enhance inclusivity. Teachers are faced with the complex task of accommodating students' significantly varying learning styles, comprehension levels and learning speeds. Learning differentiation strategies demand deep reflection on how to deliver learning materials in a way that meets the unique needs of each student.

One effective differentiation strategy is to present learning materials in a variety of ways. This can include using text, images, videos and other multimedia resources to support a variety of student learning styles. By utilizing technology, teachers can create more dynamic and engaging learning experiences that are accessible to students from different cultural backgrounds. Curriculum adaptation is also a key element of learning differentiation. Teachers can devise lesson plans that allow students to explore certain topics in greater depth or offer research projects that reflect cultural and scientific diversity. Curricula designed with a differentiation approach can help address gaps in cultural representation in teaching materials, so that students feel more connected to their learning. In addition, the use of differential assessment plays an important role in supporting

inclusivity. Assessments that consider students' different styles of expression and understanding can provide a more holistic picture of their learning progress. Teachers can use different types of assessments, including projects, oral presentations, and portfolios, to provide space for creative expression and evaluation that suits students' diversity.

The importance of open communication and dialogue between teachers, students and parents should not be overlooked in learning differentiation strategies. Teachers need to listen to students' needs and expectations, identify their strengths and challenges, and create an environment that motivates and supports individualized development. Increased collaboration between teachers and parents can help understand the cultural context of students, ensuring that learning approaches are more personalized and contextualized. In involving technology, online learning platforms can support differentiation strategies by providing learning modules that students can access independently. Game-based learning and virtual simulations can also offer an interactive way to explain science concepts that can be tailored to students' level of understanding. Through the implementation of differentiated learning strategies, teachers can create learning experiences that utilize diversity as a strength, accommodate students' individual needs, and stimulate interest and active participation in science. As such, it not only addresses the challenges of diversity in science education but also advances an inclusive approach that empowers every student to reach his or her full potential.

The discussion of the results of this literature study underscores the importance of a deep understanding of student diversity in designing inclusive science learning strategies. The challenges faced by science teachers are not only technical, but also involve social and cultural aspects that require deep sensitivity and understanding. In dealing with cross-cultural communication inequalities, teachers need to develop strong interpersonal skills and build an environment where every student feels heard and valued.

In addition, the use of technology and differentiated learning strategies show great potential for enhancing the inclusiveness of science education. However, these must be implemented carefully, ensuring that the solutions adopted are not only pedagogically effective but also take into account the holistic diversity of students. It should also be emphasized that there is no one-size-fits-all approach, and teachers must have the flexibility to respond to the unique needs of each student.

Overall, this article provides an in-depth look at the challenges and solutions in dealing with diversity in science education. By acknowledging the complexity of this issue, it is hoped that educators and researchers can design a more holistic and responsive approach to create an inclusive science learning environment that empowers every student.

1. The Importance of Teacher Interpersonal Skills.

Emphasizing the need to develop science teachers' interpersonal skills, including sensitivity to cultural aspects of students (Ridho, Wardhana, Yuliana, Qolby, & Zalwana, 2022). Creating an environment where every student feels heard and valued is key to overcoming cross-cultural communication challenges. In addressing the challenges of science education that reflects diversity, the importance of teachers' interpersonal skills becomes very prominent. Interpersonal skills include teachers' ability to communicate effectively, understand and respond to the needs of students from different backgrounds, and create an inclusive learning environment. In the context of diversity in science education, interpersonal skills are not just an additional aspect, but the core of a successful and inclusive approach.

One key aspect is the teacher's ability to build positive relationships with students from different cultural backgrounds. Teachers with good interpersonal skills are able to understand individual differences, recognize students' cultural values and respond empathetically to their needs. This opens the door for trusting relationships to form, which can help build strong bonds between

teachers and students and create an environment that supports positive development. Effective communication is also key in dealing with cross-cultural communication challenges. Interpersonal skills help teachers deliver learning materials in a way that all students can understand, regardless of their background. Teachers who understand students' cultural diversity can use language variations, recognized cultural contexts, and sensitive approaches to explain science concepts in a relevant and pervasive manner.

Teachers' interpersonal skills also provide a foundation for creating an inclusive and welcoming classroom for all students. In facing the challenges of diverse learning styles, teachers need to have the ability to differentiate learning, i.e. adjusting teaching methods to the individual needs of students. Teachers who can read classroom dynamics, identify students' learning needs and respond with individually appropriate solutions can create a more relevant and effective learning experience. The importance of teachers' interpersonal skills can also be seen in their collaboration with peers, school staff and parents. Effective collaboration requires good communication and positive engagement from all parties. Teachers who are able to communicate well with colleagues can facilitate the exchange of ideas and best practices in responding to diversity in the classroom.

Finally, teachers' interpersonal skills embrace their role in shaping an inclusive and supportive school culture. Teachers who can create an environment where every student feels welcome and valued can contribute to a positive educational experience for all students, regardless of their cultural background or individual diversity. Thus, teachers' interpersonal skills become a key pillar in creating diversity-responsive science education, ensuring that every student feels recognized, supported and has equal opportunities to thrive in the realm of science.

2. Flexibility in Technology Use.

While technology can be an innovative solution, it needs to be recognized that not all students have equal access to devices or internet connections (Sabilla & Susanti, 2023). Therefore, there is a need for flexible approaches and alternative solutions to ensure inclusivity. In the face of the challenges of science education influenced by diversity, flexibility in the use of technology is a key cornerstone to promoting inclusivity and formulating innovative solutions. Teachers who integrate technology in a flexible way can better accommodate diverse learning styles, student needs and different cultural contexts. Flexibility in technology use includes teachers' ability to adapt digital learning tools according to students' needs and preferences. For example, in addressing the accessibility gap challenge, teachers can choose a variety of online learning platforms that can be accessed through various devices, allowing students with different levels of technology access to remain engaged in the learning process.

In dealing with the diversity of learning styles, technological flexibility can be reflected in the choice of diverse learning content. Teachers can utilize digital resources, such as videos, interactive simulations or educational apps, to deliver learning materials in various formats. This allows students to choose how they learn best, which in turn can improve understanding and retention of the material. Technology also plays a role in overcoming cross-cultural communication challenges. Flexibility in the use of technology allows for the integration of automatic translation tools, facilitating better communication between teachers and students with different languages. In addition, the utilization of online collaborative platforms can open pathways for enriching discussions and exchange of ideas, allowing students to share their perspectives on science according to their cultural context. The importance of flexibility in the use of technology is also seen in curriculum adaptation. Teachers can select or design learning resources that can be adapted to students' cultural contexts, making technology a tool to create connections between science concepts and students' life experiences. In this way, this flexible approach mobilizes diversity as a strength in science learning.

Finally, flexibility in the use of technology also creates opportunities for teachers to design diverse and inclusive assessments. Teachers can utilize digital tools to create tasks or projects that allow students to demonstrate their understanding in ways that match their expertise or interests, creating a more equitable and relevant assessment experience. By embracing flexibility in the use of technology, teachers can address the challenges that arise from diversity in science education. Flexible use of technology is not only a learning tool, but also a medium to build bridges between differences and create a learning environment that promotes inclusion and respect for student diversity.

3. The Importance of Adjusting to Student Uniqueness.

Highlighting the importance of understanding the uniqueness of each student and responding individually. Learning differentiation strategies are not just about providing different materials, but also understanding the needs and strengths of each student (Saksono, 2023). Adjustment to student uniqueness includes the teacher's ability to understand and respond to differences in student learning styles. In designing and delivering learning materials, teachers need to be able to identify individual learning preferences, be it through visual, auditive or kinesthetic approaches. This requires precision in developing teaching strategies that take into account various learning needs. In addition, adjusting to students' uniqueness also includes recognizing students' cultural values and backgrounds. Teachers need to incorporate elements that reflect cultural diversity in learning materials, creating a classroom environment that enriches and honors multiple perspectives. By acknowledging and celebrating this diversity, teachers open the door for students to feel recognized, accepted and motivated to actively participate in the learning process.

The importance of adjusting to students' uniqueness is also reflected in teachers' ability to overcome cross-cultural communication challenges. Teachers need to utilize a variety of tools and strategies to ensure effective communication, including inclusive language use, utilization of automatic translation technology, and creating spaces for students to share their experiences in their own language and culture. Adjustment to student uniqueness also involves teachers' ability to identify and respond to the needs of students with disabilities or special needs. This can involve using accessible teaching materials, providing additional support, and collaborating with special education experts to create an inclusive environment that supports the growth and development of every student. In an innovative framework, adapting to students' uniqueness also includes utilizing technology and digital resources. Teachers can use educational apps that can be customized to students' level of understanding or online learning platforms that support independent and project-based learning. By embracing student customization, teachers not only create an inclusive space for science learning, but also build a foundation for each student's personal and academic development. This approach not only accounts for differences but also taps into the unique potential of each individual, resulting in a learning environment that is empowering, inclusive and encourages a love of science in all students.

4. Commitment to Inclusive Education.

Inclusive science education requires a strong commitment from educators. The discussion emphasized that awareness raising, training and continuous support are needed to ensure equitable and inclusive education. Teachers who are committed to inclusive education recognize that each student brings his or her own uniqueness to the classroom, be it in terms of culture, learning style or special needs. They are committed to creating a space that welcomes all students, where differences are valued as richness that enriches the learning experience. This commitment becomes the foundation for adjusting teaching strategies, learning materials and assessments so that every student can access, understand and master science concepts. In the face of teachers' challenges in communicating with students from different cultural backgrounds, a commitment to inclusive

education encourages teachers to understand and respect students' cultural values. They look for ways to incorporate cultural elements in science learning so that students can feel represented and connected to the learning materials. This commitment also creates space for teachers to learn from students, better understand their cultural context and apply contextualized approaches.

In addition, a commitment to inclusive education encourages teachers to continue learning and developing. They seek innovation and creative solutions to address the challenges of diversity in science education. Teachers who are committed to inclusive education are open to additional training, collaboration with peers and the application of technology that supports inclusiveness. This commitment is also reflected in teachers' efforts to create an inclusive classroom in terms of student engagement and participation. Teachers are committed to motivating each student, creating an atmosphere that allows open questions and discussions, and building positive relationships with each student. They realize that student engagement is not only about delivering learning materials, but also about opening opportunities for students to have a voice and contribute to learning. In the face of accessibility gaps and differences in student learning styles, a commitment to inclusive education encourages teachers to seek innovative solutions. This could include utilizing technology to provide resources that are accessible to all students, creating game-based learning experiences, or designing differentiation strategies that meet the diverse learning needs of students. Thus, a commitment to inclusive education is not only the responsibility of teachers, but also the impetus that drives change and innovation in science education. It is a call to create an environment where every student can thrive and succeed, permeate the values of inclusivity into the core of education, and affirm the hope that science belongs to everyone.

D. CONCLUSION

In response to diversity in the context of science education, this article highlights a number of challenges faced by teachers and explores innovative solutions that can be implemented to create inclusive learning environments. Cross-cultural communication challenges, differences in students' learning styles and learning accessibility gaps are the main concerns in the literature. Innovative solutions, such as the use of technology in teaching and the implementation of learning differentiation strategies, have emerged as effective approaches.

Addressing diversity in science education requires a strong commitment to inclusive education from teachers. This commitment is reflected in adapting to students' uniqueness, where teachers seek to understand and respond to students' cultural differences, learning styles and special needs. Teachers committed to inclusive education engage in flexible teaching strategies, utilize technology wisely, and create a classroom environment that enriches diversity.

The importance of teachers' interpersonal skills in dealing with diversity is highlighted in the discussion, emphasizing that understanding and respecting cultural differences is key to creating an inclusive learning environment. Flexibility in the use of technology and adapting to students' uniqueness was also a point of discussion, recognizing that solutions should not be one-size-fits-all. Inclusive education requires a strong commitment from educators, and constant efforts in raising awareness, training and support.

With this commitment, teachers become not only facilitators of learning, but also agents of change in realizing science education that embraces diversity. Continuous self-improvement, ongoing efforts to overcome challenges and creativity in implementing innovative solutions are key to the success of inclusive education. Thus, teachers who embrace this commitment not only help students to understand science concepts, but also shape a learning culture that values and celebrates the uniqueness of each individual.

In conclusion, this article asserts that a holistic approach involving innovative solutions,

interpersonal skill development and a commitment to inclusive education is needed to address the challenges of diversity in science education. In the face of a future filled with the complexity of student diversity, evaluation and continued research remain crucial steps to ensure the sustainability and improvement of inclusive approaches in the context of science education.

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