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21st Century Skills: The Perspective of Chemistry Teachers in Indonesia

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Abstract
The 21st century provides many changes and challenges for teachers and students. The rapidly developing digital era broadly impacts learning development in Indonesia. The Ministry of Education and Culture of the Republic of Indonesia has promoted the implementation of an merdeka curriculum which provides flexibility for teachers to develop students' 21st century abilities. The new merdeka curriculum was established so that teachers are still adapting to these changes. This article reviews the perspectives of chemistry teachers on 21st-century skills that have developed in Indonesia. The research method used is descriptive qualitative with surveys, questionnaires, and interviews. Respondents were Chemistry teachers, totaling eighty-four teachers and scattered throughout Indonesia. Interviews followed this up with ten teachers deliberately selected from the overall sample. The results showed that 94% of Chemistry teachers understand the importance of 21st-century skills. The study reveals that optimizes 21st-century skills. Several ways can be taken, namely, using constructivist learning methods to improve skills, providing engaging learning media, making motivational learning videos, and providing more time for students to complete problem-based learning or projects. They mentioned several challenges that hindered them from applying 21st-century skills in their teaching practice. The reasons for time constraints and concerns about teaching chemistry concepts were not completed according to schedule; the assessment needed to be more optimal because it was still focused on written tests and limited resources and infrastructure. Despite the many challenges, most teachers are still keen to implement learning that applies 21st-century skills in their classes.

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INTRODUCTION

Chemistry teaching in high schools always keeps up with the times. Education in the 21st century goes hand in hand with digital technology and 21st-century learning skills. 21st century or 4C skills include creative, critical thinking, communication, and collaboration ((Levin-Goldberg, 2012; Sarah et al., 2021). The achievement of 21st-century skills is supported by the teacher's ability to develop lesson plans that contain 4C activities (Ismono et al., 2020). 4C skills can be combined with chemistry learning so that students are expected to be able to solve various problems encountered in their daily environment (Redhana, 2019; Suardana et al., 2018). Therefore, to bring out the 4C skills in students in chemistry lessons, teachers need to be educators who are sensitive and responsive to the needs of students. The teacher creates an attractive, inspiring, creative learning atmosphere (Tambunan, 2019).

The chemistry learning process requires the help of concrete media to give students an excellent conceptual understanding of abstract Chemistry concepts (Chittleborough, 2014; Sary et al., 2018). The 21st Century skills known as 4C – Creativity, Critical Thinking, Collaboration, and Communication (Levin-Goldberg, 2012) are essential in learning chemistry. Critical thinking skills enable students to analyze complex information, evaluate evidence, and develop rational arguments in chemistry. In learning chemistry, students must understand abstract concepts, identify problems, formulate questions, and make decisions based on relevant evidence and data (Khery et al., 2021; Kriswantoro, 2021; Setiawan, 2017). Creativity abilities play an important role in learning chemistry, encouraging students to think outside conventional boundaries (Thompson, 2017). Through creativity, students can generate new ideas, formulate innovative hypotheses, and find creative solutions to complex problems (Pagliaro, 2019). In learning chemistry, students must be allowed to develop their creativity in designing experiments, interpreting data, and creating new concepts or models (Setiawan & Rosli, 2023).

Collaboration skills are fundamental in chemistry learning because many aspects involve teamwork, such as laboratory practicum, research projects, and group discussions (Setiawan & Rosli, 2022). Through collaboration, students can share knowledge, develop social skills, learn from different perspectives, and overcome challenges together (Redhana, 2019). Collaboration also encourages students to appreciate the vital role of communication and cooperation in achieving common goals (Bennett, 2012). Practical communication skills enable students to convey their ideas clearly and persuasively in chemistry (Jeon & Park, 2014; Weng et al., 2022). In learning chemistry, students must be able to compile accurate laboratory reports, communicate research results, and participate in scientific discussions. Good communication also allows students to share knowledge with classmates and teachers, understand the views of others, and receive constructive feedback (Beardsworth, 2020).

To improve 21st-century capabilities, the Ministry of Education and Culture of the Republic of Indonesia changed the K-13 curriculum into an Merdeka curriculum. Merdeka Curriculum is a curriculum concept that gives freedom to high schools in Indonesia to design a curriculum that is more relevant to students and local needs (Irawati et al., 2022). In the Merdeka Curriculum, schools can choose subjects, adjust curriculum content, and develop appropriate learning methods (Armadani et al., 2023). This curriculum aims to engage students in student-centered learning, develop 21st-century skills, and prepare them to face future challenges while emphasizing character development and diverse extracurricular activities (Diah et al., 2022).

Teachers face various challenges in implementing the Merdeka Curriculum, including adjusting the curriculum, developing learning materials and resources, improving teaching skills, various evaluations and assessments, and time and resource management (Hutabarat et al., 2022; Irawati et al., 2022). To overcome this challenge, teachers must increase understanding, skills, and access to supportive resources. Adequate support from schools and the education system is also needed to ensure Merdeka Curriculum's successful implementation and teachers' professional development (Fauzi, 2022). In addition, students face several challenges in implementing Merdeka Curriculum, including adjusting the choice of subjects, time management, and various learning assignments, developing 21st-century skills, adapting to various assessments, and increasing independence and responsibility in learning. (De Vega & Nur, 2022; Kasman & Lubis, 2022). Support from schools, teachers, and families is significant in helping students overcome these challenges and develop the skills needed to face a complex future (Fauzi, 2022).

This scientific article will discuss the perspectives of chemistry teachers in Indonesia in facing the challenges of developing 21st-century skills in their students. Chemistry teachers have a central role in giving birth to a generation competent and ready to face changes in the global

era. This article will analyze the challenges and opportunities chemistry teachers face in integrating 21st-century skills into their teaching methods.

METHOD

The method used is descriptive qualitative. The sample consisted of eighty-four high school chemistry teachers from all regions of Indonesia, with ten months of data collection. Data collection was carried out through questionnaire survey and interviews (Nida et al., 2020, 2021). Following the questionnaire survey, interviews were conducted with teachers who were selected from the sample. After screening the questionnaires, ten teachers were selected based on variations in personal data and their answers to the questionnaire. In the questionnaire, respondents were asked to describe their background, including teaching qualifications, teaching institution, and teaching experience. The 84 teachers work in 60 different schools. Some of the participants taught at public high schools. Others work in the private school sector. Details of gender, type of affiliation, and teaching experience are given in Table 1.

Table 1. Background of the participants (N = 84)

Aspect	Profile	Number of Teachers
Gender	Male	14
	Female	70
School type	Private junior secondary school	59
	Public junior secondary school	25
Teaching experience	Teaching < 5 Year	8
	5 year ≤ teaching < 10 years	29
	10 year ≤ teaching < 15 years	17
	15 year ≤ teaching < 20 years	22
	20 years ≤ teaching	8

The data analysis technique used was qualitative data analysis techniques using the Miles and Huberman model (Miles et al., 2011), namely data reduction, data display, and conclusion drawing (Figure 1).

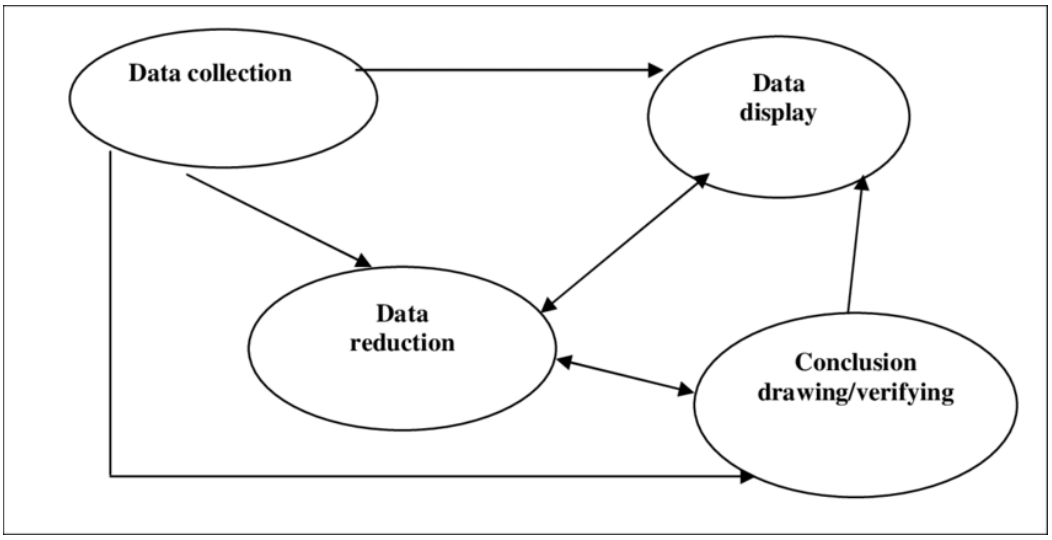

Figure 1. The iterative qualitative Miles and Huberman model (Miles et al., 2011)

RESULTS AND DISCUSSION

Education in the current global era demands developing 21st-century skills, including critical thinking, creativity, collaboration, and communication (Levin-Goldberg, 2012). In the context of chemistry education, it is essential to understand the perspective of chemistry teachers in Indonesia on the importance of 21st-century skills and integrate them into chemistry learning. Data was collected using surveys, questionnaires, and interviews with high school Chemistry teachers. Data collection time took place between September 2022 to June 2023 in Indonesia. A total of 84 Chemistry teachers contributed to this study. Online questionnaires were distributed to respondents, and interviews were conducted in person. Based on Figure 2, it is known that the distribution of respondents came from all over Indonesia. Most respondents came from the province of East Java.

Respondents were dominated by female teachers, as much as 83%, and the rest were male teachers (figure 3). Based on teaching experience, it is dominated by Chemistry teachers who have teaching experience of 5 to 10 years, namely 35% of respondents. Then as much as 25% of respondents have teaching experience for 15 to 20 years. As many as 20% of respondents have experience teaching Chemistry for 10 to 15 years. Chemistry teachers with work experience of less than five years, 10%, and 10% of respondents have experience teaching Chemistry for more than 20 years (Figure 4). From these data, the respondents were dominated by teachers with long teaching experience, so these teachers were very experienced in teaching Chemistry concepts at the high school level.

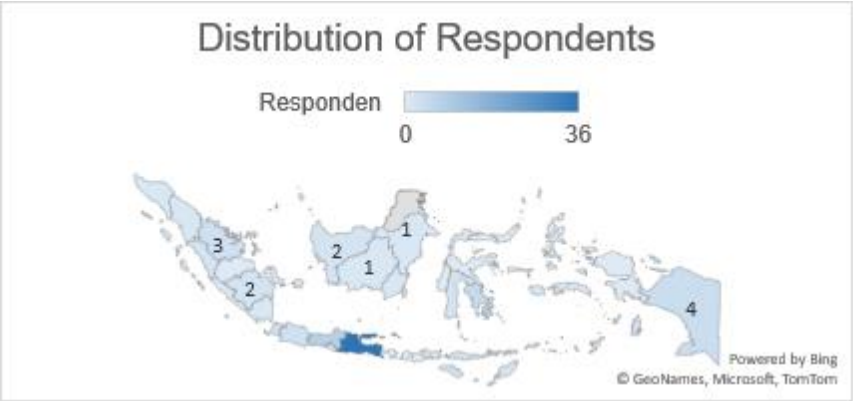

Figure 2. Distribution of Respondents (N = 84)

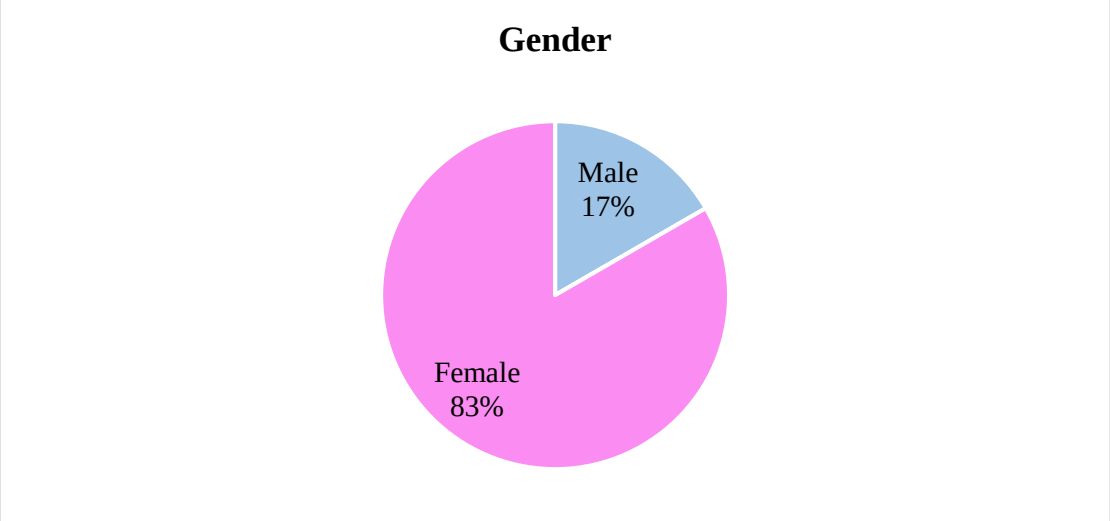

Figure 3. The Diagram of Gender

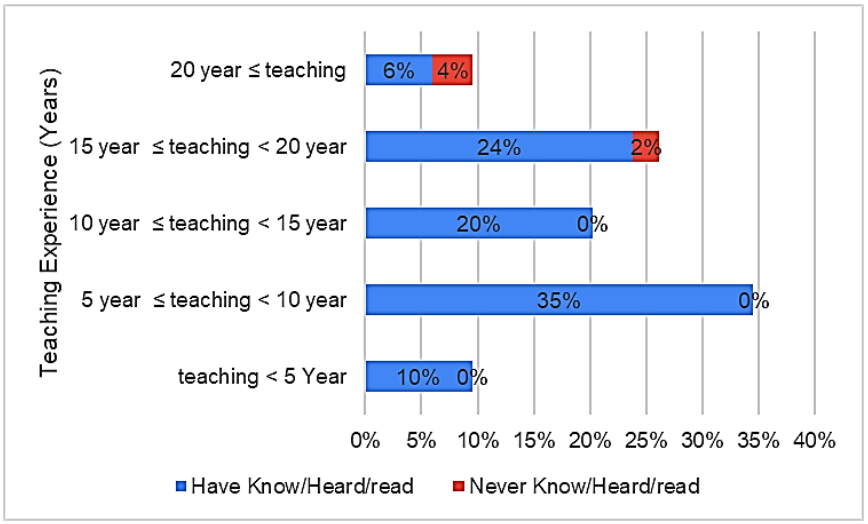

Figure 4. Teachers' general knowledge about 21st century skills

Questionnaires were distributed online to respondents and filled in by individual respondents. Based on the questionnaire data, it is known that 94% of respondents already know about 21st-century capabilities, and only 6% of respondents do not know about 21st-century skills (Figure 4). From the data of respondents who understand 21st-century skills, data is obtained that 100% of respondents know about it from the internet, 44% of respondents know from seminars or workshops, 41% of respondents know from reading journals, 30% of respondents know from reading books, and 25% of respondents know from colleagues' work (Figure 5). This shows that respondents are very enthusiastic about increasing understanding in preparing for learning. It is proven that 100% of respondents know the capabilities of the 21st century from the internet. The role of the teacher in the digital era is crucial to develop learning that is by the times (Pagliaro, 2019). Teachers must be professional in developing learning tools to fulfill learning competencies (Porter et al., 2014; Vos et al., 2017).

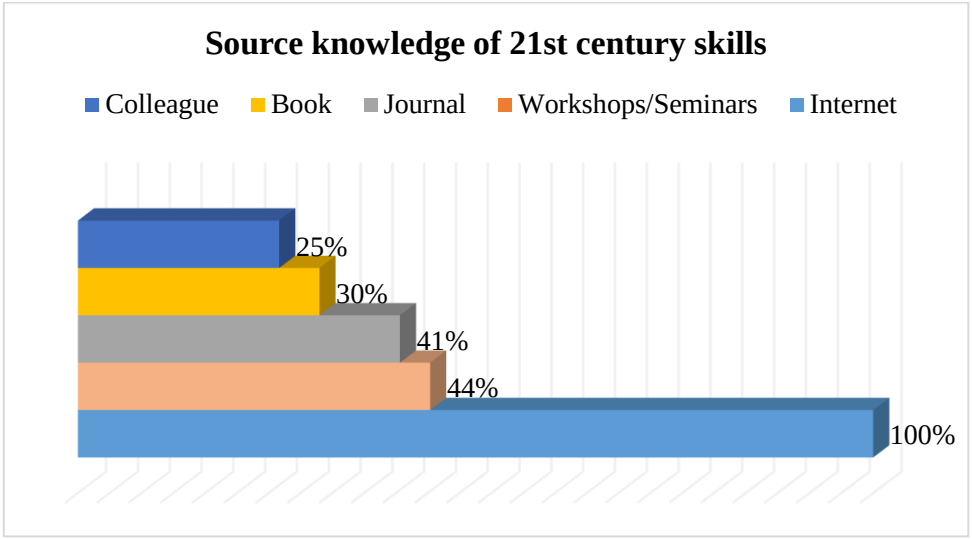

Figure 5. Source Knowledge of 21st Century Skills

Interviews were conducted with ten responders who had applied learning to improve 21st-century skills and represented each group of respondents with previous teaching experience. The interview lasted 15-20 minutes and was conducted in person. Interview data was recorded and recorded using audio recording.

Table 2. Questions Guide

Guide to questions during the interview	• What abilities were measured?
	• Do students experience positive changes in learning outcomes?
	• What are the constraints of implementing the learning?
	• What are the challenges in implementing 21st-century learning?

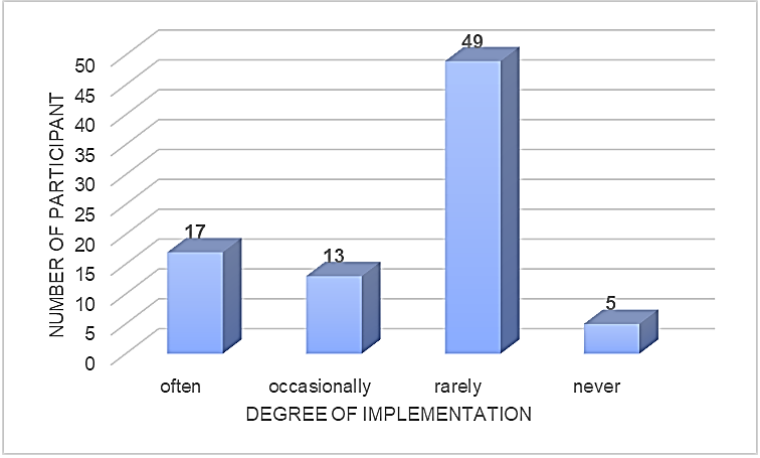

Figure 6. Frequency in implementing 21st century skills

The lack of implementation among teachers who rarely/never implement 21st-century skills-based learning in their classrooms may be due to their teaching focus. For these teachers, Chemistry learning content is the fundamental goal, as expressed in the following interview excerpt: "*I focus more on completing Chemistry material by the learning objectives. Like the concept of reaction rate, students are given student worksheets, then worked on and given written exams*".

Based on the results of the interviews, it is known that all respondents have measured their communication and collaboration skills (figure 7). As many as 40% of respondents have measured critical and creative thinking skills. Respondents argue that measuring critical and creative thinking requires an assessment instrument that is more difficult than collaboration and communication skills. Assessment instruments for critical and creative thinking skills require a thorough assessment of the learning model used, so respondents need help applying it in class. In addition, respondents tend to find it easier to find sources of collaboration and communication skills assessment instruments online because there have been many examples from existing studies, even though they are not in the same chemical scientific family.

All respondents gave positive experiences to students taught by developing 21st-century skills (Figure 8). Student learning outcomes and 21st-century skills (critical thinking skills, creativity, collaboration, and communication) have increased. Students' self-confidence also increases, with an increased desire to learn Chemistry. 21st-century skills provide positive learning experiences for students (Andrini, 2016; Apriwanda & Hanri, 2022; Fitriani et al., 2020; Zubaidah, 2016). These skills will provide strong provisions for students in changing times (Rahayu, 2017).

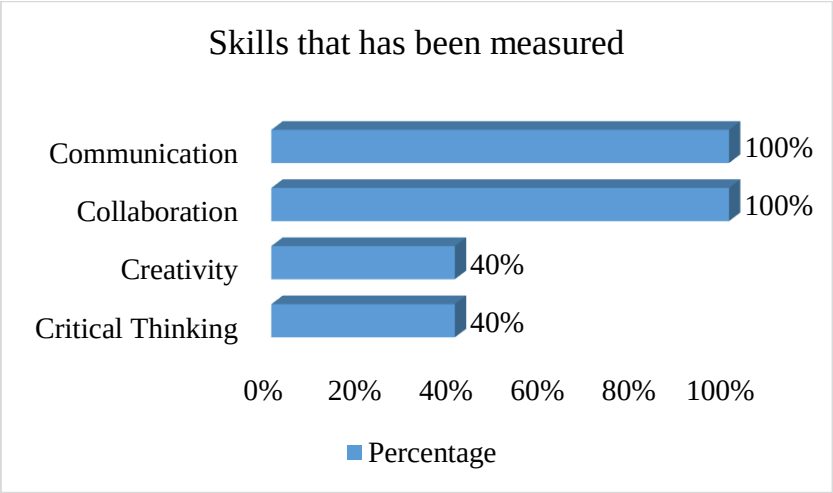

Figure 7. Skills that has been measured

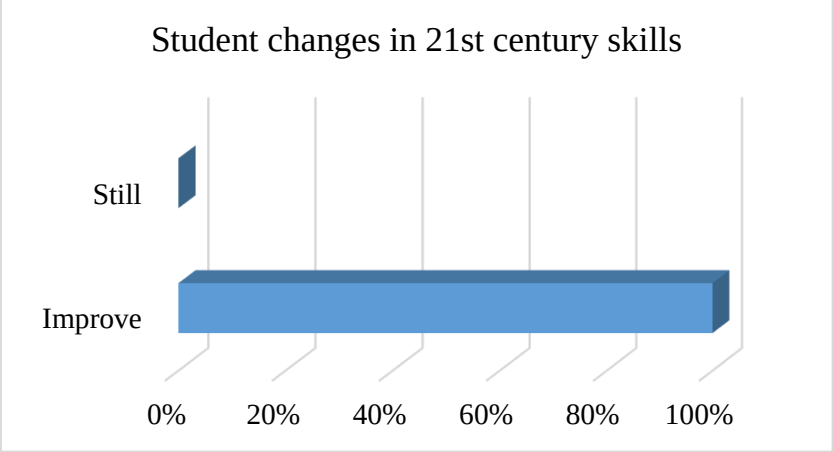

Figure 8. Student changes in 21st century skills

Based on the results of the interviews obtained, various obstacles. After grouping it, it is known that the main obstacles for teachers in implementing learning to improve 21st-century skills, these obstacles include:

- Time constraints and worry about chemical materials not being finished according to the schedule.
- Assessment that is not optimal because it is still focused on written tests.
- Limited Resources and Infrastructure.

Based on the opinion of the respondents, 21st-century skills can be optimized by overcoming these obstacles in several ways, which include:

- Prepare learning by using constructivist learning methods or models so that they can improve 21st-century skills.
- Prepare engaging learning media so that students are interested in learning.
- Create interesting learning videos to motivate learning.
- Provide more time for students to complete problem-based learning or projects.

Teachers are very passionate about developing 21st-century skills. Partly abstract chemistry concepts challenge teachers to provide concrete explanations so that students can understand these concepts (Muntholib et al., 2021; Setiawan et al., 2020; Setiawan & Rosli, 2023). Digital learning media makes it easy for students to understand abstract concepts (Curtis J. Bonk & Graham, 2013; Setiawan et al., 2021; Setiawan & Rosli, 2022).

This study provides an overview of the perspectives of chemistry teachers in Indonesia regarding 21st-century skills in teaching chemistry. The findings of this study indicate that chemistry teachers are aware of the importance of developing 21st-century skills in chemistry education. However, challenges in integrating these skills remain. Therefore, comprehensive support from various parties is needed to help chemistry teachers overcome these challenges and apply learning approaches relevant to students' needs and current developments.

CONCLUSION

Chemistry teachers in Indonesia know the importance of integrating 21st-century skills in chemistry learning. They acknowledge that chemistry education can no longer be limited to understanding basic concepts but must also focus on critical thinking, creativity, collaboration, and communication skills. The data shows that 94% of Chemistry teachers understand the importance of 21st-century skills. 21st-century skills play an essential role in the development of students in adapting to the times.

RECOMMENDATIONS

Based on the research findings, governments, educational institutions, and the chemistry education community must adequately support chemistry teachers. This could include training and professional development to enhance teachers' understanding and integrate 21st-century skills in chemistry learning.

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