QUANTUM: Jurnal Inovasi Pendidikan Sains, Vol. 16, No. 1, 44-51
p-ISSN : 2086-7328 e-ISSN : 2550-0716
Website: https://ppjp.ulm.ac.id/journal/index.php/quantum/index
DOI: http://dx.doi.org/10.20527/quantum.v16i1

VALIDITY OF WETLAND-BASED CHEMISTRY MEDIA WITH VIRTUAL WORKSPACE-SCCRT MODEL TO IMPROVE 6C'SKILLS IN SOCIETY 5.0

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Abstract. This study aims to develop and evaluate the validity of wetland-based chemistry learning media with the SCCrT model supported by Virtual Workspace to improve 6C skills in the Society 5.0 era. The method used is Research and Development (R&D) with the ADDIE (Analyze, Design, Develop, Implement, Evaluate) model, including validation by material and media experts. The results of validation by five experts showed that the learning media had very high validity (average score of 90%), especially in the aspects of curriculum suitability (92%) and relevance to environmental issues (91%). This media successfully integrates the concept of chemistry with sustainability issues and supports the development of 21st-century skills, such as critical thinking, collaboration, and civic thinking. These results show that the learning media developed is effective and relevant to improving the quality of chemistry learning and students' environmental awareness.

Keywords: learning media, wetlands, Society 5.0, 6C skills, validity

INTRODUCTION

The rapid development of technology in the Society 5.0 era has created an urgent need for improved competencies and skills relevant to the times' demands. Society 5.0, which marks the era of synergistic collaboration between humans and technology, aims to create a better, more comfortable, and sustainable life by strengthening the social, economic, and environmental dimensions. (Agung, 2024; Sisinyize, 2024). In this context, education is the main driver in preparing prospective teacher students to face various challenges in the digital era (Utami et al., 2024). Education in the Society 5.0 era not only needs to adapt to the rapid advancement of technology but must also be able to develop the 6C skills (Critical Thinking, Creativity, Collaboration, Communication, Compassion, and Computational Thinking), which are an important foundation in the formation of intelligent, creative, resilient, and adaptive human resources to rapid changes (Lasmana et al., 2024; Shahidi Hamedani et al., 2024).

Published by: Program Studi Pendidikan Kimia FKIP Universitas Lambung Mangkurat
How to Cite: Rusmansyah, Syahmani, Prasetyo, Y. D., Aufa, M. N., Purnama, A., Maulida, Sinaga, K., & Istyadji, M. (2025). Validity of Wetland-Based Chemistry Media with Virtual Workspace-SCCRT Model to Improve 6c'skills In Society 5.0. *QUANTUM: Jurnal Inovasi Pendidikan Sains*, 16(1), 44–51. https://dx.doi.org/10.20527/quantum.v16i1.21117

Article History:
Received : 10-12-2024, *Accepted* : 20-03-2025, *Published* : 08-05-2025

On the other hand, the learning approach based on local wisdom is a significant alternative in enriching the learning context and deepening the meaning for students (De Villiers, 2024). One relevant example is the rich wetland ecosystem in South Kalimantan, which has ecological value and provides an opportunity to integrate environmental issues into chemistry learning. This wetland-based learning allows students to understand various chemical concepts such as nutrient cycling, decomposition of organic matter, environmental management, and interactions between chemical elements and ecosystems (Almubarak & Saadi, 2022; Rodríguez-Pérez & Blázquez, 2023; Salam et al., 2022). This approach facilitates the understanding of scientific concepts and fosters students' awareness and responsibility towards the importance of preserving wetland ecosystems as part of environmental sustainability (Nayak & Bhushan, 2022). Thus, learning becomes more contextual, based on local conditions, and prepares students to become agents of change in environmental conservation (Louka et al., 2024; Tan et al., 2023).

The school chemistry course in the Chemistry Education Study Program of FKIP ULM weighs three credits, consisting of 2 theoretical credits and one practical credit. It focuses on chemistry material at the high school level. In this course, students learn the basic concepts of chemistry and are exposed to more complex materials, such as solving advanced chemistry problems and chemical experiments that hone practical skills. The integration of wetland context in this course aims to enable prospective teacher students to apply chemical knowledge in understanding and analyzing their local environmental problems and internalize the important values of environmental conservation to be applied in daily life. Through this approach, it is hoped that students can connect chemical theory with real societal problems, making learning more relevant and meaningful (States et al., 2023).

In addition, in the digital era, such as Society 5.0, learning cannot be separated from the use of technology (Wu et al., 2023). A virtual workspace is an innovative solution that supports more effective and interactive chemistry learning. This technology allows students to conduct chemistry experiments virtually, collaborate with fellow students or lecturers, and explore learning materials in a more interesting and challenging way. The virtual workspace also offers a platform for students to develop 6C skills, especially in critical thinking, creative thinking, collaboration, communication, character, and civic thinking skills that are very relevant in the digital era. Through this technology, students can learn more flexibly and dynamically without being limited by time and space (Firmansyah et al., 2022; Umardani et al., 2024).

The SCCrT (Scientific Critical Thinking) model has a role as a pedagogical framework that integrates scientific understanding with context-based application, deep reflection, and thought transformation that allows students to understand chemical concepts well. Increasing the effectiveness of using the SCCrt model can be helped by the existence of a virtual workspace that can support the implementation of SCCrT (Rusmansyah et al., 2020). Virtual Workspace allows students to access various learning resources, simulate experiments, and document and reflect on their learning outcomes in a structured and interactive environment. With this technology, students can contextualize chemistry concepts in various real situations, reflect on experimental data, and transform their understanding into innovative solutions to environmental problems related to wetlands (Zhang et al., 2024).

Thus, developing Wetland-Based School Chemistry Learning with the Virtual Workspace-Assisted SCCrT Model is important to creating a holistic and futuristic learning design. This learning design is expected to improve the 6C skills of prospective teacher students as skills and equip them with a deep understanding of environmental issues around them. Thus, they will be better prepared to face the

challenges of the world of education in the era of Society 5.0 and can become agents of change who play an active role in sustainable education development.

RESEARCH METHODS

This research approach uses the Research and Development (R&D) method with the ADDIE model approach, including the stages of Analyze, Design, Develop, Implementation, and Evaluation, and the implementation stage with a quasi-experimental design. The learning media used is a virtual workspace that is integrated with the SCCrT model. The research sample involved students from the Chemistry Education Study Program who took the School Chemistry course and Elementary School Teacher Education students who enrolled in the Science 3 (Chemistry) FKIP course at Lambung Mangkurat University and saw the validity of the learning media made by the researchers. Before testing, the media is validated by material experts and the media. The criteria for expert validation use criteria according to Akbar (2013).

Table 1. Validity criteria

Validity Percentage	Validation Information	Information
85,01 – 100,00	Highly valid	Small-Scale Revisions
70,01 – 85,00	Valid	Small-Scale Revisions
50,01 – 70,00	Less valid	Small-Scale Revisions
≤ 50.00	Invalid	Unusable

(Akbar, 2013)

RESEARCH RESULTS AND DISCUSSION

The purpose of this research is to develop virtual learning media in the form of e-learning assisted by a workspace which is designed to facilitate learning that allows learning to be done online. This virtual media is equipped with a virtual classroom and also equipped with a virtual lab.

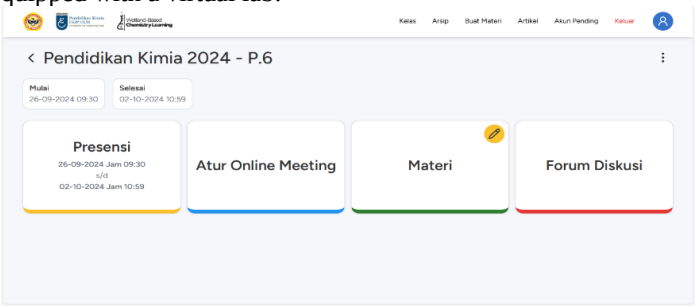

Figure 1. View of web learning media

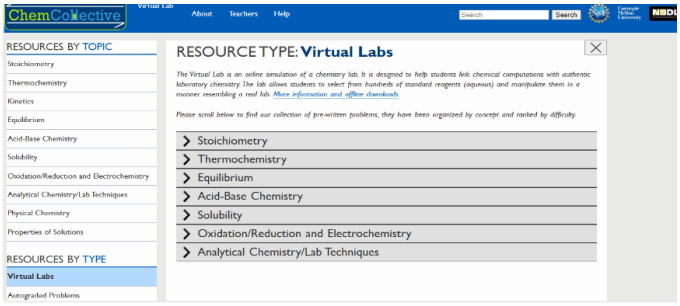

Figure 2. View of lab virtual

In this article, it is analyzed up to the validity stage. After the media has been designed, the testing stage is carried out by experts. The results of the validation of various aspects of the development of wetland-based chemistry learning media using the SCCrT model assisted by Virtual Workspace show that the developed instruments have high validity. Five experts carried out this validation process. The validity results reflect a high level of compatibility between the instrument and the desired learning objectives. This validation is an integral part of the development stage in the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model, which is very important to ensure that the learning instruments developed are effective and in accordance with educational needs (Zulkepli et al., 2024).

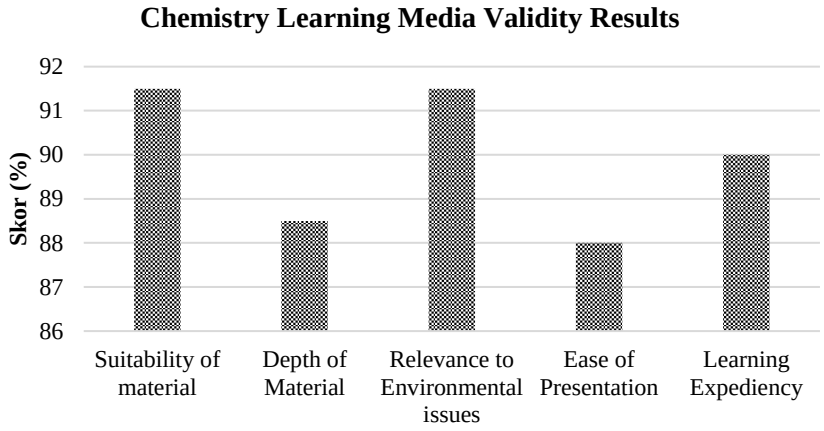

Figure 1. Results of validity of chemistry learning media

The results of the validity of the learning media are visualized in the bar diagram above. The highest score was obtained in the aspect of conformity with the curriculum (92%), indicating that this media is very in line with the chemistry learning standards. The relevance aspect of environmental issues (91%) also reflects that this media has successfully integrated chemistry learning with relevant global issues. Ease of presentation (88%) has the lowest score, indicating areas that could still be improved, such as simplifying virtual workspace navigation or improving the user interface. This visualization confirms that the learning media as a whole has met the criteria of high validity in various aspects, supporting its relevance to improve the quality of chemistry learning in the modern era. The diagram also provides a clearer picture of the distribution of validity scores in each aspect of assessment, emphasizing the strengths and opportunities for improvement of the developed media.

In terms of conformity with the curriculum, a validity score of 92% reflects that the learning media has been designed with the applicable chemistry learning standards in mind. The material presented not only covers core concepts such as the carbon cycle and redox reactions but also relates them to the real context, namely wetland ecosystems. This approach ensures that chemistry learning is not only theoretical but also applicable. The depth aspect of the material, with a score of 89%, shows that the material presented is able to explore chemical concepts in depth. The integration of wetland themes provides a rich perspective, where students not only understand chemical theory but also its application in solving real environmental problems (Martinez-Guerra et al., 2020). For instance, a discussion of the role of wetlands in climate change mitigation and carbon sinks shows how chemistry plays a role in ecosystem sustainability (Malerba et al., 2022). In terms of relevance to environmental issues, the score of 91% shows that this learning medium has

succeeded in connecting the concept of chemistry with global issues, such as sustainability and climate change mitigation. Wetlands, as an important ecosystem that is often overlooked, are a relevant context to build students' awareness of the importance of chemistry in maintaining environmental sustainability(Liu & Zhang, 2024; Ramachandra et al., 2024). This approach is in line with research that states that the integration of environmental issues in science education increases students' awareness of global challenges (Lee, 2023).

The ease of presentation, with a score of 88%, reflects that this media is designed interactively to facilitate student learning. Virtual workspaces allow the presentation of interesting materials through simulation and visualization so that students can understand chemical concepts more easily. This approach supports technology-based learning, an important element in the era of Society 5.0. Regarding learning benefits, a score of 90% shows that this learning media positively impacts the development of 21st-century skills (6c's). The SCCrT model encourages students to think critically when analyzing problems, collaborating in teams, and creating innovative solutions. The virtual workspace supports project-based learning, where students can visualize data, run simulations, and evaluate the results of chemical analysis in the context of sustainability (Bourguet & Omfalos, 2024; Firmansyah et al., 2022).

This learning media is designed to prepare students to face challenges in the era of society 5.0. Integrating technology in learning allows students to develop thinking skills through digital-based simulations and analysis. In addition, students are also trained to collaborate and communicate in teams, which are essential skills in the modern world of work. This approach aligns with research (Vidyarthi, 2024), which shows that collaboration-based learning effectively builds higher-order thinking skills (Basari, 2023; Norhasyimah Hamzah et al., 2024). In addition, integrating wetland themes in chemistry learning significantly contributes to sustainability-based education. This media increases students' understanding of chemical concepts and builds their awareness of the importance of maintaining ecosystems and social responsibility. With a problem-based approach, students are invited to think critically, creatively, and absolutely in overcoming environmental challenges, as recommended by (Abidin & Sulaiman, 2024).

The results of wetland-based chemistry learning media validity with the SCCrT model supported by the virtual workspace showed an average score of 90%, which was categorized as very valid. This media has been proven to meet high-quality criteria in terms of suitability with the curriculum, depth of material, relevance to environmental issues, ease of presentation, and usefulness of learning. This score shows that the learning media is well designed to support modern chemistry learning relevant to global challenges, especially in the Society 5.0 era. This is in line with research (Ichinose, 2024). It also supports the importance of integrating environmental issues in science education, which has been proven to increase students' awareness of global issues and encourage them to contribute to sustainability solutions. By raising the theme of wetlands, this media provides an applicable, relevant, and meaningful learning context, directly increasing students' learning motivation.

CONCLUSION

The validation results in this study confirmed that the media developed for wetland-based chemistry learning design using the SCCrT model, namely Virtual Workspace, showed an average score of 90%, which was included in the very valid category. This media is proven to meet the criteria of conformity with the curriculum, depth of material, relevance to environmental issues, ease of presentation, and

usefulness of learning. Most of the indicators in this media obtained a high Aiken score, which shows that the learning media is well designed to support the improvement of 6C skills that support modern chemistry learning and are relevant to global challenges, especially in the era of Society 5.0. However, some things need further improvement, such as ease of access and the addition of features that can support the virtual web media.

REFERENCES

Abidin, Z., & Sulaiman, F. (2024). The Effectiveness of Problem Based Learning on Students' Ability to Think Critically. *Zabags International Journal of Education*, *2*(1), 1–6. https://doi.org/10.61233/zijed.v2i1.13

Agung, F. C. W. (2024). Pemantapan Literasi Digital oleh Pendidik dan Peserta Didik dalam Menghadapi Era Society 5.0. *Revorma: Jurnal Pendidikan Dan Pemikiran*, *4*(1), 23–31. https://doi.org/10.62825/revorma.v4i1.103

Akbar, S. (2013). *Instrumen Perangkat Pembelajaran*. Rosdakarya.

Almubarak, A., & Saadi, P. (2022). Validity, Practicality, Effectiveness: Wetland Contexted-Chemical Representation Module as a Media for Learning. *Journal of Mathematics Science and Computer Education*, *2*(1), 56. https://doi.org/10.20527/jmscedu.v2i1.5067

Basari, J. (2023). Using Collaborative Learning Techniques Strategies To Improve Student's Collaborative Skills In Secondary School. *International Journal of Education, Psychology and Counseling*, *8*(50), 412–429. https://doi.org/10.35631/IJEPC.850030

Bourguet, M.-L., & Omfalos, E. (2024). Work-in-Progress—Student's Co-creation of Collaborative Learning Spaces on the Metaverse. *Academic Proceedings of the 10th International Conference of the Immersive Learning Research Network (iLRN2024)*, 217–223. https://doi.org/10.56198/U6C0W5UQT

De Villiers, C. (2024). The Impact of Society 5.0 on Curriculum Development in Higher Education. *Journal of Ethics in Higher Education*, *4*, 1–25. https://doi.org/10.26034/fr.jehe.2024.5953

Firmansyah, J., Suhandi, A., Setiawan, A., & Permanasari, A. (2022). Evaluation of Virtual Workspace Laboratory: Cloud Communication and Collaborative Work on Project-Based Laboratory. *Journal on Efficiency and Responsibility in Education and Science*, *15*(3), 131–141. https://doi.org/10.7160/eriesj.2022.150301

Ichinose, T. (2024). The Possibility of Problem-Based Learning Targeted Toward SDGs to Undertake Transformative Actions for Sustainability. In J. C.-K. Lee & K. J. Kennedy, *The Routledge International Handbook of Life and Values Education in Asia* (1st ed., pp. 460–475). Routledge. https://doi.org/10.4324/9781003352471-59

Lasmana, O., Festiyet, F., Razak, A., & Fadilah, M. (2024). Transforming Education in the 5.0 Era: Utilizing Technology to Improve Critical Thinking and Creativity in The Digital Generation. *Proceedings of the 1st International Conference on Social Science (ICSS)*, *3*(2), 285–294. https://doi.org/10.59188/icss.v3i2.208

Lee, A. (2023). The importance of cultivating awareness of environmental matters in science classrooms: A cross-regional study. *Australian Journal of Environmental Education*, *39*(4), 467–491. https://doi.org/10.1017/aee.2023.7

Liu, J., & Zhang, M. T. (2024). Beyond Limit: A Service Design Intervention to Enhance Sustainable Awareness in Sanyang Wetland Community. In F.

Ying, L. C. Jain, R. Wan, Q. Wu, & F. Shi (Eds.), *Frontiers in Artificial Intelligence and Applications*. IOS Press. https://doi.org/10.3233/FAIA240059

Louka, E., Androutsou, D., Anastasiou, A., & Sudirman, A. (2024). Fostering Ecoliteracy to Enhance Environmental Awareness among Children and Adolescents. In *Educational Administration and Leadership: Perceptions of Educational Leaders in Relation to their Leadership Style* (1st ed., pp. 14–25). Innovare Academic Sciences Pvt Ltd. https://doi.org/10.22159/ED.c2

Malerba, M. E., Friess, D. A., Peacock, M., Grinham, A., Taillardat, P., Rosentreter, J. A., Webb, J., Iram, N., Al-Haj, A. N., & Macreadie, P. I. (2022). Methane and nitrous oxide emissions complicate the climate benefits of teal and blue carbon wetlands. *One Earth*, *5*(12), 1336–1341. https://doi.org/10.1016/j.oneear.2022.11.003

Martinez-Guerra, E., Ghimire, U., Nandimandalam, H., Norris, A., & Gude, V. G. (2020). Wetlands for environmental protection. *Water Environment Research*, *92*(10), 1677–1694. https://doi.org/10.1002/wer.1422

Nayak, A., & Bhushan, B. (2022). Wetland Ecosystems and Their Relevance to the Environment: Importance of Wetlands. In A. K. Rathoure (Ed.), *Practice, Progress, and Proficiency in Sustainability* (pp. 1–16). IGI Global. https://doi.org/10.4018/978-1-7998-9498-8.ch001

Norhasyimah Hamzah, Normah Zakaria, Arihasnida Ariffin, & Siti Nur Kamariah Rubani. (2024). The Effectiveness of Collaborative Learning in Improving Higher Level Thinking Skills and Reflective Skills. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, *42*(1), 191–198. https://doi.org/10.37934/araset.42.1.191198

Ramachandra, T. V., Asulabha, K. S., & Jaishanker, R. (2024). Editorial Wetlands for human well-being. *Journal of Environmental Biology*, *45*(2), i–iv. https://doi.org/10.22438/jeb/45/2/Editorial

Rodríguez-Pérez, A. E., & Blázquez, A. M. (2023). *WETLANDS AS A TEACHING MATERIAL FOR SECONDARY SCHOOL STUDENTS*. 3649–3654. https://doi.org/10.21125/inted.2023.0982

Rusmansyah, Yuanita, L., Ibrahim, M., Isnawati, Rizkiana, F., & Kusuma, A. E. (2020). Effect of scientific critical thinking model to train critical thinking skills and student self efficacy. *Journal of Physics: Conference Series*, *1422*(1), 012015. https://doi.org/10.1088/1742-6596/1422/1/012015

Salam, A., Miriam, S., Lazuardi, M. A., Norhalimah, N., & Andiantosa, S. W. (2022). Multimodel-Based Learning Strategy And Wetland Environment-Based Learning Approach: Alternative Solution to train Higher Order Thinking Skills. *Berkala Ilmiah Pendidikan Fisika*, *10*(2), 171. https://doi.org/10.20527/bipf.v10i2.12373

Shahidi Hamedani, S., Aslam, S., Mundher Oraibi, B. A., Wah, Y. B., & Shahidi Hamedani, S. (2024). Transitioning towards Tomorrow's Workforce: Education 5.0 in the Landscape of Society 5.0: A Systematic Literature Review. *Education Sciences*, *14*(10), 1041. https://doi.org/10.3390/educsci14101041

Sisinyize, N. L. (2024). Sustainable Development for Society 5.0: In S. O. Atiku, A. Jeremiah, E. Semente, & F. Boateng (Eds.), *Practice, Progress, and Proficiency in Sustainability* (pp. 133–148). IGI Global. https://doi.org/10.4018/979-8-3693-7322-4.ch007

States, N., Stone, E., & Cole, R. (2023). Creating Meaningful Learning Opportunities through Incorporating Local Research into Chemistry Classroom Activities. *Education Sciences*, *13*(2), 192. https://doi.org/10.3390/educsci13020192

Tan, S. K., M Shah, M. F., Sufian, S., & Chai, P. V. (2023). Constructed Wetland as an Alternative to Conventional Industrial Wastewater Treatment to Promote Carbon Sequestration for Sustainable Future. *Day 2 Thu, March 02, 2023*, D021S025R004. https://doi.org/10.2523/IPTC-22913-EA

Umardani, R., Saehu, A., & Zuhairi, A. (2024). Developing Students' Descriptive Reading Skills And Critical Thinking Through The Scaffolding Strategy Using Google Workspace For Education (GWE). *Jurnal Visi Ilmu Pendidikan*, *16*(2), 328. https://doi.org/10.26418/jvip.v16i2.78267

Utami, L. W. C., Meilanie, R. S. M., & Hapidin. (2024). Transforming Educational Practices With Digital Technologies Use The Role Of E-Book In The Era Of Educational Disruption. *Proceedings of International Conference on Education*, *2*(1), 584–588. https://doi.org/10.32672/pice.v2i1.1422

Vidyarthi, D. (2024). Collaborative Teaching a Pre-requisite of Effective Learning. *International Journal For Multidisciplinary Research*, *6*(1), 11916. https://doi.org/10.36948/ijfmr.2024.v06i01.11916

Wu, W.-C. V., Manabe, K., Marek, M. W., & Shu, Y. (2023). Enhancing 21st-century competencies via virtual reality digital content creation. *Journal of Research on Technology in Education*, *55*(3), 388–410. https://doi.org/10.1080/15391523.2021.1962455

Zhang, Y., Yang, Y., Chu, Y., Sun, D., Xu, J., & Zheng, Y. (2024). Virtual Laboratories In Science Education: Unveiling Trajectories, Themes, And Emerging Paradigms (2013-2023). *Journal of Baltic Science Education*, *23*(5), 990–1009. https://doi.org/10.33225/jbse/24.23.990

Zulkepli, N., Safina Mohd Ariff Albakri, I., Zarina, Megat Khalid, P., & Faisal Farish Ishak, M. (2024). Using the ADDIE Model to Develop an Online Professional Development Program for Non-Specialist ESL Teachers. *Arab World English Journal*, *10*, 302–313. https://doi.org/10.24093/awej/call10.19

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