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The Understanding by Design Strategy in 21st-Century Education

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ABSTRACT

The 21st-century learning One, solution that can be used is by using the Understanding by Design (UbD) curriculum. The aim of this research is to examine the application of UbD in teaching, the implementation of UbD in Indonesia, expected student learning outcomes within the UbD framework, and the role of teachers in the implementation of UbD. The method used is the literature study method. The data analysis technique uses deductive qualitative analysis. The results obtained are that UbD learning can be used as a reference in preparing learning implementation plans that are oriented towards learning goals. Learning using UbD has not been fully implemented by all teachers in Indonesia, because there are still many teachers who prioritize the results of final grades rather than students' understanding. The implementation of UbD has actually been planned in the latest curriculum, namely the independent curriculum, but this curriculum has not been fully implemented by all schools. In implementing UbD, students are expected to have 6 abilities, namely explaining, interpreting, applying, taking a perspective, empathizing and having self-knowledge. The role of teachers is very essential in UbD, which involves designing, implementing, and directing learning activities.

Pentingnya Penerapan Strategi Understanding by Design dalam Pembelajaran Abad 21

ABSTRAK. *Pembelajaran abad 21, salah satu solusi yang dapat digunakan yaitu dengan menggunakan kurikulum Understanding by design (UbD). Tujuan penelitian ini yaitu untuk mengkaji penerapan UbD dalam pembelajaran, implementasi UbD di Indonesia, hasil pembelajaran peserta didik yang diharapkan dalam kerangka UbD dan peran guru dalam implementasi UbD. Metode yang digunakan yaitu dengan metode studi kepustakaan. Teknik analisis data menggunakan analisa kualitatif deduktif. Hasil yang didapatkan yaitu strategi UbD dapat dijadikan sebagai acuan dalam menyusun perencanaan pelaksanaan pembelajaran yang berorientasi kepada tujuan pembelajaran. Pembelajaran menggunakan UbD belum sepenuhnya diterapkan oleh semua guru di Indonesia, karena masih banyak guru yang mementingkan hasil nilai akhir dibandingkan pemahaman peserta didik. Penerapan strategi UbD sebenarnya sudah dicanangkan di kurikulum terbaru yaitu kurikulum merdeka, tetapi kurikulum ini belum sepenuhnya diterapkan oleh semua sekolah. Pada penerapan strategi UbD, peserta didik diharapkan memiliki 6 kemampuan yakni menjelaskan, interpretasi, menerapkan, melakukan perspektif, berempati dan memiliki pengetahuan diri. Peran guru sangat esensial dalam UbD, yaitu merancang, melaksanakan dan mengarahkan kegiatan pembelajaran.*

INTRODUCTION

The fast advancement of information and communication technology in all sectors of life has characterized the start of the 21st-Century (Kai et al., 2021). Information and communication technology advancements have offered several benefits in all aspects of life. Technology can eliminate the "time and space" barrier, allowing people to engage from all over the world (González-pérez & Ramírez-montoya, 2022). This phenomenon affects the growth of new skills that everyone must learn. As a result, the abilities required in the 21st Century must be ingrained in learners and achieved by learners after learning (Saleh, 2019). Students must learn more and be more proactive to be prepared to face the global difficulties that will occur (Supriyati et al., 2018);(Muthmainnah et al., 2023).

Based on this description, the Indonesian government tries to increase education quality at all levels in a sustainable manner by reacting to changing times and technology. One of the initiatives implemented is the partnership for the 21st-century innovative learning framework (Rizaldi et al., 2020). According to the Minister of National Education Regulation No. 16 of 2007, the development of information technology media is one of the fundamental foundations in constructing the 21st-century curriculum (Istiana et al., 2020). It has implications for everyone participating in the education process in Indonesian schools who want to learn ICT or literacy skills (Afandi et al., 2019). Teachers, students, and even students' parents must be technologically literate to confront the problems of 21st-century educational development (Pratama et al., 2020);(Angelica & Novitasari, 2020). The problem in the 21st Century is determining how to develop high-quality resources to establish social and economic order through curriculum creation that meets the demands of 21st-century skills (Haka et al., 2020).

The challenges are also related to rapidly evolving technology, the need for learning that is integrated into daily life so that the material taught is more easily understood, and the acquisition of new skills such as creativity, critical thinking, cooperation, problem-solving, communication skills, community and character skills (Zubaidah, 2020).

Teachers have a critical role in addressing the issues of the 21st Century. A teacher must be capable of designing, implementing, and evaluating learning following the desired learning objectives (Mayasari et al., 2016). Teachers can apply the Understanding by Design (UbD) technique while developing learning. Pertiwi et al. (2019) state that designing using UbD can enhance the implementation of differentiated learning and increase students' enthusiasm for learning. Resa (2023) claims that using the UbD strategy can assist teachers in ensuring a link between goals, evaluation, and learning phases so that learning can be more focused and objectives can be attained.

UbD learning stresses student participation as a participant, and the teacher, as the center of learning, must grasp the design strategy to be employed (Setiyawati et al., 2023). As a result, the UbD strategy can be one of the recommendations for creating a goal-oriented learning design. The UbD strategy can assist learners in better understanding the material and improving their skills (Dack & Merlin-Knoblich, 2019). Vatahanavong (2019) believes that the UbD strategy also focuses on learning that is interwoven with technology, media, and learners' daily lives, making learning more relevant (2021) also stated that employing the UbD strategy in learning makes learning more concentrated and structured, which can improve students' knowledge and learning achievement.

Backward design is used in the UbD strategy. Backward design is critical in 21st-century learning because it assists teachers in developing focused and successful lesson plans (Kuntari et al., 2019). UbD is a strategy that emphasizes planning before engaging in

learning activities, outlining the goals to be reached and the skills to be developed in learners before deciding on the content and learning methods to be used (Gloria et al., 2019). Implementing UbD allows teachers to guarantee that learning objectives are met efficiently and that students grasp the material (Taiyabi, 2021). This technique also assists learners in developing digital-era abilities such as critical thinking, communication, and cooperation (Gloria et al., 2020).

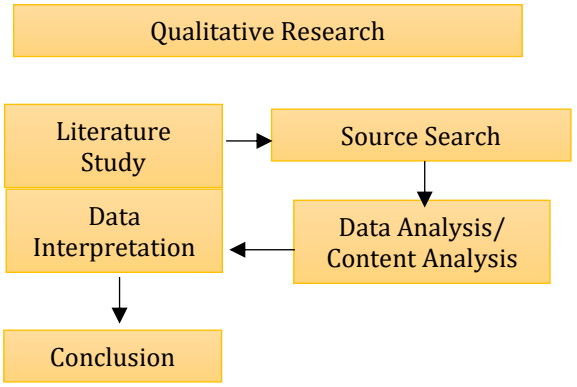
The primary distinction between UbD and other learning designs is the sequence of evaluation design, learning, and steps. Typically, teachers construct learning from learning objectives to phases to learning evaluation. However, in UbD, the design process begins with learning objectives, learning evaluation, and learning step planning. According to research, the problem is still using traditional learning, which only focuses on the transfer of information and does not train students' critical and creative thinking (Siregar et al., 2022);(Sumandya et al., 2023).

This study describes how applying the UbD strategy in learning biology leads to the predicted student learning results within the UbD framework, as well as the involvement of teachers in the strategy's implementation.

METHOD

The method employed in this study was the literature review or literature study. A literature review contains theories relevant to the challenges researchers address in their research. The purpose of the literature review is to establish theoretical aspects as well as practical benefits (Padilla et al., 2020).

Bibliographic research comprises a list of information in books written by authors and experts in various subjects, competence, or specific publishers. The information gathered and analyzed is entirely based on literature and other documentary materials, such as journal articles and other currently researched media (Falakhiya, 2022). This study's data is divided into two types: primary data and secondary data. The author's data-gathering technique in this research is a literature review. Data analysis techniques employ qualitative procedures in a deductive manner, implying that general things or theories are used to generate specific findings. The following is the scenario of the literature study approach followed in this research:



RESULTS AND DISCUSSION

The 21st Century is known as the "knowledge century." The rapid development of technology and information influences many facets of life. Education in the 21st Century has undergone considerable changes, as evidenced by the demands of skills students must acquire (Ratama et al., 2021). Based on the literature review findings, Erdogan (2019) argued that the 21st Century expects humans to be lifelong learners with 4C skills. This idea is also stated by Bedir (2019) and Tohani & Aulia (2022), who say that learning in the 21st Century demands students possess the 4C skills: communication, collaboration, critical thinking, problem-solving, creativity, and innovation.

According to (Haka et al., 2022), the ability to solve problems and collaborate is required in the 21st Century. Learners must reflect on their ideas, have analytical skills, increase their critical and creative thinking abilities, and be self-motivated. According to Mutohhari et al. (2021), the skills that must be learned in the 21st Century (Figure 1) are

problem-solving skills (ability to think critically, laterally, and systemically, especially in the context of problem-solving), communication and collaboration skills (ability to communicate and collaborate effectively with various parties), critical thinking and problem-solving skills (ability to think critically, laterally, and systemically, especially in the context of problem-solving), communication and collaboration skills (ability to communicate and collaborate effectively with Literacy (the ability to use information and communication technologies to better one's performance and day-to-day activities) (Sholihah & Lastariwati, 2020);(Widya et al., 2021).

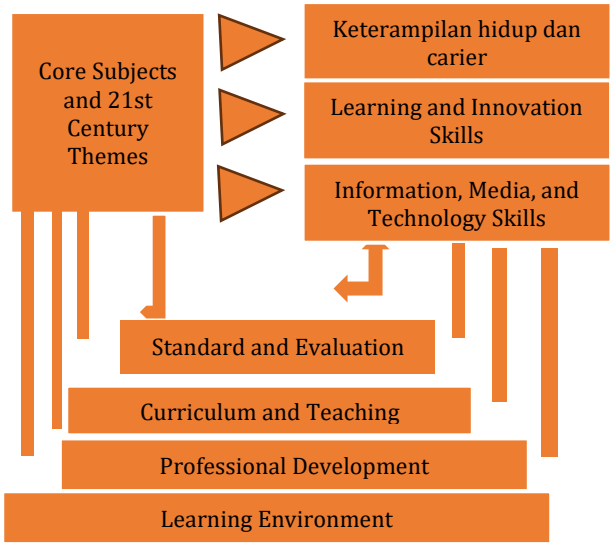


Figure 1. 21st Century learner skills

The rapid advancement of technology also distinguishes the 21st Century. This technology can impact the learning process and the expectations of learning to include technology. Szabo et al. (2020) argued that the advancement of technology and information influences the character of the nation's youngsters. Children born in the 21st Century are known as the millennial generation and the Alpha generation, and they are comfortable with technology and the Internet (Novianti et al., 2019). This generation is said to be the smartest compared to previous generations, being more pragmatic and materialistic, thinking extremely practically, and giving less heed to values and technological experts (Erfan, 2018). Rapid technology advancements will also impact learning styles, interests, and motivation. Learning using technology can capture the interest of millennial and alpha-generation youngsters and boost their desire to learn (Aulia et al., 2020).

Based on the issues and demands of the 21st Century, teachers play a significant role in assisting students in developing abilities that must be had and character development by the needs of the 21st Century. According to Fitriani et al. (2020), teachers play a crucial role in learning because they serve as learning designers, implementers, and evaluators. Teachers in the 21st Century must also be facilitators, guiding students to enhance their talents (Wulandari & Nofina, 2022).

Teachers can use the UbD strategy when creating lesson plans. Using the UbD strategy can assist learners in overcoming 21st-century obstacles and developing necessary abilities (Tshering, 2022). UbD strategy concentrates on the learning objectives that must be met for learners to better understand the topic. The UbD strategy also emphasizes learning that is integrated with technology and media and is interwoven with students' lives to make learning more relevant (Ria et al., 2019). As a result, studying with UbD corresponds to the nature of students of the 21st century age and are very familiar with technology. According to Taiyabi (2021), the UbD strategy stresses design oriented toward learning objectives and goals, making learning more focused.

The UbD strategy is critical in 21st Century learning because it assists teachers in developing focused and successful lesson plans. UbD is a strategy that emphasizes advanced preparation before engaging in learning activities, identifying the objectives to be reached and the abilities to be developed in learners before deciding on the content and learning methods to be employed (Kuntari et al., 2019).

Teachers can use the UbD strategy to guarantee that learning objectives are met effectively and that students grasp the topic. This technique also assists learners in developing digital-era abilities such as critical thinking, communication, and cooperation. According to Tshering (2022), the UbD strategy can be utilized to increase critical thinking abilities because it demands learners to know how to explain, interpret, apply, perspective, empathy, and self-regulation.

Backward Design is a method of learning that is organized backward. Teachers must first define the ultimate aim of learning, then conduct an evaluation to collect proof of learning, and then determine the methods or processes to be implemented (Gloria et al., 2020).

Figure 2 depicts the three steps of Backward Design, as mentioned by Uluçınar (2021).

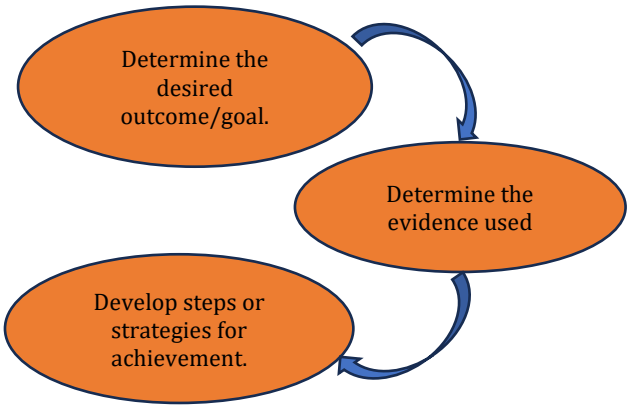


Figure 2. Backward Design Stages

Backward design in UbD is divided into three stages: establishing the results and objectives, determining the evidence to be used, and strategizing to achieve the intended objectives. This stage directs the learning design to focus on the goals to be attained. Setting goals early and clearly will improve learning and focus on obtaining desired outcomes (Dack & Merlin-Knoblich, 2019). Furthermore, by determining the evidence utilized in the second stage, an evaluation that agrees with the objectives will be developed to measure the objectives' achievement properly. The final stage is strategizing utilizing the WHERETO formula to achieve the predetermined goals. This is done so that each stage is oriented toward the desired learning objectives and goals, resulting in more directed learning (Sumandya et al., 2023).

Uluçınar (2021) also expresses this, stating that adopting the UbD strategy with a backward framework can assist teachers in developing plans tailored to the aims and needs of the students being taught. Ria et al. (2019) state that UbD can increase students' critical and creative thinking skills. Using UbD phases can help focus learning on the targeted learning outcomes and improve the efficacy of developing learning processes and activities. Tshering (2022) also expresses this, explaining that with the backward structure in UbD, planning learning by first identifying objectives and then preparing evaluation and instruction will assist learners in attaining the intended results. This is because the design will adapt to the results determined at the outset. The stages of UbD also encourage teachers to think creatively and critically, as seen by the demands that teachers answer questions such as "What is the goal?" What resources or content are used in the assessment? How can we help kids learn so that they can attain their objectives? UbD also necessitates reflection on the part of the teacher (Dack & Merlin-Knoblich, 2019).

Integrating UbD in learning can be done as follows:

a. Identifying the Desired Outcomes

The first step that the teacher must take is to define the desired outcome that will be attained from the learning. Once that objective has been clearly stated, the methods and learning materials can be developed to fulfill the objective. The objectives set must be in line with the qualities and needs of the learners because learners differ in their strengths and weaknesses, as well as how their disabilities affect learning and what approaches or accommodations are required to facilitate

learning in the classroom. The instructional unit will be formed when intended learning outcomes or objectives are specified. Teachers might develop crucial questions to frame standards or goals in a way that connects or engages students and serves to bridge the gap between standards and curriculum. A well-written, important question piques learners' interest and keeps them engaged in the learning until the conclusion.

b. Identifying Evidence of Learning and Assessment Methods

Following the development of learning objectives, teachers can look for assessment methods or assessments that will be used to measure the achievement of these learning objectives. The achievement of learning objectives must be reliably measured. Teachers must be able to create exams that can evaluate objectives to gain actual and accountable evidence and confirmation of learning success. The assessment can be designed using the steps outlined below.

1) Examine what evidence will demonstrate that students have grasped the subject's concept/idea.
2) Consider what items demonstrate that learners have grasped and can apply what they have learned and how performance will be evaluated.
3) Determine what evidence is collected and can be used to demonstrate learners' mastery of essential information, understanding, and abilities.

c. Planning the Learning Strategies and Methods

Backward Design's final stage is to determine the execution of learning in detail, including materials, methods, strategies, and other items employed during learning. The selection of strategies or approaches must be guided by the goals that have been established. This learning stage is intended to help students grasp the subject so that they can work on evaluation questions to meet learning objectives at the end.

UbD employs the WHERETO design in the planning and instruction of learning:
W: *Where its going* (dimulai dari mana);
H: *Hook & Hold;*
E: *Equip, Experience, Explore*;
R: *Rethink & Revise*;
E: *Evaluate*;
T: *Tailored*;
O: *Organized*.
(Sumandya et al., 2023)

Most teachers in Indonesia have not applied the UbD strategy framework in their classrooms. This is because most teachers are still more concerned with students' final results or final exam scores than with students' learning and ability to apply their understanding in real life. The adoption of the UbD strategy places a greater emphasis on student understanding, how learning objectives can be met through meaningful learning processes and experiences, and students' ability to apply and transfer their knowledge in community life (Ria et al., 2019).

The government continues to seek to improve education, and as a result, educational innovation, notably the autonomous curriculum, has arisen. This independent curriculum stresses learner-centered learning, meaning students can study based on their characteristics, learning styles, and cognitive development to allow each learner to reach their full potential. The independent curriculum leads to the UbD strategy because learning is designed to be more meaningful. After all, learning is designed from learning experiences and activities oriented toward learner goals; the concept of the material taught is essential, and the emphasis is on formative assessment or assessment of the learning process (Taiyabi, 2021). This process is done so students can develop meaningful

information and use it in community life. As a result, the independent curriculum highlights the personality of the Pancasila learner profile.

Within the UbD strategy framework, the desired student learning outcomes are that students can have a deep grasp, apply and transfer the understanding gained, and agree with the expected learning objectives. In UbD, understanding is organized into six categories: explanation, interpretation, application, viewpoint, empathy, and self-knowledge (Kuntari et al., 2019)(Table 1).

Table 1. Understanding of the UbD Strategy

Facet 1 Explanation	*Facet 2 Interpretation*	*Facet 3 Application*	*Facet 4 Perspective*	*Facet 5 empathy*	*Facet 6 Self-knowledge*
Accurate Coherent Justified Systematic Predictive	*Meaningful Important Significant Illustrative Illumination*	*Effective Efficient Fluent Practical gracefu l*	*Credible Revealing Insightful Plausible unusual*	*Sensitive Open Receptive tactful*	*Self-aware Metacognition Self-adjusting Reflective Wise*

When employing UbD design in learning, the teacher acts as a facilitator, guiding students through learning experiences to deepen their understanding. This is done to make learning more enjoyable. The teacher's role in the UbD strategy also includes developing a learning design that will be implemented in the classroom and is oriented toward learning objectives (Tshering, 2022). Teachers must be able to create learning objectives tailored to their students' characteristics. Create evaluations that are in line with the objectives and establish learning activities that are meaningful and appropriate for the student's characteristics. According to Uluçınar (2021), under the UbD strategy, the teacher is a facilitator who guides students in learning.

Teachers are involved in the implementation, which means they will run and apply the UbD strategy. Teachers, as adapters, apply the curriculum by harmonizing or changing it to the characteristics and needs of their students and the school environment (Wahyudi et al., 2019). Teachers, as curriculum developers, imply that they are given the ability to design the curriculum, including choosing the objectives, content, methodologies, and assessments to be used (Puspita et al., 2018). Teachers, as researchers, imply that they are responsible for testing various curriculum components. The UbD strategy has not been fully adopted in Indonesia since there are still many schools where teachers are more concerned with students' ultimate results or exam scores than how students understand. The government is working to improve the quality of education by developing an autonomous curriculum. This curriculum corresponds to the UbD stages (Setiyawati et al., 2023).

CONCLUSIONS AND SUGGESTIONS

Learning through the UbD strategy can solve the issues of the 21st Century. Backward design is used in the UbD strategy. When the UbD strategy is utilized, learning becomes more goal-oriented and concentrated. The stages in UbD are establishing the learning objectives to be attained, developing assessments to measure the achievement of the objectives, and planning learning activities that align with the objectives. UbD also assists teachers in implementing technology-enhanced learning that equips students with 21st-century skills.

UbD strategy enables learners to explain, interpret, apply, viewpoint, empathize, and have self-awareness. Teachers play an important role in UbD. The teacher's responsibility is to create learning activities aimed at obtaining results and objectives and to implement the design and direct the learning activities that will be carried out. Teachers must be creative, imaginative, and capable of making learning more meaningful to attain objectives.

REFERENCES

Afandi, Sajidan, Akhyar, M., & Suryani, N. (2019). Development frameworks of the Indonesian partnership 21 st -century skills standards for prospective science

teachers: A Delphi study. *Jurnal Pendidikan IPA Indonesia*, *8*(1), 89–100. https://doi.org/10.15294/jpii.v8i1.11647

Angelica, D., & Novitasari, A. (2020). The Influence of Resource-based Learning Model based on Flashcard toward Students' Problem-Solving Abilities. *Biosfer: Jurnal Tadris Biologi*, *11*(1), 78–85. https://doi.org/10.24042/biosfer.v11i1.4791

Aulia Novitasari, Jatmiko, A., & Elen, F. (2020). Pengaruh Model Pembelajaran Sains Teknologi Masyarakat (STM) Terhadap Kemampuan Berpikir Kreatif Dan Self Regulation. *Symbiotic: Journal of Biological Education and Science*, *1*(2), 61–69. https://doi.org/10.32939/symbiotic.v1i2.15

Bedir, H. (2019). Pre-service ELT teachers' beliefs and perceptions on 21st century learning and innovation skills (4Cs) Hasan. *Journal of Language and Linguistic Studies*, *15*(1), 231–246. Retrieved from www.jlls.org

Br. Siregar, C., Derlina, D., & Juliani, R. (2022). *Development of Design and Implementation of Hybrid Learning About Vibration and Waves Using Understanding by Design (UbD) Approach*. 1–5. https://doi.org/10.4108/eai.20-9-2022.2324705

Dack, H., & Merlin-Knoblich, C. (2019). Improving Classroom Guidance Curriculum With Understanding by Design. *The Professional Counselor*, *9*(2), 80–99. https://doi.org/10.15241/hd.9.2.80

Erdogan, V. (2019). Integrating 4C Skills of 21st Century into 4 Language Skills in EFL Classes. *International Journal of Education and Research*, *7*(11), 113–124.

Erfan, G. (2018). Pesantren Di Antara Generasi Alfa Dan Tantangan Dunia Pendidikan Era Revolusi Industri 4.0. *OASIS : Jurnal Ilmiah Kajian Islam*, *2*(2), 94–109.

Falakhiya, R. (2022). Pemanfaatan Model Pembelajaran Concept Sentence Berbantuan Media Gambar dalam Meningkatkan Kemampuan Menulis Teks Editorial. *Prosiding Seminar Nasinal Daring*, *3*(2), 710–717.

Fitriani, Y. S., Juanda, A., & Roviati, E. (2020). Internalization of Religious Values Using the Argument-Driven Inquiry Model to Improve Critical Thinking Skills during the COVID-19 Pandemic. *Biosfer: Jurnal Tadris Biologi*, *11*(2), 139–150. https://doi.org/10.24042/biosfer.v11i2.7338

Gloria, R. Y., Sudarmin, Wiyanto, & Indriyanti, D. R. (2020). Formative assessment with understanding by design to improve students'habits of mind. *Journal of Physics: Conference Series*, *1521*(4), 6–12. https://doi.org/10.1088/1742-6596/1521/4/042094

Gloria, R. Y., Sudarmin, Wiyanto, & Indriyanti, D. R. (2019). Applying Formative Assessment through Understanding by Design (UbD) in the Lecture of Plant Physiology to Improve the Prospective Teacher Education Students' Understanding. *Journal of Turkish Science Education*, *16*(3), 350–363. https://doi.org/10.12973/tused.10287a

González-pérez, L. I., & Ramírez-montoya, M. S. (2022). Components of Education 4.0 in 21st Century Skills Frameworks: Systematic Review. *Sustainability (Switzerland)*, *14*(3), 1–31. https://doi.org/10.3390/su14031493

Haka, N. B., Anggoro, B. S., Hamid, A., Novitasari, A., Handoko, A., & Puspita, L. (2020). The Development of Biology Module Based on Local Wisdom of West Lampung: Study of Ecosystem Material. *Journal of Physics: Conference Series*,

1467(1). https://doi.org/10.1088/1742-6596/1467/1/012013

Haka, N. B., Sari, L. K., Supriyadi, Handoko, A., Hidayah, N., & Masya, H. (2022). Model Pembelajaran RICOSRE Berbantuan Podcast Terhadap Peningkatan Keterampilan Komunikasi dan Berpikir Analisis pada Mata Pelajaran Biologi Kelas XI. *J-HyTEL: Journal of Hypermedia & Technology-Enhanced Learning*, *1*(1), 15–22. https://doi.org/10.58536/j-hytel.v1i1.23

Istiana, R., Sunardi, O., Herlani, F., Ichsan, I. Z., Rogayan Jr, D. V., Rahman, M. M., … Arif, W. P. (2020). Environmentally Responsible Behavior and naturalist intelligence: Biology Learning to Support Sustainability. *Biosfer: Jurnal Tadris Biologi*, *11*(2), 87–100. https://doi.org/10.24042/biosfer.v11i2.7626

Kai, S., Chu, W., Reynolds, R. B., Tavares, N. J., & Notari, M. (2021). *21st Century Learning*. https://doi.org/10.4018/978-1-7998-4102-9.ch002

Kuntari, F. R., Rondonuwu, F. S., & Sudjito, D. N. (2019). Understanding by Design (UbD) for the Physics Learning about Parabolic Motion. *Jurnal Penelitian Fisika Dan Aplikasinya (JPFA)*, *9*(1), 32. https://doi.org/10.26740/jpfa.v9n1.p32-43

Mayasari, T., Kadarohman, A., Rusdiana, D., & Kaniawati, I. (2016). Apakah Model Pembelajaran Problem Based Learning Dan Project Based Learning Mampu Melatihkan Keterampilan Abad 21? *Jurnal Pendidikan Fisika Dan Keilmuan (JPFK)*, *2*(1), 48. https://doi.org/10.25273/jpfk.v2i1.24

Muthmainnah, R., Mulyani, L. S., & Fitriyani, W. (2023). Nature Club Activity: Knowledge Exploration on Javan Slow Loris (Nycticebus javanicus) and Protected Endemic Animals in Conservation Education Program. *Biosfer: Jurnal Tadris Biologi*, *14*(1), 131–139. https://doi.org/10.24042/biosfer.v14i1.17766

Mutohhari, F., Sutiman, S., Nurtanto, M., Kholifah, N., & Samsudin, A. (2021). Difficulties in implementing 21st century skills competence in vocational education learning. *International Journal of Evaluation and Research in Education*, *10*(4), 1229–1236. https://doi.org/10.11591/ijere.v10i4.22028

Novianti, R., Hukmi, & Maria, I. (2019). Generasi Alpha-Tumbuh Dengan Gadget Dalam Genggaman. *Jurnal Educhild: Pendidikan & Sosial*, *8*(2), 65–70.

Padilla-Rivera, A., Russo-Garrido, S., & Merveille, N. (2020). Addressing the social aspects of a circular economy: A systematic literature review. *Sustainability (Switzerland)*, *12*(19), 1–17. https://doi.org/10.3390/SU12197912

Pertiwi, S., Sudjito, D. N., & Rondonuwu, F. S. (2019). Perancangan Pembelajaran Fisika tentang Rangkaian Seri dan Paralel untuk Resistor Menggunakan Understanding by Design (UbD). *Jurnal Sains Dan Edukasi Sains*, *2*(1), 1–7. https://doi.org/10.24246/juses.v2i1p1-7

Pratama, R., Handoko, A., & Anwar, C. (2020). Association of physical body-kinesthetic (Multiple Intelligences) mobility with learning results biology in SMA negeri 2 bandar lampung. *Journal of Physics: Conference Series*, *1521*(4), 0–7. https://doi.org/10.1088/1742-6596/1521/4/042001

Puspita, L., Supriadi, N., & Pangestika, A. D. (2018). Pengaruh Model Pembelajaran Creative Problem Solving (Cps) Disertai Teknik Diagram Vee Terhadap Keterampilan Berpikir Kreatif Peserta Didik Materi Fungi Kelas X Man 2 Bandar Lampung. *Biosfer : Jurnal Tadris Biologi*,

9(1), 01. https://doi.org/10.24042/biosf.v9i1.2871

Ratama, I. P., Padmadewi, N. N., & Artini, L. P. (2021). Teaching the 21st Century Skills (4Cs) in English Literacy Activities. *Journal of Education Research and Evaluation*, *5*(2), 223. https://doi.org/10.23887/jere.v5i2.30849

Resa, A. (2023). Implementasi Kurikulum Merdeka Berdasarkan Pendekatan Understanding By Design. *Journal Primary*, *4*(1), 1–8.

Rizaldi, D. R., Nurhayati, E., & Fatimah, Z. (2020). The Correlation of Digital Literation and STEM Integration to Improve Indonesian Students' Skills in 21st Century. *International Journal of Asian Education*, *1*(2), 73–80. https://doi.org/10.46966/ijae.v1i2.36

Saleh, S. E. (2019). Critical Thinking As A 21 St Century Skill: Conceptions, Implementation And Challenges In The Efl Classroom. *European Journal of Foreign Language Teaching*, *4*(1), 1–16. https://doi.org/10.5281/zenodo.2542838

Setiyawati, N., Milianti, M., Septiani, U. R., & Titin, T. (2023). Analisis Pengembangan Rancangan Pembelajaran dengan Pendekatan Ubd. *Jurnal Penelitian, Pendidikan Dan Pengajaran: JPPP*, *4*(3), 170–174. https://doi.org/10.30596/jppp.v4i3.16126

Sholihah, T. M., & Lastariwati, B. (2020). Problem based learning to increase competence of critical thinking and problem solving. *Journal of Education and Learning (EduLearn)*, *14*(1), 148–154. https://doi.org/10.11591/edulearn.v14i1.13772

Sumandya, I. W., Widana, I. W., Suryawan, I. P. P., & Handayani, I. G. A. (2023). Analysis of understanding by design concept of teachers ' independence and creativity in developing evaluations of mathematics learning in inclusion schools. *Edelweiss Applied Science and Technology*. *7*(2), 124–135. https://doi.org/10.55214/25768484.v7i2.382

Supriyati, E., Setyawati, O. I., Purwanti, D. Y., Salsabila, L. S., & Prayitno, B. A. (2018). Profil Keterampilan Berpikir Kritis Siswa SMA Swasta di Sragen pada Materi Sistem Reproduksi. *Bioedukasi: Jurnal Pendidikan Biologi*, *11*(2), 72–78.

Szabo, Z. K., Körtesi, P., Guncaga, J., Szabo, D., & Neag, R. (2020). Examples of problem-solving strategies in mathematics education supporting the sustainability of 21st-century skills. *Sustainability (Switzerland)*, *12*(23), 1–28. https://doi.org/10.3390/su122310113

Taiyabi, F. (2021). Understanding by Design (UbD) "Curriculum Innovation and Instructional Development." *International Journal of Innovation, Creativity and Change.*, *15*(4), 1142–1152.

Tohani, E., & Aulia, I. (2022). Effects of 21st Century Learning on the Development of Critical Thinking, Creativity, Communication, and Collaboration Skills. *Journal of Nonformal Education*, *8*(1), 46–53. Retrieved from https://journal.unnes.ac.id/nju/index.php/jne/article/view/33334

Tshering, S. (2022). The Impact of Using Understanding by Design (UbD) Model on Class 10 Student's Achievement in Chemistry. *IJCER (International Journal of Chemistry Education Research)*, *6*(April), 29–33. https://doi.org/10.20885/ijcer.vol6.iss1.art4

Uluçınar, U. (2021). Findings of qualitative studies on Understanding by Design: A meta-synthesis. *Uluslararası Eğitim Programları ve Öğretim Çalışmaları*

Dergisi, *11*(2), 167–194. https://doi.org/10.31704/ijocis.2021.009

Vatahanavong, T., Souttaphong, B., & San, S. (2019). Curriculum Development on Understanding by Design (UbD) Through the Use of CIPPA Principles for Lecturers. *Souphanouvong Journal*, *5*(1), 165–178.

Wahyudi, R., Rukmini, D., & Bharati, D.A.L. (2019). Developing discovery learningbased assessment module to stimulate critical thingking and creativity of students' speaking performance. *English Education Journal*, *9*(2), 172–180. https://doi.org/https://doi.org/10.15294/eej.v9i2.28992

Widya, Maielfi, D., & Alfiyandri. (2021). Need Analysis for Physics E-Module Based on Creative Problem Solving Integrated 21st Century Skills. *Journal of Physics: Conference Series*, *1940*(1). https://doi.org/10.1088/1742-6596/1940/1/012110

Wulandari, R. W., & Nofina, M. (2022). The Development of POE-based (Predict, Observe, and Explain) E-Student Worksheet for Eleventh-Grade Plant Histology Subject. *Biosfer: Jurnal Tadris Biologi*, *13*(1), 21–35. https://doi.org/10.24042/biosfer.v13i1.11270

Zubaidah, S. (2020). Self Regulated Learning : Pembelajaran dan Tantangan pada Era Revolusi Industri 4 .0. *Publikasi Ilmiah*, *5*(4), 1–19.