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Original Research Article

Tapping into collaborative skills and learning achievement: The effect of implementing the common knowledge construction model equipped with podcasts on chemical bonds topic

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ABSTRACT

The impact of integrating the Common Knowledge Construction Model (CKCM) with Chemical Bonds-focused Podcasts on students' collaboration skills and cognitive learning achievements is investigated in this study. A quasi-experimental design was employed, with cluster random sampling to select the experimental (N=23) and control (N=30) classes from a private high school in Solo City. Descriptive and inferential analyses were conducted, employing the Mann-Whitney test for hypothesis testing. Results showed that the CKCM approach significantly enhanced collaboration skills ($p < 0.001$) and learning achievements ($p = 0.014$), indicating substantial educational benefits. In conclusion, integrating the CKCM with Chemical Bonds podcasts positively influenced students' collaboration skills and cognitive learning achievements. Moreover, this comprehensive model addressed conventional learning objectives and integrated elements of ethnoscience, providing students with a broader and more culturally contextualized understanding. The CKCM model, supplemented by podcasts, facilitated a dynamic learning environment that actively engaged students in knowledge construction. These findings advocate for integrating CKCM and podcasts into educational curricula, offering a scalable model for enhancing 21st-century skills.

Introduction

Fundamental changes in the order of human life characterize life in the 21st century. The challenge of 21st-century education is to produce superior and quality human resources. In addition, in 21st-century education, students must not only rely on knowledge abilities, but skill abilities must also be mastered by students (Mardhiyah et al., 2021). Collaboration skills, critical thinking, communication, and creative thinking are skills that students must have in 21st-century education to face the times (Shidiq & Yamtinah, 2019).

However, the quality of education in Indonesia from 2018 to 2021 shows a figure that is in the low category when compared to other countries in the world. The results of a survey conducted by the PISA (Programme for International Student Assessment) in 2019 regarding the secondary education system stated that Indonesia occupies a low position, ranked 74th out of 79 countries (Cerelia et al., 2021). In addition, Indonesia has low competitiveness and is ranked 37 out of 57 countries. This proves that the education component has not been fully successfully applied to the education system in Indonesia, especially in the branch of chemistry.

Chemistry is one of the branches of science in the field of Natural Sciences (IPA) that has direct relevance to everyday life. However, chemistry is often considered a difficult subject for most high school students. This difficulty can be interpreted as a situation where students face various obstacles in the learning process that prevent them from achieving optimal learning outcomes. One of the main indicators of student learning difficulties is the low learning achievement obtained in these chemistry subjects (Shidiq et al., 2019; Yakina et al., 2017).

Chemistry learning in schools faces the constant challenge of engaging students effectively with complex concepts. For example, the abstract nature of chemical bonding often hinders students' ability to understand basic knowledge, reflecting broader problems in science education that demand innovative solutions. Traditional teaching methods, which rely largely on passive learning, fail to meet the learning needs of today's students. This is especially evident in the teaching of chemical bonding, where the need for an interactive, student-centered approach hinders conceptual understanding and engagement. The constructivist-based learning model can be used as a solution because it is considered not only able to increase learning possibilities by incorporating various pedagogy and techniques (i.e., relational conceptual changes, direct activities, and thoughts, discourses of students) but also facilitates chemistry learning (Çalik &; Cobern, 2017). One constructivist-based learning model that can be applied is the Flipped-Common Knowledge Construction Model (CKCM) learning model. This model aims to reform traditional teaching methods that are inefficient and often fail to engage students in the classroom with a concept.

CKCM informs students to build beliefs about the world through personal interaction with natural phenomena and social interaction with others (Haydari & Coştu, 2021). CKCM argues that schools should equip students with social and basic skills. Therefore, the learning environment should be built where students can grow as individuals who think critically and are responsible and aware of global issues. The teacher must give his students a chance in this regard. If teachers show empathy, understanding, and sensitivity towards and interact positively with their students, students' learning experience and ability to deal with their problems are improved effectively. This model has four interactive phases: Exploring and Categorizing, Construction and Negotiation, Translating and Extending, and Reflecting and Assessing.

Based on the results of previous studies, the CKCM learning model meets the requirements and expectations of the current science curriculum, namely science literacy, scientific thinking habits, and socio-scientific problems) (Çalik &; Cobern, 2017). When previous CKCM studies were reviewed, it was determined that CKCM provides a significant improvement in students' conceptual understanding and ensures permanence of knowledge (Haydari &; Coştu, 2021), has a positive impact on attitudes towards chemistry lessons (Bakırcı et al., 2017), has a positive effect on students' academic achievement (Bakirci &; Ensari, 2018), has a positive impact on improving the nature of science (Özden &; Yenice, 2020), a positive influence on students' science process skills (Haydari & Coştu, 2021), positively impacting socio-scientific problems (Haydari & Coştu, 2021). A critical aspect of CKCM is that it gives teachers flexibility in their choice of methods and techniques, and many learning theories can be synthesized. In addition, it allows students to transfer what new knowledge they have just learned into similar real-life situations (Haydari & Coştu, 2021).

The CKCM learning model with a constructivist-located learning paradigm prioritizes the learning process in groups. Students will work in groups to analyze phenomena, build conceptions, expand conceptions of socio-scientific issues with cultural dimensions (ethnoscience), and conclude by evaluating and reflecting on conceptions and learning processes. Therefore, collaboration skills are one of the skills that students need to master, especially in facing increasingly complex 21st-century challenges (Hidayanti et al., 2020).

Meanwhile, 21st-century life is accompanied by rapid technological advances. Information can be accessed by all elements of society quickly. The learning media used also needs to adjust to the times. Podcast media is one of the uses of technology as a learning medium in applying the CKCM learning model. According to Sutarto et al. (2020), using engaging learning media such as podcast learning videos can help make it easier for students to understand learning material. This is also a step to keep up with the times and efforts to answer the challenges of the 21st century, namely technological improvement.

Recent advances in educational technology and pedagogical models offer new avenues for improving chemistry education. CKCM, for example, represents a pioneering approach to collaborative learning, while podcasts are emerging as a versatile tool for delivering engaging content. However, integrating these strategies in the teaching of chemical bonding still needs to be explored, marking a critical gap in the literature. This research aims to bridge this gap by examining the efficacy of the CKCM-equipped podcast approach in teaching chemical bonding. Through investigating this integration, specific challenges in chemistry education are addressed and contribute to a broader discourse on teaching strategy innovation, marking a significant advance in the state of the arts.

Methods

Population and Sample

The research was conducted at a private high school in Solo City, Central Java. The population of interest comprised grade XI MIPA students for the 2023/2024 school year from five classes (XI 2-5) at the school. Two classes were selected using cluster random sampling. These classes were then designated as the experimental and control groups. Homogeneity between the classes was tested based on their odd semester chemistry PTS scores.

General Procedure

This research utilizes a quasi-experimental method, where data from a sample of the study population is analyzed using appropriate statistical methods. The experimental class will receive treatment through the implementation of the CKCM learning model, incorporating podcast-mediated ethnoscience, while the control class will undergo treatment using the discovery learning model. Both classes will undergo initial diagnostic tests before the intervention of learning activities. Subsequently, both groups will undergo posttests. Data will be processed and analyzed to evaluate the impact of the CKCM learning model on collaboration skills and student learning outcomes in chemical bonds (Table 1).

This research goes through research steps consisting of 3 (three) stages, namely: the preparation stage, the implementation stage, and the final stage. The preparation stage consists of a) observation of schools and students, b) conducting homogeneity tests based on odd Midterm Assessment scores in 2023/2024 to determine control and experimental classes. Learning outcomes instruments are used for ethnoscience AKM-like (Minimum Competency Assessment, AKM) problems, while collaboration skill instruments are developed based on the skill dimension. Collaboration skills include communication, interaction, commitment, and responsibility skills (Dhitasarifa et al., 2023).

Table 1. Quasi-experimental design

Group	Treatment	Post-test
Control	K_1	O_1
Experiment	X_1	O_2

Information:
K_1: Learning with discovery learning model (control group)
x_1: Learning with the Common Knowledge Construction Model (CKCM) learning model loaded with mediated ethnoscience podcasts (experimental clusters)
O_1: post-test (control group)
O_2: post-test (Experimental group)

At the implementation stage: a) providing treatment to the experimental group in the form of a Common Knowledge Construction Model (CKCM) learning model using podcast media, b) providing treatment to the control group in the form of a discovery learning model with PowerPoint media (PPT), c) providing post-test to the experimental group and the control group. The final stage is to conduct an analysis and hypothesis test. From the results obtained, the formulation of the problem can be analyzed in this study, namely whether there is an effect of the application of the flipped-Common Knowledge Construction Model (CKCM) learning model on collaboration skills and learning outcomes in chemistry subjects.

Data Analysis

Data processing is facilitated using SPSS 25 software. Collaboration skills are assessed throughout the learning process with the assistance of observers, while learning outcomes are evaluated using ethnoscience-based summative AKM questions. In hypothesis testing, it is determined that the data in this study is not normally distributed. Therefore, the hypothesis is tested using the Mann-Whitney Test rather than the independent sample T-test. Following this, statistical tests are conducted on the collected data. A significance value of $p < 0.05$ indicates a significant difference in knowledge between the CKCM learning and discovery learning models.

Results

The Effect of the Podcast-Based CKCM Learning Model on Student Learning Outcomes

Table 2 shows the learning outcomes of the experimental and control classes in the post-test can be known. The average learning outcome score in the experimental class was 66.67, while in the control class, it was 54.9. From these gains, the average difference between the experimental and control classes was 11.77. Based on test scores, the learning outcomes of experimental classes tend to have a higher average than control classes.

Table 2. Post-test value data description.

Class	Lowest Value	Highest Rated	Average
Experiment	41.18	76.47	66.67
Control	45.1	66.67	54.9

Statistical Analysis

Table 3 shows the results of the normality test of learning outcomes in the experimental and control classes. Based on these data, the experimental class had a significance value of 0.002, while the control group had a value of Sig. <0.05. So, it can be concluded that the learning outcome data in the experimental and control classes are not normally distributed.

Table 3. Learning outcome normality test.

Class	N	Sig.	Result	Conclusion
Experiment	23	0.002	H_0 Rejected	Not normally distributed
Control	30	0.040	H_0 Rejected	Not normally distributed

Table 4 shows the results of the homogeneity test of learning outcomes in the experimental and control classes. Based on these data, the homogeneity test obtained a significance value of 0.001 with a sig value. <0.05. So, it can be concluded that the learning outcome data in the experimental and control classes are not homogeneous. Therefore, further testing is needed using a non-parametric statistical test, namely the Mann-Whitney test.

Table 4. Test the homogeneity of learning outcomes.

Class	N	Sig.	Result	Conclusion
Experiment	23	0.001	H_0 Rejected	Not homogeneous data
Control	30			

Table 5 shows that the results of the Mann-Whitney test learning outcomes in the experimental and control classes have a significance value of 0.014, which has a sig value. > 0.05. So, there is a significant difference between the control and experimental classes.

Table 5. Mann-whitney test learning outcomes.

Class	N	Sig.	Result	Conclusion
Experiment Control	23 30	0.014	H_0 rejected	There is a significant difference

The Effect of the Podcast-Based CKCM Learning Model on Student Collaboration Skills

Table 6 shows the learning outcomes of the experimental and control classes in the post-test can be known. The average learning outcome score in the experimental class was 72.51, while in the control class it was 56.86. The average difference between the experimental and control classes was 15.65 from these gains. Based on test scores, the learning outcomes of experimental classes tend to have a higher average than control classes.

Table 6. Collaboration skills value data description.

Class	Lowest Value	Highest Rated	Average
Experiment	47.06	76.47	72.51
Control	50.98	66.67	56.86

Statistical Analysis

Table 7 shows the normality test results of learning outcomes in the experimental and control classes. Based on these data, the experimental class has a significance value of 0.006 and has a Sig. Value of <0.05, while the control group is 0.416 and has a Sig. value of > 0.05. So, it can be concluded that the learning outcome data in the experimental class is not normally distributed, and the control is normally distributed.

Table 7. Collaboration skills normality test.

Class	N	Sig.	Result	Conclusion
Experiment	23	0.006	H_0 Rejected	Not normally distributed
Control	30	0.416	H_0 Accepted	Normally distributed

Table 8 shows the homogeneity test results of learning outcomes in the experimental and control classes. Based on these data, the homogeneity test obtained a significance value of 0.892, a sig value. > 0.05. So, the data on collaboration skills in experimental and control classes are homogeneous. However, the results of collaboration skills are not normally distributed, so they need to be tested further using a non-parametric statistical test, the Mann-Whitney test.

Table 8. Homogeneity test of collaboration skills.

Class	N	Sig.	Result	Conclusion
Experiment Control	23 30	0.892	H_0 Accepted	Homogeneous data

Table 9 shows that the results of the Mann-Whitney test learning outcomes in the experimental and control classes have a significance value of 0.000, which has a sig. Value> 0.05. So, there is a significant difference between the control and experimental classes.

Table 9. Test mann-whitney collaboration skills.

Class	N	Sig.	Result	Conclusion
Experiment Control	23 30	0.000	H_0 Rejected	There is a significant difference

Discussion

The Effect of the Podcast-Based CKCM Learning Model on Student Learning Outcomes

The Common Knowledge Construction Model (CKCM) is a constructivist-based learning model that aims to make students build their knowledge through pre-existing knowledge (Kiryak & Çalik, 2017). This learning model encourages students to use intellectual tools (i.e., scientific thinking habits) in various contexts in studying socio-scientific problems (Çalik & Cobern, 2017). There are four phases in the CKCM learning model having 4 (four) phases, namely: 1) exploring and categorizing, 2) construction and negotiation, 3) translating and expanding, and 4) reflecting and assessing (Yildırım & Bakırcı, 2019). In previous studies, this learning model was successfully applied by investigating the effect of CKCM lesson sequences in the specific context of water pollution. The study's results confirmed the effectiveness of the CKCM series of lessons, providing a deeper conceptual understanding (Kiryak &. In addition, there is an increase in the use of scientific language compared to everyday language (Kiryak & Çalik, 2017).

Applying the CKCM learning model uses a podcast-mediated ethnoscience approach that connects cultures that exist in everyday life with further scientific knowledge (Abonyi et al., 2018). In the learning process, students are instilled with scientific thinking habits and meaningful experiences in the CKCM lessons. Learning is carried out by investigating socio-scientific issues, thereby increasing students' awareness of the complex interactions between science, technology, society, and environment through critical thinking skills (Çalik & Cobern, 2017). Ethnoscience in this study is the phenomenon of batik, pottery, and lampindo mud and its relation to chemical bonds. The results of previous studies said that ethnoscience can adequately introduce students to local phenomena in the surrounding environment and related to scientific concepts (Alperi & Handayani, 2022).

Learning outcomes include changes in a person's abilities after experiencing the learning process, which can affect cognitive, affective, and psychomotor aspects. This study focused only on cognitive aspects because this aspect was directly related to students' ability to understand the subject matter (Mapendra, 2016). The data collection process was carried out using AKM posttest learning outcomes questions with 24 questions (Shidiq et al., 2022; Yamtinah et al., 2022). The results obtained are then carried out with prerequisite analysis tests, namely homogeneity tests and normality tests, to determine whether the data obtained is homogeneous and normally distributed.

Based on the results of the tests that have been carried out, it is clear that applying the CKCM learning model with a podcast-mediated ethnoscience approach significantly influences student learning outcomes. This is shown by the results of the Mann-Whitney test on the learning outcomes test, namely Sig. $0.014 < 0.05$, so Ho was rejected. This means that, in general, there are significant differences in learning outcomes between the experimental and control classes.

The average score for the experimental group using the CKCM learning model is significantly higher than that for the control group. It also stated that constructivist learning facilitates more significant opportunities for students' active involvement in the classroom, allowing them to explore and explore their potential and abilities more deeply, both in terms of cognitive, affective, and psychomotor. In the constructivist approach, students are not dogmatically guided; instead, they are allowed to discover and explore knowledge using their understanding and experience to improve student learning outcomes.

The discovery learning model uses the syntax or stages observing, questioning, reasoning, associating, and communicating. This model is a scientific way to obtain knowledge, starting from the process of observation through the use of the senses of sight, hearing, or reading, as well as observation (Lubis, 2020). Discovery learning can effectively improve students' learning abilities by applying scientific work skills or scientific skills. This approach involves students actively in the learning process to increase their understanding of the concepts taught (Sundari, 2017).

In this study, the constructivist-based CKCM learning model in experimental classes is superior to the discovery learning models in control classes. In line with the findings of a survey conducted by Çalik & Cobern (2017), CKCM not only increases learning opportunities by integrating various pedagogical and engineering approaches (such as relational conceptual change, hands-on activities, and reflection of students' minds) but also facilitates the chemistry learning process. CKCM meets the standards and expectations of the current science curriculum, such as science literacy, habituation of scientific thinking, and socio-scientific problem-solving.

The learning process using CKCM and the Discovery Learning model both significantly impact student learning outcomes, as reflected by a significant increase in learning outcomes scores. However, differences were seen in the influence on student learning outcomes between the Discovery and CKCM learning models. It can be seen from the comparison of the average final score of students between the experimental and control classes, where the average final score of students in the experimental class is 66.67 higher than the control class, which is 54.9.

At this time, collaboration skills are one of the essential aspects of 21st-century learning that must be emphasized. The key competencies and skills required in this era, as laid out in the framework of the 21^{st} century, are the ability to think critically, communication, collaboration, and creativity (4C). Learning needs to develop students' higher-order thinking and collaboration skills to compete in the era of the Industrial Revolution 4.0 (Shidiq et al., 2015; Hidayanti et al., 2020; Widarti et al., 2023).

In addition, students' collaboration skills correlate with student learning outcomes. Collaboration skills are one of the essential options to be developed to overcome student learning difficulties in understanding chemistry to improve student learning outcomes. There are 4 (four) aspects of collaboration skills, namely: 1) communication skills, 2) interaction skills, 3) commitment skills, and 4) responsible skills (Table 10) (Wiyarsi et al., 2020). The collaboration skills that learners must have can be trained during the implementation of CKCM.

Table 10. Collaboration skills indicators

Aspects	Indicator
Communication skills	Listen
	Speak
Interaction skills	Participate
	Contribute
Committed skills	Motivation of acceptance
Responsible skills	Responsibility

Exploring dan Categorizing

The first phase of CKCM is to explore learners' initial knowledge of ethnoscience. To attract students' attention to the definition of ethnoscience, teachers use video podcast media that contains ethnoscience phenomena in everyday life, such as tempeh making, keris making, and tape making. Worksheets about ideas that students want to put forward still need to be understood, and things that students want to understand are given to students (Shidiq, 2016; Kasi et al., 2022). The element stability worksheet explains more contextual phenomena, such as the stability of H2O molecules (water molecules) during flushing before marriage. On the ion bond worksheet, the phenomenon of the salt-making process in Madura is explained. On the covalent bond worksheet, students are given examples of phenomena related to the rocks that make up the Borobudur temple. In this phase, alternative concepts are revealed for students to understand the material of elemental stability, ionic bonds, and covalent bonds through phenomenography in video podcast shows. Alternative concepts have been solved with the help of activities in other stages (Haydari & Coştu, 2021). In this phase, students can also develop collaboration skills, namely listening.

Construction and Negotiation

The second phase of CKCM is establishing and negotiating, and teacher-student and peer-to-peer interaction is implemented. Teachers guide students and ensure that information is socially structured in the light of scientific discourse. "Why are water compounds said to be stable? How are the bonds formed by elements in water molecules (H_2O)? How do elements tend to form ionic bonds? How are ionic bonds in $MgCl_2$ formed based on Lewis structures? How is the formation of covalent bonds in hydrochloric acid based on Lewis structures? Identify the type of covalent bond of silica and carbon dioxide compounds. In the first stage, the teacher gives students worksheets of learners. Before completing the worksheet, students watched a video podcast, observed environmental phenomena, and found contradictions. The contradiction is resolved by comparing predictions and observations based on video. After that, students discuss the answers with group mates. Based on this activity, collaboration skills, namely participating and contributing, can also be fulfilled (Haydari & Coştu, 2021).

Translating and Extending

The third phase of CKCM is translating and expanding. Students identify and discuss socio-scientific issues related to elemental stability, ionic bonding, and covalent bonding. In addition, with structuring, students transfer their knowledge to new situations by associating them with different disciplines and concepts. Activities of finding solutions to local or national problems in the environment or around the world are also carried out in this phase. At this stage, students are given examples of ethnoscientific phenomena to attract their attention, such as "Inhaling Night Smoke (Batik Candles) Is It Dangerous?", "Pottery Crafts," and "Lapindo Mud: The Largest Contributor to Methane Gas Emissions on Earth. The aim is to show students that the phenomena of batik, pottery, and lapindo mud are related to chemical bonds. With this activity, students study the formation of compound bonds in batik making, lapin-do mud, and pottery. Based on this activity, collaboration skills, namely participating and contributing, can also be fulfilled (Haydari & Coştu, 2021)

Reflecting and Assessing

The fourth phase of CKCM is reflecting and judging. This phase is where students learn subjects using alternative assessment and evaluation techniques. Teachers can use different methods to measure students' understanding of those subjects. In this phase, students realize that they have experienced meaningful learning according to their behavior at the beginning of learning (Haydari & Coştu, 2021). In this phase, students are asked to provide conclusions based on the discussion results. In this phase, all aspects of collaboration skills are met.

Based on the results of prerequisite tests that have been conducted, the application of the podcast-mediated ethnoscience-based CKCM learning model has a significant influence on students' collaboration skills. This is shown from the results of the Mann-Whitney test, which obtained a signification value of 0.000 and a Sig value of < 0.05. In general, there are significant differences in collaboration skills between the experimental class and the control class. The results of this study show that the CKCM learning model is more influential than the discovery learning model in improving collaboration skills. This can be seen from the average collaboration score obtained by the experimental class of 72.51, which is higher than that of the control class of 56.86. In line with the research conducted by Bakırcı (2019), discussions that occur after experiments and activities in the second stage of CKCM, as well as collaborative activities in the third stage of the learning model, can have a positive impact on the development of students' entrepreneurial skills.

In addition, student feedback highlights the engaging nature of podcasts, suggesting that a more profound exploration of content diversity can further improve learning outcomes. Compared to traditional methods, CKCM's interactive framework, supported by podcasts, facilitates a richer and more engaging learning environment. This is in line with research that stated students responded positively to video podcasts, with 86% of respondents showing ease in understanding the material presented, which indicates that podcast learning videos are exciting and effective in facilitating understanding of the concept of material (Widarti et al., 2024).

Although our research is promising, the limited scope of chemistry topics highlights the potential for broader application, thus inviting further investigation into the versatility of CKCM in chemistry education. Our integrated analysis shows CKCM with podcasts as an essential advance in chemistry education and establishes the introductory course for future exploratory studies into an interactive learning model.

Conclusion

Based on the results of the study, it can be concluded that there are significant differences in learning outcomes and collaboration skills when implementing a flipped-Common Knowledge Construction Model (CKCM) with podcasts for grade XI students. This comprehensive model addressed conventional learning objectives and integrated elements of ethnoscience, providing students with a broader and more culturally contextualized understanding. The flipped-CKCM model, with the added dimension of podcasts, facilitated a dynamic learning environment that actively engaged students in constructing knowledge. In essence, the study results underscore the effectiveness of this pedagogical approach in fostering meaningful differences in academic achievements and collaborative skills among grade XI students. This approach aligns with contemporary educational trends and highlights the potential for enriching the learning experience through innovative and culturally relevant methodologies.

Conflict of Interests

The author(s) declares that there is no conflict of interest in this research and manuscript.

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References

Abonyi, O. S., Achimugu, L., & Ijok Adibe, M. (2018). Innovations in science and technology education: A case for ethnoscience based science classrooms. *International Journal of Scientific & Engineering Research*, 5(1), 52–56.

Alperi, M., & Handayani, D. (2022). Layanan konsultasi pembuatan multimedia interaktif dengan articulate storyline untuk meningkatkan kompetensi guru SMP Kota Bengkulu. *Prosiding Seminar Nasional Pendidikan Biologi*, p. 388-395.

Bakirci, H., & Ensari, O. (2018). The effect of common knowledge construction model on academic achievement and conceptual understandings of high school students on heat and temperature. *Egitim ve Bilim*, 43(196), 171–188. https://doi.org/10.15390/EB.2018.7457

Bakırcı, H., Çalık, M., & Çepni, S. (2017). The effect of the common knowledge construction model-oriented education on sixth grade students' views on the nature of science. *Journal of Baltic Science Education*, 16(1), 43–55. https://doi.org/10.33225/jbse/17.16.43

Çalik, M., & Cobern, W. W. (2017). A cross-cultural study of CKCM efficacy in an undergraduate chemistry classroom. *Chemistry Education Research and Practice*, 18(4), 691–709. https://doi.org/10.1039/c7rp00016b

Cerelia, J. J., Sitepu, A. A., N, F. A. L., Pratiwi, I. R., Almadevi, M., Farras, M. N., Azzahra, T. S., & Toharudin, T. (2021). Learning loss akibat pembelajaran jarak jauh selama pandemi covid-19 di Indonesia. *Seminar Nasional Statistik X*, 1(1), 1–14.

Dhitasarifa, I., Yuliatun, A. D., & Savitri, E. N. (2023). Penerapan model problem based learning untuk meningkatkan keterampilan kolaborasi peserta didik pada materi ekologi di SMP Negeri 8 Semarang. *Seminar Nasional IPA*, 684–694.

Haydarİ, V., & Coştu, B. (2021). The Effect of Common Knowledge Construction Model-Based Instruction on 5th grade students' conceptual understanding of biodiversity. *Journal of Education in Science Environment and Health*, 7(3), 182-199. https://doi.org/10.21891/jeseh.840798

Hidayanti, E., Savalas, L. R. T., & 'Ardhuha, J. (2020). Keterampilan kolaborasi: Solusi kesulitan belajar siswa SMA dalam mempelajari kimia. *Seminar Nasional Pendidikan Inklusif PGSD UNRAM*, 1(1), 1–7.

Kasi, Y. F., Widodo, A., & Samsudin, A. (2022). Science Concepts in Traditional Game "dhongi Koti" from Nagekeo-NTT for Developing Science Learning. *AIP Conference Proceedings*, 2468. https://doi.org/10.1063/5.0102485

Kiryak, Z., & Çalik, M. (2017). Improving Grade 7 students' conceptual understanding of water pollution via common knowledge construction model. *International Journal of Science and Mathematics Education*, 16(6), 1025–1046. https://doi.org/10.1007/s10763-017-9820-8

Lubis, S. (2020). Penerapan discovery learning dalam mewujudkan pembelajaran efektif. *Andragogi: Jurnal Diklat Teknis Pendidikan Dan Keagamaan*, 8(1), 366–378. https://doi.org/10.36052/andragogi.v8i1.136

Mapendra, H. (2016). *Penerapan pendekatan contextual teaching and learning (ctl) untuk meningkatkan hasil belajar matematika siswa kelas VIII SMP Negeri 6 Tapung*. Tesis, Universitas Riau.

Mardhiyah, R. H., Aldriani, S. N. F., Chitta, F., & Zulfikar, M. R. (2021). Pentingnya keterampilan belajar di abad 21 sebagai tuntutan dalam pengembangan sumber daya manusia. *Lectura: Jurnal Pendidikan*, 12(1), 29-40. https://doi.org/10.31849/lectura.v12i1.5813

Özden, B., & Yenice, N. (2020). The effect of common knowledge construction model-based teaching on the cognitive and psychomotor learning of 7th grade students. *Journal of Science Learning*, 4(1), 31–40. https://doi.org/10.17509/jsl.v4i1.25607

Shidiq, A. S. (2016). Pembelajaran Sains Kimia Berbasis Etnosains Untuk Meningkatkan Minat Dan prestasi belajar siswa. *Seminar Nasional Kimia dan Pendidikan Kimia VIII*, 227–236.

Shidiq, A. S., Masykuri, M., & Susanti, E. (2015). Analisis higher order thinking skills (HOTS) menggunakan instrumen two-tier multiple choice pada materi kelarutan dan hasil kali kelarutan untuk siswa kelas XI SMA N 1 Surakarta. *Prosiding Seminar Nasional Pendidikan Sains*, p. 2015–2159.

Shidiq, A. S., & Yamtinah, S. (2019). Pre-service chemistry teachers' attitudes and attributes toward the twenty-first century skills. *Journal of Physics: Conference Series*, 1157, p.042014. https://doi.org/10.1088/1742-6596/1157/4/042014

Shidiq, A. S., Yamtinah, S., & Masykuri, M. (2019). Identifying and addressing students' learning difficulties in hydrolysis using testlet instrument. *AIP Conference Proceedings*, 2194, p. 020117. https://doi.org/10.1063/1.5139849

Shidiq, A. S., Yamtinah, S., Masykuri, M., Ulfa, M., & Mulyani, B. (2022). Penguatan kemampuan guru-guru kimia SMA di Surakarta dalam menyiapkan instrumen AKM literasi membaca dan numerasi berbasis sains kimia. *Bubungan Tinggi: Jurnal Pengabdian Masyarakat*, 4(4), 1402. https://doi.org/10.20527/btjpm.v4i4.6158

Sundari, R. (2017). Penggunaan LKS dengan pendekatan saintifik berbasis discovery learning pada pembelajaran larutan asam dan basa. *Jurnal Ilmiah Kanderang Tingang*, 8(2), 140–152.

Sutarto, S., Sari, D. P., & Fathurrochman, I. (2020). Teacher strategies in online learning to increase students' interest in learning during COVID-19 pandemic. *Jurnal Konseling dan Pendidikan*, 8(3), 129. https://doi.org/10.29210/147800

Widarti, H. R., Wiyarsi, A., Yamtinah, S., Shidiq, A. S., Sari, M. E. F., Nuriyanti, D., Wijaya, G. D., & Rokhim, D. A. (2024). preliminary study of chemical bonding learning media based on podcast as digital entertainment Era 5.0. *E3S Web of Conferences*, 481, 04001. https://doi.org/10.1051/e3sconf/202448104001

Widarti, H. R., Yamtinah, S., Mawardi, Rokhim, D. A., Syafruddin, A. B., & Firdaus, Z. Z. S. (2023). Using instagram as rate of reaction learning media based on PjBL to increase students' motivation and creative thinking Ability. *International Journal of Information and Education Technology*, 13(10), 1520–1525. https://doi.org/10.18178/ijiet.2023.13.10.1957

Yakina, Y., Kurniati, T., & Fadhilah, R. (2017). Analisis kesulitan belajar siswa pada mata pelajaran kimia kelas X di SMA Negeri 1 Sungai Ambawang. *AR-RAZI Jurnal Ilmiah*, 5(2), 287–297. https://doi.org/10.29406/arz.v5i2.641

Yamtinah, S., Utami, B., Masykuri, M., Mulyani, B., Ulfa, M., & Shidiq, A. S. (2022). Secondary school science teacher response to minimum competency assessment: Challenges and opportunities. *Jurnal Penelitian Pendidikan IPA*, 8(1), 124–131. https://doi.org/10.29303/jppipa.v8i1.1075

Yıldırım, İ., & Bakırcı, H. (2019). The effect of common knowledge construction model based science education on entrepreneurship skills of secondary school students. *International Journal of Progressive Education*, 15(6), 134–150. https://doi.org/10.29329/ijpe.2019.215.9