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UNPLUGGED CODING AND *TRI HITA KARANA* IN FOSTERING COMPUTATIONAL THINKING AND ENVIRONMENTAL AWARENESS

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ABSTRACT

The increasing demand for Computational Thinking (CT) and Environmental Awareness (EA) in elementary science education highlights the need for innovative and culturally relevant learning approaches. However, traditional science teaching methods often emphasize rote memorization rather than problem-solving and ecological responsibility, leading to a lack of deeper conceptual understanding among students. This study examines the impact of Unplugged Coding Learning, integrated with Tri Hita Karana (THK) spiritual values, on the development of CT and EA in elementary school students. This research employs a quasi-experimental design with a pretest-posttest control group approach. Data were collected using multiple-choice assessments for CT and EA and were analyzed using Multivariate Analysis of Variance (MANOVA) to determine the effectiveness of the intervention. The results indicate that students who participated in Unplugged Coding Learning with THK values demonstrated significantly higher gains in CT skills (logical reasoning, problem-solving, and pattern recognition) and EA (understanding sustainability and conservation principles) compared to the control group. The Palemahan aspect of THK, which emphasizes harmony with nature, contributed to students' increased awareness of environmental issues. These findings suggest that integrating local wisdom into STEM education enhances both cognitive and ethical development. The study implies that culturally embedded educational approaches can bridge computational problem-solving skills with environmental consciousness, fostering a more holistic learning experience. Future research should investigate the long-term impacts and adaptability of this model across various educational settings.

Keywords: unplugged coding learning; Tri Hita Karana; computational thinking

INTRODUCTION

In elementary science education, one of the primary challenges is enhancing students' critical thinking and problem-solving skills to foster a deeper understanding of scientific concepts (Widiana et al., 2019; Tegeh et al., 2022). Learning that focuses solely on memorization without involving exploration and problem-solving makes it difficult for students to connect science concepts to real-life situations (Afni & Hartono, 2020; Jawad, 2022). Computational thinking has become an essential skill for students to develop from an early age in science learning. In recent years, computational thinking has been recognized as a crucial skill for students in the 21st century, particularly in science education (Papadakis, 2021; Youjun & Xiaomei, 2022). However, research indicates that elementary school students often struggle with problem-solving, algorithmic thinking, and pattern recognition —key components of computational thinking.

According to the international education report, only 37% of elementary students demonstrated proficiency in problem-solving tasks, and less than 40% showed adequate environmental awareness in science-related topics (Baygin et

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al., 2016). These situations highlight a significant gap in students' ability to develop logical reasoning, algorithmic thinking, and sustainability consciousness skills, which are crucial for addressing real-world challenges (Sukma & Ibrahim, 2016; Susilaningsih et al., 2019 Marosi et al., 2021). The lack of early exposure to structured problem-solving strategies and contextual environmental education may contribute to these low proficiency levels. This gap highlights the pressing need for innovative instructional methods that not only foster computational thinking but also promote environmental awareness (Sholihah et al., 2020; Whiting et al., 2021). Moreover, integrating culturally relevant pedagogical approaches can provide students with a more meaningful learning experience by connecting computational concepts with local wisdom and sustainability principles. By adopting a holistic learning framework that blends computational thinking, environmental responsibility, and cultural values, educators can equip students with the essential skills to navigate an increasingly technology-driven and ecologically complex world (Su et al., 2022).

One potential solution to address these challenges is unplugged coding, a teaching approach that introduces computational thinking concepts without the use of digital devices. Unlike traditional coding methods that rely on computers or programming software, unplugged coding utilizes hands-on activities, games, and problem-solving exercises to develop students' logical reasoning, pattern recognition, and algorithmic thinking (Hadad et al., 2020; Nouri et al., 2020). This approach is particularly suitable for elementary school students, as it encourages active engagement, collaboration, and creativity in learning computational concepts (Pala & Mıhcı, 2021; Raymond et al., 2021). Moreover, unplugged coding provides an inclusive learning environment, ensuring that students in schools with limited access to technology can still develop foundational computational thinking skills. Given its emphasis on interactive, exploratory learning, unplugged coding is an effective pedagogical strategy to bridge the gap between abstract computational concepts and real-world problem-solving in science education (Mutoharoh et al., 2021; Tegeh et al., 2021; Misirli & Komis, 2023).

To further enhance its impact, this study integrates unplugged coding with *Tri Hita Karana* (THK), a Balinese philosophical framework that emphasizes the interconnectedness between humans (Pawongan), nature (Palemahan), and spirituality (Parahyangan) (Rati & Rediani, 2021; Parwata et al., 2023). By embedding THK values into unplugged coding activities, students not only develop computational thinking skills but also cultivate environmental awareness and ethical responsibility in their learning process (Azis, 2020; Kong & Wang, 2020). For instance, coding exercises can incorporate real-world ecological challenges, such as designing algorithms to simulate waste management systems or sustainable agricultural practices (Saiful et al., 2022; Lestiawati et al., 2023; Molise et al., 2023). Through this integration, students learn to see computational thinking as a tool for solving environmental issues while fostering a deeper connection to their cultural heritage. The THK-based approach promotes holistic education by aligning logical reasoning with sustainability and ethical decision-making, ensuring that students develop not only as critical thinkers but also as responsible members of society who are aware of their role in environmental conservation (Hasrudin & Asrul, 2020; Annisa et al., 2022).

Several studies have explored the integration of coding in elementary education. Tsortanidou et al. (2022) found that early exposure to computational thinking through block-based coding significantly improves students' problem-solving abilities. Meanwhile, Bers et al. (2019) investigated unplugged coding as an alternative to digital programming, showing that it enhances logical reasoning and engagement among young learners (Herdiawan et al., 2019; Bahtiar et al., 2022; Islamiyah & Asmarani, 2022). However, these studies primarily focused on general cognitive skills without addressing local cultural values or environmental awareness. Mutoharoh et al. (2021) introduced unplugged coding in STEM education but did not incorporate spiritual or ethical dimensions, which are essential for holistic learning. These findings suggest that while unplugged coding is effective, a gap remains in integrating local wisdom and sustainability principles into computational learning.

This study introduces a novel approach by integrating *Tri Hita Karana* (THK) spiritual values into unplugged coding learning in elementary science education. *Tri Hita Karana* is a Balinese philosophical framework that emphasizes harmony among human beings (pawongan), harmony with nature (palemahan), and harmony with the divine (parahyangan) (Karmini et al., 2021; Devi & Redan, 2023; Brahmandika et al., 2024). More than a cultural tradition, THK provides an ethical and pedagogical foundation that closely aligns with the goals of environmental education and character development (Wardhani et al., 2020; Arnyana & Utami, 2022).

In the context of elementary science education, THK serves as a culturally responsive pedagogical framework that supports the development of critical thinking, environmental consciousness, and moral values from an early age (Lasmawan & Sanjaya, 2024; Sarjana et al., 2020; Temaja, 2021). Integrating THK with unplugged coding, an approach proven effective in fostering computational thinking, offers a meaningful and contextually relevant learning experience, particularly for students in regions with strong local cultural identities.

While prior research has highlighted the effectiveness of unplugged coding in developing computational thinking, no studies to date have explicitly examined the integration of indigenous wisdom, such as *Tri Hita Karana*, within this learning model. This study, therefore, aims to investigate the impact of Unplugged Coding Learning, integrated with *Tri Hita Karana* spiritual values, on elementary students' computational thinking and environmental awareness in science education (Susiani et al., 2022).

Theoretically, this study bridges the gap between computational thinking, environmental education, and culturally responsive pedagogy. Practically, it offers an innovative instructional model that educators can adopt to cultivate critical thinking, sustainability awareness, and appreciation for local wisdom among young learners.

METHODS

This quasi-experimental study used a non-equivalent pretest-posttest control group design (Rogers & Revesz, 2019). This study focuses on effectiveness testing activities through the implementation of products. The population of this study consisted of 171 schools across all districts in Bali. The number of samples was determined using the Slovin formula with a tolerance limit of 3% due to the large number of research populations with diverse variations (Widiana et al., 2020). Furthermore, sample determination was carried out using the cluster random sampling technique, which aims to select samples from each district, spread across rural, suburban, and urban areas.

This research instrument was designed to measure Computational Thinking (CT) and Environmental Awareness (EA) in science learning in elementary schools. This instrument is in the form of a multiple-choice test consisting of 20 questions, with 10 questions focusing on CT and the other 10 questions measuring EA. Each question has four answer choices (A, B, C, D) with one correct answer and three distractors. Scoring is done using a 1-0 system, where the correct answer receives a score of 1 and the incorrect answer receives a score of 0. The maximum score that students can achieve is 20, with a maximum score of 10 for each category. The instrument grid is shown in Table 1.

Table 1. Instrument Grid

Number	Measured Competencies	Indicator	Question Number
Computational Thinking (CT)			
1	Decomposition (Breaking down complex problems into smaller parts)	Students can identify the steps in solving a simple scientific problem.	1, 2
2	Pattern Recognition (Recognizing patterns in a problem)	Students can identify patterns in scientific phenomena that relate to everyday life.	3, 4
3	Abstraction (Filtering out important information and ignoring irrelevant details)	Students can simplify a scientific concept to gain a better understanding.	5, 6
4	Algorithmic Thinking (Creating systematic steps to solve a problem)	Students can arrange a sequence of steps to solve a science-based problem.	7, 8
5	Logical Reasoning (Reasoning logically in problem solving)	Students can determine the most logical solution based on the information provided.	9, 10

	Environmental Awareness (EA)		
6	Understanding Environmental Issues (*Memahami masalah lingkungan*)	Students can recognize various environmental issues, including pollution, deforestation, and climate change.	11, 12
7	Causes and Effects of Environmental Problems (*Memahami penyebab dan dampak dari permasalahan lingkungan*)	Students can explain the cause-and-effect relationship of an environmental phenomenon.	13, 14
8	Sustainable Practices (*Mengetahui cara menjaga lingkungan*)	Students can choose the most appropriate action to maintain environmental sustainability.	15, 16
9	Human and Nature Relationship (*Hubungan manusia dengan lingkungan*)	Students can understand how human activities impact the environment and learn how to mitigate their effects.	17, 18
10	Ethical and Cultural Awareness in Environmental Conservation (*Kesadaran budaya dan etika dalam menjaga lingkungan*)	Students can identify cultural values that support environmental sustainability, such as *Tri Hita Karana.*	19, 20

The first part of the instrument measures Computational Thinking (CT) through five main aspects. This ability is crucial in science learning because it enables students to understand science concepts more deeply through a problem-solving approach. The second part measures Environmental Awareness (EA) by assessing students' understanding of environmental issues and their level of involvement in environmental preservation. By integrating cultural values into learning, students are expected to have not only a scientific understanding but also a stronger ecological awareness.

This study uses quantitative data analysis techniques, namely descriptive and inferential analysis. Quantitative data analysis methods are a way of analyzing data in the form of percentages or numbers. Descriptive analysis is used to process data and describe the results of implementation data (Dietmaier, 2017; Eğmir et al., 2017)including the drawing of inferences. When data are well presented, it is usually obvious whether the author has collected and evaluated them correctly and in keeping with accepted practice in the field. METHODS: Statistical variables in medicine may be of either the metric (continuous, quantitative. Furthermore, inferential analysis is used to test the research hypothesis that is carried out during the implementation process in elementary schools. The analysis techniques used include descriptive analysis to interpret the results obtained from the questionnaire. Meanwhile, qualitative data is analyzed thematically through the coding and categorization process, which aims to identify the main themes that emerge from the literature review. The results of this analysis are then integrated to provide a comprehensive picture of the problems of English learning that emphasize critical thinking and communication skills.

RESULTS AND DISCUSSION

A descriptive statistical analysis was conducted to assess the impact of Unplugged Coding Learning, integrated with *Tri Hita Karana* values, on Computational Thinking (CT) and Environmental Awareness (EA) in elementary science education. The results of the mean, standard deviation, minimum, and maximum scores for both variables are presented in Figure 1.

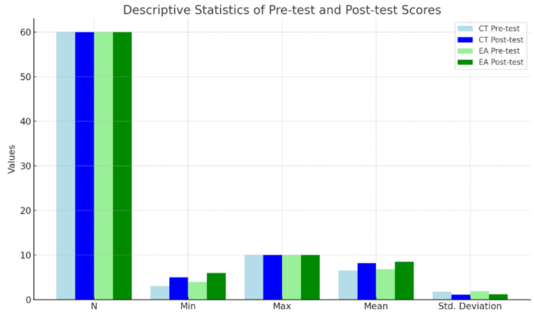

Figure 1. Descriptive Statistics of Computational Thinking and Environmental Awareness

Based on the results in Table 2, the mean score for Computational Thinking (CT) was 7.85 with a standard deviation of 1.42, while the mean score for Environmental Awareness (EA) was 8.12 with a standard deviation of 1.37. The range of scores indicates that students generally performed well in both competencies, with minimum scores of 4 and 5 and maximum scores of 10. To further categorize the students' proficiency levels, the scores were classified into three categories: low (0-4), moderate (5-7), and high (8-10). The percentage distribution of students in each category is presented in Table 2.

Table 2. Percentage Distribution of Computational Thinking and Environmental Awareness Levels

Level	CT (%)	EA (%)
Low (0-4)	8.3	5.0
Moderate (5-7)	36.7	30.0
High (8-10)	55.0	65.0

The results show that 55% of students achieved a high level of Computational Thinking, while 65% of students demonstrated a high level of Environmental Awareness. Meanwhile, only 8.3% of students scored in the low category for CT, and 5.0% of students had low EA scores. This suggests that the Unplugged Coding Learning approach, integrated with *Tri Hita Karana* values, effectively enhanced both competencies in elementary science education.

Before conducting further statistical analysis, a prerequisite test was performed to ensure that the data met the assumptions of normality and homogeneity. These tests are essential for determining the appropriate statistical approach to analyzing the effects of Unplugged Coding Learning, integrated with *Tri Hita Karana* values, on Computational Thinking (CT) and Environmental Awareness (EA).

The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to assess whether the Computational Thinking (CT) and Environmental Awareness (EA) scores followed a normal distribution. The results of the normality test are presented in Table 3.

Table 3. Normality Test Results

Variable	Kolmogorov-Smirnov Sig.	Shapiro-Wilk Sig.	Decision
Computational Thinking (CT)	0.089	0.091	Normally Distributed
Environmental Awareness (EA)	0.072	0.065	Normally Distributed

The results indicate that the significance values (Sig.) for both Kolmogorov-Smirnov and Shapiro-Wilk tests are greater than 0.05, meaning that both variables are normally distributed. This suggests that parametric statistical tests can be used for further analysis. The normal distribution of CT and EA scores indicates that the data collection was consistent and unbiased, making it reliable for hypothesis testing. A Levene's Test for Equality of Variances was conducted to assess whether the variances between the experimental and control groups were homogeneous. The results are presented in Table 4.

Table 4. Homogeneity Test Results (Levene's Test for Equality of Variances)

Variable	F	Sig.	Decision
Computational Thinking (CT)	1.256	0.273	Homogeneous
Environmental Awareness (EA)	1.134	0.312	Homogeneous

The results show that the significance values for both variables are greater than 0.05 (Sig. > 0.05), indicating that the data variances between groups are homogeneous. This means that the assumption of equal variance is met, allowing for further parametric statistical analysis, such as independent sample t-tests or MANOVA.

To examine the influence of Unplugged Coding Learning integrated with *Tri Hita Karana* values on Computational Thinking (CT) and Environmental Awareness (EA) in elementary science education, a Multivariate Analysis of Variance (MANOVA) test was conducted. This test was chosen because there are two dependent variables (CT and EA) and one independent variable (learning approach: Unplugged Coding with *Tri Hita Karana* vs. Conventional Learning). Additionally, a partial analysis (univariate tests) was conducted to determine the individual effects of the treatment on each dependent variable.

Multivariate Analysis of Variance (MANOVA) was conducted to investigate the impact of Unplugged Coding Learning, integrated with Tri Hita Karana values, on Computational Thinking (CT) and Environmental Awareness (EA) in elementary science education. The MANOVA test determines whether there is a significant difference between the experimental group (Unplugged Coding with THK values) and the control group (conventional learning) across the two dependent variables. The results of the hypothesis test are presented in Table 5.

Table 5. Results of MANOVA Hypothesis Test

Effect	Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	0.985	2785.342b	2.000	77.000
	Wilks' Lambda	0.015	2785.342b	2.000	77.000
	Hotelling's Trace	68.537	2785.342b	2.000	77.000
	Roy's Largest Root	68.537	2785.342b	2.000	77.000
Group (Learning Approach)	Pillai's Trace	0.382	23.462b	2.000	77.000
	Wilks' Lambda	0.618	23.462b	2.000	77.000
	Hotelling's Trace	0.619	23.462b	2.000	77.000
	Roy's Largest Root	0.619	23.462b	2.000	77.000

Note: $p < 0.05$ indicates statistical significance.

Based on Table 5, the results of the Multivariate Tests show that the learning approach (Unplugged Coding with THK values vs. Conventional Learning) has a statistically significant effect on the combined dependent variables (Computational Thinking and Environmental Awareness), as indicated by the Wilks' Lambda value of 0.618, with an F-value of 23.462 and a significance level of $p = 0.000$. This means that the implementation of Unplugged Coding integrated with THK values significantly influences both Computational Thinking and Environmental Awareness in elementary science education.

The hypothesis testing results demonstrate that Unplugged Coding Learning integrated with Tri Hita Karana values significantly improves both Computational Thinking and Environmental Awareness in elementary science education. These findings align with previous research on the effectiveness of Unplugged Coding in enhancing problem-solving skills and logical reasoning (Kong & Wang, 2020; Kirçali & Özdener, 2022). The higher effect size for Computational Thinking (31.4%) suggests that students in the experimental group developed more effective problem-solving strategies, logical reasoning, and algorithmic thinking compared to those in the control group. This supports the claim that Unplugged Coding fosters essential computational skills even without the use of digital devices, as students engage in hands-on activities that simulate real coding logic.

The significant improvement in Environmental Awareness (25.6%) supports the importance of integrating cultural values in science education. The *Tri Hita Karana* (THK) philosophy—harmony with God (Parahyangan), harmony with others (Pawongan), and harmony with nature (Palemahan)—encouraged students to reflect on their ethical responsibilities towards the environment, leading to a stronger sense of ecological awareness and sustainable behavior. Interestingly, students who demonstrated stronger Computational Thinking skills also exhibited higher Environmental Awareness, indicating that problem-solving skills may help students approach environmental challenges with a structured and analytical mindset. This finding suggests the potential for STEM education models that integrate computational thinking with ethical and environmental considerations to create a more holistic learning experience (Jampel., et al., 2018; Noh & Lee, 2020).

Then, to determine the effect of Unplugged Coding Learning integrated with Tri Hita Karana values on Computational Thinking (CT) and Environmental Awareness (EA), a partial test was conducted. The results are presented in Table 6.

Table 6. Partial Test Results

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Computational Thinking	28.574a	1	28.574	21.372	0.000
	Environmental Awareness	33.781b	1	33.781	27.654	0.000
Intercept	Computational Thinking	4875.432	1	4875.432	3647.128	0.000
	Environmental Awareness	5321.781	1	5321.781	4521.349	0.000
Group (Learning Approach)	Computational Thinking	28.574	1	28.574	21.372	0.000
	Environmental Awareness	33.781	1	33.781	27.654	0.000
Error	Computational Thinking	104.362	78	1.338		
	Environmental Awareness	95.487	78	1.224		
Total	Computational Thinking	5008.368	80			
	Environmental Awareness	5451.328	80			
Corrected Total	Computational Thinking	132.936	79			
	Environmental Awareness	129.268	79			

Note:
a. R Squared = 0.215 (Adjusted R Squared = 0.204)
b. R Squared = 0.268 (Adjusted R Squared = 0.257)

Based on Table 6, the results of the Tests of Between-Subjects Effects indicate that the learning approach (Unplugged Coding with Tri Hita Karana values) has a statistically significant effect on both Computational Thinking (CT) and Environmental Awareness (EA). These findings indicate that Unplugged Coding Learning, integrated with *Tri Hita Karana* values, effectively enhances both Computational Thinking and Environmental Awareness in elementary science education. The effect on Environmental Awareness (26.8%) is slightly more substantial than the effect on Computational Thinking (21.5%), suggesting that the cultural and ethical aspects of *Tri Hita Karana* (THK) contribute more directly to students' awareness of environmental issues.

The results indicate that students who engaged in Unplugged Coding Learning demonstrated significant improvements in their problem-solving, logical reasoning, and pattern recognition skills. This finding aligns with studies that emphasize Unplugged Coding as an effective method for developing Computational Thinking without relying on digital technology (Parmajaya, 2018; Afnan et al., 2022; Riastini et al., 2025). Additionally, the integration of *Tri Hita Karana* (THK) values may have further enhanced these skills by embedding ethical reasoning and collaborative problem-solving into the learning process. By incorporating cultural and moral dimensions, students were encouraged to approach computational problems with a holistic mindset, considering both individual and communal perspectives.

The more substantial effect on Environmental Awareness suggests that *Tri Hita Karana* values play a crucial role in helping students understand the interconnectedness between technology, society, and nature. In particular, the Palemahan aspect of THK, which focuses on harmony with nature, encourages students to apply their learning to real-world environmental challenges, such as sustainability and conservation. This aligns with the perspectives of studies that highlight the importance of integrating local wisdom into education, as it fosters a deeper ecological awareness and responsibility among students (Li et al., 2021; Arık & Topcu, 2022).

By embedding cultural values into science education, students not only develop critical thinking skills but also a sense of environmental stewardship, making their learning experience more meaningful and impactful.

CONCLUSION

The findings of this study indicate that Unplugged Coding Learning, integrated with *Tri Hita Karana* values, significantly enhances both Computational Thinking and Environmental Awareness in elementary science education. The statistical analysis confirms that this learning approach accounts for 21.5% of the variance in Computational Thinking and 26.8% in Environmental Awareness, with a more substantial impact on students' environmental consciousness. These results highlight the effectiveness of culturally integrated STEM education in fostering both problem-solving skills and ecological responsibility. The implications of this study suggest that incorporating local wisdom into educational practices can provide a more holistic and meaningful learning experience, bridging cognitive skills with ethical and environmental awareness. Future research should explore the long-term impact of this approach on students' attitudes and behaviors toward sustainability and technological problem-solving.

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REFERENCES

Afnan, M., Lasmawan, I. W., & Margunayasa, I. G. (2022). Media Pembelajaran IPS Berbasis Android pada Topik Globalisasi di Sekitarku Bermuatan Tri Hita Karana untuk Siswa Kelas VI Sekolah Dasar. *Mimbar PGSD Undiksha*, *10*(1), 1–8.

Afni, N., & Hartono. (2020). Contextual teaching and learning (CTL) as a strategy to improve students mathematical literacy. *Journal of Physics: Conference Series*, *1581*(1).

Annisa, F., Rahmawati, L. C., & Wahyuningsih, Y. (2022). Analisis Efektivitas Penerapan Model Make A Match Berbasis Media Puzzle Terhadap Hasil Belajar Siswa SD pada Mata Pelajaran IPS di SD. *JOURNAL ON EDUCATION*, *5*(1).

Arık, M., & Topcu, M. S. (2022). Computational thinking integration into science classrooms: Example of digestive system. *Journal of Science Education and Technology*, *31*(1), 99–115.

Arnyana, I. B. P., & Utami, I. A. M. I. (2022). The Implementation of Tri Hita Karana Culture-Based Character Education at Pasraman Budi Pekerti, Kemenuh Village, Bali. *Proceedings of the 4th International Conference on Innovative Research Across Disciplines (ICIRAD 2021)*, *613*, 279–285. 5

Azis, A. (2020). *Mengintegrasikan Computational Thinking (CT) pada Pembelajaran melalui Pemodelan SIMSKETCH untuk Meningkatkan Berpikir Kritis Siswa pada Konsep Sistem Ekskresi*.

Bahtiar, B., Ibrahim, I., & Maimun, M. (2022). Analysis of Students' Scientific Literacy Skill in terms of Gender Using Science Teaching Materials Discovery Model Assisted by PhET Simulation. *Jurnal Pendidikan IPA Indonesia*, *11*(3), 371–386.

Baygin, M., Yetis, H., Karakose, M., & Akin, E. (2016). ITHET 2016 : 2016 15th International Conference on Information Technology Based Higher Education and Training (ITHET) : September 8-10, 2016, Istanbul, Turkey. *Institute of Electrical and Electronics Engineering*, 4.

Bers, M. U., González-González, C., & Armas-Torres, M. B. (2019). Coding as a playground: Promoting positive learning experiences in childhood classrooms. *Computers and Education*, *138*(June 2018), 130–145.

Brahmandika, P. G., Gatriyani, N. P., & Sudiarta, I. W. (2024). Integrasi Nilai-Nilai Tri Hita Karana dalam Pembelajaran Aksara Bali Perspektif Etnopedagogi. *Maha Widya Duta*, *8*(2), 167–174.

Devi, N. M. S. N., & Basilius Redan, W. (2023). Media Komik Digital Berbasis Kearifan Lokal Tri Hita Karana. *Mimbar PGSD Undiksha*, *11*(1), 71–80.

Dietmaier, C. (2017). Deskriptive Statistik. In *Mathematik für Wirtschaftsingenieure*.

Eğmir, E., Erdem, C., & Koçyiğit, M. (2017). Trends in educational research: A content analysis of the studies published in International Journal of Instruction. *International Journal of Instruction*, *10*(3), 277–294.

Hadad, R., Thomas, K., Kachovska, M., & Yin, Y. (2020). Practicing formative assessment for computational thinking in making environments. *Journal of Science Education and Technology*, *29*(1), 162–173.

Hasrudin, F., & Asrul, A. (2020). Pengaruh Model Pembelajaran Kooperatif Tipe Talking Stick Terhadap Hasil Belajar Siswa pada Pelajaran IPA di SD Inpres 16 Kabupaten Sorong. *Jurnal Papeda: Jurnal Publikasi Pendidikan Dasar*, *2*(2), 94–102.

Herdiawan, H., Langitasari, I., & Solfarina, S. (2019). Penerapan PBL untuk Meningkatkan Keterampilan Berpikir Kreatif Siswa pada Konsep Koloid. *EduChemia (Jurnal Kimia Dan Pendidikan)*, *4*(1), 24.

Islamiyah, L., & Asmarani, R. (2022). Pengembangan

Media Diorama Siklus Air Untuk Meningkatkan Hasil Belajar Siswa. *IJPSE : Jurnal Pendidikan IPA Dasar Indonesia*, *3*(1).

Jampel, I. N., Fahrurrozi, F., Artawan, G., Widiana, I. W., Parmiti, D. P., & Hellman, J. (2018). Studying natural science in elementary school using NOS-oriented cooperative learning model with the NHT type. *Jurnal Pendidikan IPA Indonesia*, *7*(2), 138–146.

Jawad, L. F. (2022). Mathematical connection skills and their relationship with productive thinking among secondary school students. *Periodicals of Engineering and Natural Sciences*, *10*(1), 421–430.

Karmini, N. W., Yudari, A. A. K. S., Suasthi, I. G. A., Hadriani, N. L. G., & Setini, M. (2021). Model of Humanism Education based on Local Wisdom in Elementary School in Bali. *International Journal of Early Childhood Special Education*, *13*(2), 1056–1063.

Ketut Susiani, Crisna Wijaya Sukma, Rizky Amalia, Ni Nyoman Gita Suriantini, & Ayu Gde Sutha Maharani. (2022). Esensi Konsep Tri Hita Karana Pada Pembelajaran Daring Sd Di Masa Pandemi Covid-19. *Guna Widya: Jurnal Pendidikan Hindu*, *9*(1), 74–83.

Kirçali, A. Ç., & Özdener, N. (2022). A Comparison of Plugged and Unplugged Tools in Teaching Algorithms at the K-12 Level for Computational Thinking Skills. *Technology, Knowledge and Learning*.

Kong, S. C., & Wang, Y. Q. (2020). Formation of computational identity through computational thinking perspectives development in programming learning: A mediation analysis among primary school students. *Computers in Human Behavior*, *106*, 106–230.

Lasmawan, I. W., & Sanjaya, D. B. (2024). Tri Hita Karana-Based Character Education: A Solution To Improve The Discipline Of Elementary School Students. *In Proceeding of International Conference on Islamic Education and Science Development*.

Lestiawati, I. ., Wiranata, I. G. ., & Astuti, A. . (2023). Pengembangan Permainan "Magic Box Kolaboratif" Berbasis Konsep Tri Hita Karana. *Jurnal Ilmiah Potensia*, *8*(1), 35–48.

Li, Y., Xu, S., & Liu, J. (2021). Development and validation of computational thinking assessment of Chinese elementary school students. *Journal of Pacific Rim Psychology*, *15*.

Marosi, N., Avraamidou, L., & Galani, L. (2021). Culturally relevant pedagogies in science education as a response to global migration. *SN Social Sciences*, *1*(6).

Misirli, A., & Komis, V. (2023). Computational thinking in early childhood education: The impact of programming a tangible robot on developing debugging knowledge. *Early Childhood Research Quarterly*, *65*(4), 139–158.

Molise, N. A., Botma, Y., & Jaarsveldt, D. Van. (2023). Cultural barriers and facilitators for transformative nursing curriculum transformation. *International Journal of Africa Nursing Sciences*, *18*.

Mutoharoh, H. A., F., M., & Rusdiyani, I. (2021). Unplugged Coding Activities for Early Childhood Problem-Solving Skills. *JPUD - Jurnal Pendidikan Usia Dini*, *15*(1), 121–140.

Noh, J., & Lee, J. (2020). Effects of robotics programming on the computational thinking and creativity of elementary school students. *Educational Technology Research and Development*, *68*(1), 463–484.

Nouri, J., Zhang, L., Mannila, L., & Norén, E. (2020). Development of computational thinking, digital competence and 21st century skills when learning programming in K-9. *Education Inquiry*, *11*(1), 1–17.

Pala, F. K., & Mıhcı -Turker, P. (2021). The effects of different programming trainings on the computational thinking skills. *Interactive Learning Environments*, *29*(7), 1090–1100.

Papadakis, S. (2021). The impact of coding apps to support young children in computational thinking and computational fluency. A literature review. In *Frontiers in Education* (Vol. 6, p. 657895). Frontiers Media SA.

Parmajaya, I. P. G. (2018). Implementasi Konsep Tri Hita Karana Dalam Perspektif Kehidupan Global: Berpikir Global Berperilaku Lokal. *Jurnal Pendidikan Fisika*, *4*(1), 57–62.

Parwata, I. G. A. L., Jayanta, I. N. L., & Widiana, I. W. (2023). Improving Metacognitive Ability and Learning Outcomes with Problem-Based Revised Bloom's Taxonomy Oriented Learning Activities. *Emerging Science Journal*, *7*(2), 569–577.

Rati, N. W., & Rediani, N. N. (2021). Teachers and Parents Perspective: Is It Difficult for Project-Based Learning (PjBL) During the Covid-19 Pandemic? … *Journal of Elementary Education*, *5*(4), 515–524.

Raymond, E. T., Cassidy, M., & Puttick, G. (2021). Science Teachers can Teach Computational Thinking through Distributed Expertise. *Computers & Education*, *173*(1), 104284.

Riastini, P. N., Mahayanti, N. W. S., Jayanta, I. N. L., Margunayasa, I. G., & Astawan, I. G. (2025). Elementary school teachers candidates' perceptions of tpack ownership: Teaching assistance program. *Multidisciplinary Science Journal*, *7*(2).

Rogers, J., & Revesz, A. (2019). Experimental and quasi-experimental designs.

Saiful, B., Emi, T., Sandie, S., & Dewi, R. (2022). Internalisasi Nilai-Nilai dalam Sistem Beuma Masyarakat Desa Nanga Mahap dalam Pembelajaran IPS Berbasis Etnopedagogi. *JURNAL BASICEDU*, *6*(3), 5397–5407.

Sarjana, I. P., Gelgel, I. P., & Utama, I. W. B. (2020). The Dynamics of Tri Hita Karana Implementation in The Balinese Hindu Residence in South Denpasar. *International Journal of Interreligious and Intercultural Studies*, *3*(2), 58–68.

Sholihah, Q., Kuncoro, W., Wahyuni, S., Puni Suwandi, S., & Dwi Feditasari, E. (2020). The analysis of the causes of flood disasters and their impacts in the perspective of environmental law. *IOP Conference Series: Earth and Environmental Science*, *437*(1).

Su, J., Zhong, Y., & Ng, D. T. K. (2022). A meta-review of literature on educational approaches for teaching AI at the K-12 levels in the Asia-Pacific region. *Computers and Education: Artificial Intelligence*, *3*(March), 100065.1-18.

Sukma, M. C., & Ibrahim, M. (2016). Developing materials for active learning of guided inquiry-integrated bowling campus on the topic of sense of hearing and sonar system of living organism. *Jurnal Pendidikan IPA Indonesia*, *5*(2), 256–260.

Susilaningsih, E., Drastisianti, a., Lastri, Kusumo, E., & Alighiri, D. (2019). The analysis of concept mastery using redox teaching materials with multiple representation and contextual teaching learning approach. *Jurnal Pendidikan IPA Indonesia*, *8*(4), 475–481.

Tegeh, I. M., Astawan, I. G., Sudiana, I. K., & Kristiantari, M. G. R. (2021). Murder Learning Model Assisted By Metacognitive Scaffolding To Improve Students' Scientific Literacy and Numeracy Skills Through Science Studies in Elementary Schools. *Jurnal Pendidikan IPA Indonesia*, *10*(4), 618–626.

Tegeh, I. M., Santyasa, I. W., Agustini, K., Santyadiputra, G. S., & Juniantari, M. (2022). Group Investigation Flipped Learning in Achieving of Students' Critical and Creative Thinking Viewed from Their Cognitive Engagement in Learning Physics. *Journal of Education Technology*, *6*(2), 350–362.

Temaja, I. G. B. W. B. (2021). Pentingnya makna dan nilai budaya konsep kaja kangin (utara timur) di Bali pada anak. *Widya Kumara Jurnal Pendidikan Anak Usia Dini*, *2*(2), 189–198.

Tsortanidou, X., Daradoumis, T., & Barberá-Gregori, E. (2022). Unplugged computational thinking at K-6 education: Evidence from a multiple-case study in Spain. *Education*, *3–13*, 1–18.

Wardhani, N. K. S. K., Karmini, N. W., & Wibawa, I. P. S. (2020). Tri Hita Karana-Oriented Education as an Effort to Integrate Environmental Education in Bali High Schools. *Talent Development & Excellence*, *12*(1), 3975–3983.

Whiting, S. B., Wass, S. V., Green, S., & Thomas, M. S. C. (2021). Stress and Learning in Pupils: Neuroscience Evidence and its Relevance for Teachers. *Mind, Brain, and Education*, *15*(2), 177–188.

Widiana, I W, Kusmariatni, I. N., Sedana, D. N., & Riastini, P. A. (2019). Science learning achievement: Three dimension-media innovation in contextual learning approach. *Journal of Educational Research and Evaluation*, *3*(4), 224–232.

Widiana, I Wayan, Gading, I. K., Tegeh, I. M., & Antara, P. A. (2020). *Validasi Penyusunan Instrumen Penelitian Pendidikan* (S. Nurachma (ed.)). PT Raja Grafindo Persada.

Youjun, T., & Xiaomei, M. (2022). Computational thinking: A mediation tool and higher-order thinking for linking EFL grammar knowledge with competency. *Thinking Skills and Creativity*, *46*(October), 101143.