JVCE 8 (2) (2023) : 51-60

Journal of Vocational Career Education

https://journal.unnes.ac.id/nju/index.php/jvce

Development of a Gamified Website Using the Rapid Application Development (RAD) Method for Computational Thinking Elements in Vocational High Schools

Luluk Latifah[1]✉, Dwi Wijanarko[2], Samsudin Anis[2]

[1]PT. Brightchamps Edtech, Indonesia
[2]Pascasarjana, Universitas Negeri Semarang, Indonesia

Article Info

Article History :
Received
May 2023
Accepted
July 2023
Published
December 2023

Keywords:
Computational Thinking; Rapid Application Development; Gamified Website

Abstract

The competency in computational thinking elements among students at SMK Al-Musyawirin is still lacking. The learning outcomes, averaging 75, are below the minimum passing criteria. Currently, the teaching method relies solely on textbooks, resulting in insufficient understanding of the material by the students. To address this issue, there is a need for an educational medium that can enhance students comprehension of the subject matter, such as a website. This study aims to develop a gamified website as a learning medium to improve students understanding of computational thinking elements. The website was developed using the Rapid Application Development (RAD) method, which involves stages of requirements planning, RAD design workshop, and implementation. The instruments used were: (1) black-box questionnaire; (2) material feasibility questionnaire; (3) User Acceptance Testing questionnaire; and (4) objective tests. The validity of the instruments was calculated using CVR, while their reliability was measured using Cronbach's Alpha, ICC, and Spearman-Brown. Finally, test reliability was assessed using the Spearman-Brown formula. Data analysis employed categorical analysis for media and material feasibility, as well as user acceptance levels. The effectiveness of the website was measured using N-Gain and t-tests. Results indicated that the website is feasible in terms of media and material, well-received by students, and effective and significant in improving computational thinking competencies, particularly in the conversion between number systems (binary, decimal, hexadecimal).

✉ Correspondence:
AXA Tower 45th floor, Jl. Prof. Dr Satrio Kav. 18, Kel. Karet Kuningan, Kec. Setiabudi, Kota Jakarta Selatan, Prov. DKI Jakarta, Indonesia
E-mail: luluklatifah.id@gmail.com

p-ISSN 2339-0344
e-ISSN 2503-2305

INTRODUCTION

In the Informatics course for 10th grade students at SMK, there is an element of computational thinking, specifically aimed at enabling students to convert between number systems (decimal, binary, hexadecimal). However, the current situation shows that students only achieve an average score of 75. This indicates that they have not yet mastered the material on converting between number systems. Upon observation, it was found that teachers were teaching the Informatics course using only textbooks. In fact, an interactive learning medium is needed, especially for the topic of number conversion, which is much easier to understand with animations demonstrating the conversion process.

Due to the rapid advancement of technology in the education sector, many technologies have been implemented in classroom management and learning processes (Moto, 2019). The increasing use of technology in the context of educational media provides opportunities for educators to innovate in achieving learning objectives (Muassar, 2022). Additionally, it serves as a means of presenting course material to maximize the learning process (Gunawan, 2016). One appropriate technological application in education is the use of websites. This aligns with the view of Jannah et al. (2022), who state that effective learning processes require appropriate learning media.

According to Sibero (2015), a website is a system related to documents used to display text, images, multimedia, and other elements via the internet. Information on digital pages can include text, animations, images, sounds, and videos, or a combination of all these, accessible to anyone using the internet (Sari et al., 2019). In the study by Supraptono & Setiawan (2017), 85.30% of student responses indicated that web-based learning media significantly helped improve their competencies in basic electronics course material.

The reality in the field also supports the background of this study, as SMK Al-Musyawirin does not yet have web-based learning media, and the application of technology has not been effectively implemented, either in classrooms or in daily activities. The website will be combined with gamification elements, as gamification has great potential to motivate students and make learning more engaging (Lee, 2011). Therefore, the aim of this study is to develop a gamified website focused on computational thinking elements at SMK Al-Musyawirin and to test the feasibility, user acceptance, and effectiveness of the website in enhancing computational thinking competencies.

METHOD

Research Design

The website development method used in this study is Rapid Application Development (RAD). According to Wijaya (2020), RAD is a method in the software development process. The study population consisted of 10th grade students majoring in Computer and Network Engineering at SMK Al-Musyawirin, specifically from class group 1. This study sampled 31 students from this group using a one-group pre-test post-test design.

Stages of Website Development

There are three phases in the RAD method according to Kendall & Kendall (2011): requirements planning, RAD design workshop, and implementation. Requirements Planning: In this phase, users and analysts discuss to identify the initial goals and requirements for the software or system to be developed. RAD Design Workshop: This phase involves designing and refining the system, including learning content design, user interface, website features, and research instrument design. Implementation: In this phase, the system is built according to the discussions in the previous stages. This includes testing the validity and reliability of the research instruments, system feasibility testing, and system revision. Once deemed feasible, the system is applied to the predetermined population. Formative and summative evaluations are then conducted to assess the cognitive abilities of students in computational thinking elements, followed by effectiveness testing using N-Gain and t-tests. Finally, system testing is conducted through user acceptance questionnaires completed by the students.

Research Instruments

The website testing used three research instruments: black-box questionnaires, material feasibility questionnaires, and User Acceptance Testing (UAT) questionnaires. Validity was tested using the Content Validity Ratio (CVR) formula. The reliability of the black-box questionnaire was measured using Cronbach's Alpha, while the material feasibility and UAT questionnaires used the Intraclass Correlation Coefficient (ICC). The Spearman-Brown formula was used for testing. Five experts tested the validity and reliability of the research instruments. The results of content validity and reliability testing are presented in Table 1.

Table 1. Validity and Reliability Results

Questionnaire	Validity Results	Reliability Results	Category
Black-Box	1	0.841	Valid and good reliability
Material	1	0.822	Valid and good reliability
UAT	1	0.620	Valid and moderate reliability
Test	1	0.8912	Valid and good reliability

Data Analysis Techniques

Data from the black-box questionnaires were analyzed using the feature completeness matrix, which evaluates the extent to which features can be appropriately implemented. If a feature works correctly, it scores 1; otherwise, it scores 0. A score of 1 indicates feasibility, while 0 indicates non-feasibility. Results from the material feasibility and UAT questionnaires, and tests were analyzed using measures of central tendency (mean) and descriptive analysis with percentages. The results were analyzed based on the criteria of each questionnaire.

Next, test data were subjected to a normality test using the Kolmogorov-Smirnov test. Data is considered normal if the significance value is greater than 0.05 ($p>0.05$). Conversely, if the significance value is less than 0.05 ($p<0.05$), the data is considered non-normal (Sugiyono, 2015). After ensuring that the data has a normal distribution, the next step is to test data homogeneity. The homogeneity test determines whether the pre-test and post-test data have the same variance. If the significance value is less than 0.05, the variances of the groups are not equal. If the significance value is greater than 0.05, the variances are considered equal (Rosalina et al., 2023).

The next step is to calculate the N-Gain value from the data to evaluate the effectiveness of the gamified website-based learning media. The data from the pre-test and post-test are explained descriptively by calculating the proportion or percentage. Results are classified according to effectiveness criteria: 56-75% indicates moderately effective, and >76% indicates effective. A paired sample t-test is then conducted to assess the mean difference between two related samples or groups (Syafriani et al., 2023). Decision-making using SPSS software involves comparing the Sig. (2-tailed) value with the α value. H0 is accepted when the Sig. (2-tailed) value is greater than α, and H0 is rejected when it is less (Ghozali, 2011). H0 indicates no difference between the means of two samples/groups, while Ha indicates a difference.

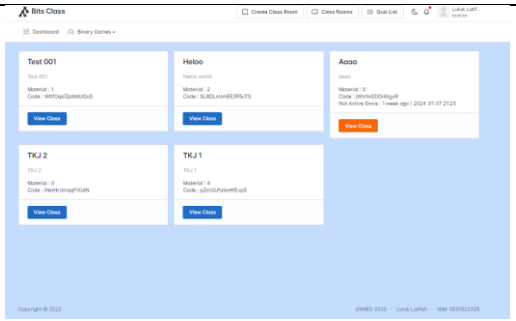
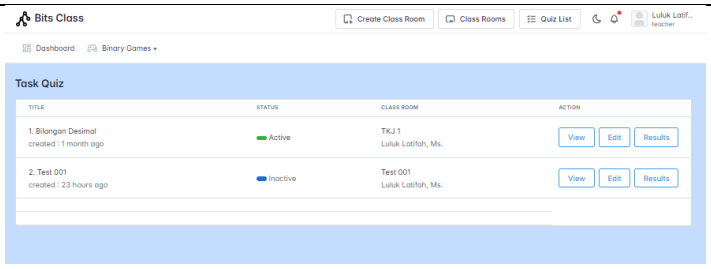
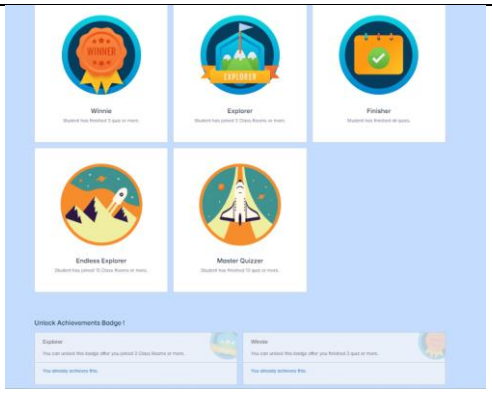
RESULTS AND DISCUSSION

Results

The gamified website focused on computational thinking elements can be accessed via the link https://bits-class.my.id/. The website is named Bits-Class, where "bits" refer to binary numbers, one of the number systems in computational thinking elements. Bits-Class was developed using Laravel versions 8.X-9.X as the primary FullStack framework. The database uses MySQL and PostgreSQL to ensure scalability and meet requirements. System security is ensured by adhering to OWASP Top 10 standards. Gamification elements, such as a scoring system, achievements, levels, and badges, were integrated according to the research objectives. Students found the website easy to use, beneficial as a primary resource for material search, and useful for evaluating their cognitive

skills. The website generated enthusiasm among students for learning and playing games related to computational thinking elements. Table 2 presents some of the website features.

Table 2. Website Features

No	Bits-class Website Display	Main Features
1		Dashboard for joining classes
2		Binary game
3		Quizzes
4		Manage profile and badges information

Feasibility Testing Results

Five experts evaluated the feasibility of the media, including content specialists. Among them were three academics: one professor from the Faculty of Computer Science and two vocational high school teachers with master's degrees. The remaining two experts were practitioners in the field. The website feasibility test was conducted using black-box testing. The results of the black-box testing are presented in Table 3.

Table 3. Average Media Feasibility Results (Media Experts)

No	Indicator	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Average	Category
1	Completeness of visual and text system	1	1	1	1	1	1	Feasible
2	System feasibility and navigation	1	1	1	1	1	1	Feasible
3	Software accuracy	1	1	1	1	1	1	Feasible

Next, content evaluation was conducted for the material presented on the website. The percentage results are shown in Table 4.

Table 4. Material Feasibility Percentage Results (Material Experts)

No	Indicator	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Material Suitability Level (%)	Category
1	Learning Design	9	8	10	8	9	88	Highly Feasible
2	Content	45	36	45	37	35	88	Highly Feasible
3	Language	24	20	25	24	20	90,4	Highly Feasible

Effectiveness Testing Results

The effectiveness of the gamified website was tested using data from objective test scores from both pre-tests and post-tests. The initial step was to test the data normality using the Kolmogorov-Smirnov test. The results of the normality test are shown in Table 5.

Table 5. Normality Test Results

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	.109	31	.200*	.981	31	.842
Posttest	.157	31	.051	.950	31	.153

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on the Kolmogorov-Smirnov significance value of 0.200 > 0.05, the pre-test data is normally distributed. Similarly, the post-test data is normally distributed with a significance value of 0.051 > 0.05. The next step was the homogeneity test to ensure that the groups had comparable variances, indicating they were homogeneous. The homogeneity test results are shown in Table 6.

Table 6. Homogeneity Test Results

Test of Homogeneity of Variances

Result

Levene Statistic	df1	df2	Sig.
1.654	1	60	.203

Based on the significance value of 0.203, which meets the criteria of 0.203 > 0.05, the pre-test and post-test data variances are considered equal or homogeneous. Next, the N-Gain value was determined from the test data to evaluate the effectiveness of the gamified website-based learning media. The average pre-test and post-test percentage scores are shown in Table 7.

Table 7. N-Gain Test Results

Pre-test	41%
Post-test	74%
N-Gain	55.93%

The calculated N-Gain of 55.93% falls into the category of moderately effective. This means that the applied learning media is sufficiently effective in enhancing computational thinking skills. Finally, a paired sample t-test was conducted to determine whether there was a significant mean difference between the two related samples (pre-test and post-test). The test results are shown in Table 8.

Table 8. Paired Sample T-Test Results

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pretest - Posttest	-32.61290	11.62376	2.08769	-36.87653	-28.34927	-15.622	30	.000

The test results indicate a significance value (2-tailed) of 0.000 < 0.05, suggesting a significant difference between the pre-test and post-test mean scores.

User Acceptance Testing Results

Overall, the user acceptance testing of the gamified website by students was conducted to ensure that the system met their needs and preferences while providing a pleasant and effective learning experience. The results are shown in Table 9.

Table 9. User Acceptance Testing Percentage Results (UAT)

No	Indicator	$\sum x$ Total Score per Item	User Acceptance (%)	Category
1	Perceived Ease of Use	717	92.5	Very Good
2	Perceived Usefulness	416	89.46	Very Good
3	Attitude Toward Using	269	86.77	Very Good
4	Behavioural Intention	407	87.52	Very Good

Based on the results, an average score of 89.56% was achieved, indicating that the gamified website received a very good rating.

Discussion

The feasibility of the gamified website as a learning medium for computational thinking elements in the Informatics subject has been affirmed by five Media Experts through black-box

testing. This finding aligns with studies by Febriyantia et al. (2021), Septiany (2018), and Swari et al. (2023), as the testing results showed a score of 1, indicating the system is good. The website features include login access, binary games, logout menu, password changes, profile data updates, joining classes, quiz list menu, taking quizzes and viewing results, creating classes, creating quizzes, uploading materials, viewing quiz details and providing feedback, creating teacher accounts, viewing all accounts, freezing student and teacher accounts, deleting student accounts, and creating notifications.

The website effectively fulfills the aspect of functional completeness by offering thorough information and features that correspond to the objectives and requirements of users. According to Anwariningsih (2011), the structure of a website should consider elements such as menu/information placement, content diversity, information comprehensiveness, alignment with visitor needs, user-friendly search capabilities, structured information presentation, and clarity of information for users. The aspect of functional appropriateness is well accommodated in the website's design and implementation. The provided features are contextually relevant to the users' needs, creating an appropriate and relevant environment. Lastly, the aspect of functional correctness is evident in the website's ability to perform expected functions without errors or issues. All major features operate consistently and as expected.

Content evaluation involved assessing the material presented on the website. The study revealed that the gamified website is highly feasible, scoring 88.75% in the material aspect. Five Content Experts evaluated the material from the perspectives of instructional design, content, and language. The instructional design of the website maintains logical and structured content progression, enabling users to follow the material effectively, from basic concepts to deeper understanding, creating an effective learning experience. This supports John Sweller's Cognitive Load Theory, which explains that well-presented material with a structured layout can help reduce the cognitive load experienced by students (Hanifah et al., 2023).

The website content aligns with the learning objectives and is designed to support target achievement. Each material section is clearly and coherently arranged, enriched with examples, images, and relevant questions. This is consistent with Sumarni et al. (2021), who found that materials supplemented with disaster images from various regions in Indonesia help clarify complex concepts, enhance user comprehension, and facilitate better understanding. The language aspect ensures the use of proper enhanced spelling system in delivering information with correct language structure, improving communication quality and understanding. This aligns with Susanto (2020), where the language and communication aspects received a very feasible category.

User acceptance testing showed that the website met user expectations, scoring 89.56%, which falls under the very good category. Regarding perceived ease of use, users found the information on the website easily accessible. The intuitive navigation design and structured menus facilitated information search. The data management system was considered efficient and easy to understand, with smooth data input and update processes. Users quickly understood the website's features, indicating a high level of system mastery. This is consistent with Uzir et al. (2023), who found significant positive effects on customer interest influenced by ease of use and consistent information access.

Perceived usefulness is defined as a belief in the enhancement of performance and productivity achieved through new technology (Agag & El-Masry, 2016). Users reported significant benefits in achieving their goals with the website's effective features, adding value and high efficiency in completing tasks without significant obstacles. Concerning attitude toward using, users showed a positive interest in the website. This aligns with Albayati (2024), where users felt that using this technology added value and enhanced their overall experience. Lastly, in the behavioral intention aspect, the results indicated a strong desire among users to continue utilizing the website's services and features. This is in line with findings that gamification effectively promotes and enhances student

engagement and can be further explored for use beyond the classroom (Ghani et al., 2022).

By using game elements like points, levels, and badges, students were more engaged and motivated in learning. The improvement was evident, with an N-Gain of 55.93% and a significant difference after the intervention with the website. Students completed tasks faster through the gamified website, which offered an interactive and enjoyable learning experience. They could monitor their progress and achieve points or badges, increasing their motivation. This resulted in more effective and sustainable learning. Pambudi et al. (2018) showed that such learning media significantly improved student achievement. Other studies also demonstrated that gamified learning media could enhance student learning outcomes, showing meaningful differences before and after implementing gamified learning media (Erlangga et al., 2023; Rusmaini et al., 2021; Khaleel et al., 2021; Andhi et al., 2021; Zhan et al., 2022). Student learning outcomes improved, particularly in the competency of converting between number systems (binary, decimal, hexadecimal), from understanding the definitions to categorizing numbers and converting them. This aligns with Asyuyuti et al. (2022), who found that applying e-modules could enhance students' soft skills and learning outcomes.

CONCLUSION

The gamified website for computational thinking elements in the Informatics subject is feasible for use in the learning process, both from media and content testing. The website is also well accepted by users. Finally, the website is moderately effective and significant in improving competency in converting between number systems (binary, decimal, hexadecimal).

REFERENCES

Agag, G., & El-Masry, A. A. (2016). Understanding the determinants of hotel booking intentions and moderating role of habit. *International Journal of Hospitality Management*, *54*, 52–67. https://doi.org/https://doi.org/10.1016/j.ijhm.2016.01.007

Albayati, H. (2024). Investigating undergraduate students' perceptions and awareness of using ChatGPT as a regular assistance tool: A user acceptance perspective study. *Computers and Education: Artificial Intelligence*, *6*, 100203. https://doi.org/https://doi.org/10.1016/j.caeai.2024.100203

Andhi, R. R., Susilo, E., & Nasution, S. (2021). Improving Student's Coding Skill with Gamification Website-based Program. *International Journal of Electrical, Energy and Power System Engineering (IJEEPSE)*, *4*(3), 191–195.

Anwariningsih, S. H. (2011). *Multi Faktor Kualitas Website*. https://api.semanticscholar.org/CorpusID:108463346

Asyuyuti, I. B., Sudana, I. M., & Kuswardinah, A. (2022). Development of Industrial Culture Learning Module to Improve Student ' s Soft Skill at SMK Muhammadiyah 2 Kuningan. *Journal of Vocational and Career Education*, *7*(28), 1–8.

Erlangga, Munir, Septem Riza, L., Piantari, E., Junaeti, E., & Seanaldi Permana, I. (2023). Implementation of the Gamification Concept in the Development of a Learning Management System to Improve Students' Cognitive In Basic Programming Subjects Towards a Smart Learning Environment. *ADI Journal on Recent Innovation*, *5*(1 SE-Articles), 43–53. https://doi.org/10.34306/ajri.v5i1.902

Sudana, I. M., Apriyani, D., Supraptono, E., & Kamis, A. (2019). Business incubator training management model to increase graduate competency. Benchmarking: *An International Journal*, 26(3), 773-787.

Febriyantia, N. M. D., Sudana, A. A. K. O., & Piarsa, I. N. (2021). Implementasi Black Box Testing pada Sistem Informasi Manajemen Dosen. *JITTER- Jurnal Ilmiah Teknologi dan Komputer*, *2*(3).

Ghani, H. A., Rathi, N. A. M., Kadir, Z. A., Halim, F. S. A., & Buhari, T. A. (2022). The effectiveness of gamification through

classroom leaderboards for student engagement. *International Journal of e-Learning and Higher Education*. https://api.semanticscholar.org/CorpusID:260103678

Ghozali, I. (2011). *Aplikasi Analisis Multivariate dengan Progam SPSS*. Universitas Diponegoro.

Gunawan, A. (2016). Pemanfaatan Teknologi Informasi dan Komunikasi melalui Penggunaan Media Pendidikan dalam Pembelajaran IPS SD. *Pedagogi*, *3*(2). https://doi.org/10.25134/pedagogi.v3i2.1162

Hanifah, D. P., Supadmi, Mustafa, Wibowo, S., Wardani, K. D. K. A., Budiyono, A., Pratama, M. P., Sari, M. N., Taufikurrahman, Maliki, R. Z., Ervianti, Wijaya, L., Prihastari, E. B., & Putri, R. A. R. (2023). *Teori dan Prinsip Pengembangan Media Pembelajaran* (D. W. Mulyasari (ed.)). Pradina Pustaka. https://www.researchgate.net/publication/376720714_TEORI_DAN_PRINSIP_PENGEMBANGAN_MEDIA_PEMBELAJARAN

Jannah, R. N., Khumaedi, M., & Widjanarko, D. (2022). Developing Audio-Visual Learning Media in the Competency of Making Robe Patterns Based on the Design. *Journal of Vocational and Career Education*, *7*(2), 1–9.

Kendall, K. E., & E., K. J. (2011). *Systems Analysis And Design* (8 ed.). Prentice Hall.

Khaleel, F. L., Ashaari, N. S. @, & Wook, T. S. M. T. (2019). An Empirical Study On Gamification For Learning Programming Language Website. *Jurnal Teknologi*. https://api.semanticscholar.org/CorpusID:86813162

Lee, J. (2011). Gamification in Education: What, How, Why Bother? *Academic Exchange Quarterly, 15*(2).

Moto, M. M. (2019). Pengaruh Penggunaan Media Pembelajaran dalam Dunia Pendidikan. *Indonesian Journal of Primary Education*, *3*, 21–28.

Samsudi, S., Supraptono, E., Utanto, Y., Rohman, S., & Djafar, T. (2024). Unraveling the Merdeka Curriculum: Exploring Differentiated Instruction's Impact on Student Learning. *Jurnal Ilmiah Peuradeun*, 12(2), 517-538.

Muassar, M. Z. (2022). Tren Penggunaan Media Pembelajaran Berbasis Teknologi Sebagai Sebagai Judul Skripsi Pada Program Studi Pendidikan Matematika FTIK IAIN Palopo. *Jurnal Penelitian Multidisiplin Ilmu*, *1*(4), 765–770. https://melatijournal.com/index.php/Metta/article/view/255

Pambudi, S., Sukardiyono, T., & Surjono, H. D. (2018). The Development of Mobile Gamification Learning Application for Web Programming Learning. *IC-ELINVO*. https://doi.org/10.1088/1742-6596/1140/1/012046

Rosalina, L., Oktarina, R., Rahmiati, & Saputra, I. (2023). *Buku Ajar Statistika* (1 ed.). CV. MUHARIKA RUMAH ILMIAH.

Rusmaini, R., Sesriyani, L., & Anwar, S. (2021). *The Development of Gamification Model Assisted by Online Learning to Improve the Quality of Student Learning in Economic Education at Pamulang University*. https://doi.org/10.4108/eai.17-7-2020.2302975

Sari, A. O., Abdilah, A., & Sunarti. (2019). *Web Programming* (1 ed.). Graha Ilmu.

Septiany, D. A. (2018). Uji Kelayakan Sistem Informasi Kemajuan Kelas Berbasis Website di SMK Muhammadiyah 1 Bantul Yogyakarta Dengan Standar Kualitas ISO 25010. *Jurnal Elektronik Pendidikan Teknik Informatika*, *7*(2).

Sibero, A. F. K. (2015). *Web Programming Power Pack*. https://api.semanticscholar.org/CorpusID:106583639

Sugiyono. (2015). *Metode penelitian kombinasi (mixed methods)*. Alfabeta.

Sumarmi, S., Bachri, S., Irawan, L., & Aliman, M. (2021). E-module in Blended Learning: Its Impact on Students' Disaster Preparedness and Innovation in Developing Learning Media. *International Journal of Instruction*, *14*, 187–208. https://doi.org/10.29333/iji.2021.14412a

Supraptono, E., & Setiawan, H. (2017). Dampak Penggunaan Media Pembelajaran Berbasis WEB Terhadap Kompetensi Materi Perkuliahan Elektronika Dasar. *Journal of Vocational and Career Education*, *2*(1).

Susanto, A. (2020). Merancang Media Pembelajaran Berbasis Web Menggunakan Aplikasi Dreamweaver Pada SMAN 1 Kapoiala. *SIMKOM*, *5*, 9–18. https://doi.org/10.51717/simkom.v5i2.43

Swari, D. A. A. I., Suryawan, I. K. D., Sugiartha, I. K., Ma hadewi, P. J., & Darmawan, I. M. P. (2023). Analisis Kualitas Aplikasi Talocraft Menggunakan Standar ISO/IEC 25010. *TEKNIMEDIA*, *4*(2), 228 – 234.

Syafriani, D., Darmana, A., Syuhada, F. A., & Sari, D. P. (2023). *Statistik Uji Beda untuk Penelitian Pendidikan*. CV.EUREKA MEDIA AKSARA. https://repository.penerbiteureka.com/media/publications/563627-buku-ajar-statistik-uji-beda-untuk-penel-ebbe320f.pdf

Uzir, M. U. H., Bukari, Z., Al Halbusi, H., Lim, R., Wahab, S. N., Rasul, T., Thurasamy, R., Jerin, I., Chowdhury, M. R. K., Tarofder, A. K., Yaakop, A. Y., Hamid, A. B. A., Haque, A., Rauf, A., & Eneizan, B. (2023). Applied artificial intelligence: Acceptance-intention-purchase and satisfaction on smartwatch usage in a Ghanaian context. *Heliyon*, *9*(8), e18666. https://doi.org/https://doi.org/10.1016/j.heliyon.2023.e18666

Wijaya, Y. D. (2020). Penerapan Metode Rapid Application Development (Rad) Dalam Pengembangan Sistem Informasi Data Toko. *Jurnal Sistem Informasi Dan Tenologi*, *3*(2).

Zhan, Z., He, L., Tong, Y., Liang, X., Guo, S., & Lan, X. (2022). The effectiveness of gamification in programming education: Evidence from a meta-analysis. *Computers and Education: Artificial Intelligence*, *3*, 100096. https://doi.org/https://doi.org/10.1016/j.caeai.2022.100096