

Learning in the Digital Age: Harnessing Decision Support Systems and Case Study for Physics Tutoring Program

Cecep Kustandi^{1*}, Dheo Rimbano², Dikky Suryadi³

¹ Universitas Negeri Jakarta, Jakarta, Indonesia; cecep_kustandi@unj.ac.id

² Universitas Bina Insan, Lubuklinggau, Indonesia; dheo_rimbano@univbinainsan.ac.id

³ STMIK ALMUSLIM, Bekasi, Indonesia; dikky98@yahoo.com

ARTICLE INFO

Keywords:

Decision Support System;
Physics Tutoring;
SAW Method

Article history:

Received 2023-08-13

Revised 2023-11-07

Accepted 2023-11-27

ABSTRACT

In the contemporary educational landscape, the integration of Decision Support Systems (DSS), particularly the Simple Additive Weighting (SAW) method, offers a structured approach to evaluating teaching methods. This study focused on applying the SAW DSS in a Physics Tutoring Program. The results highlighted Interactive Simulations as the most effective teaching approach, emphasizing the role of technology in modern education. Hands-on Experiments and Group Discussions followed closely, underscoring the importance of experiential learning. Traditional Lectures, while foundational, benefit from enhanced interactivity. The SAW DSS's systematic approach ensures objective decision-making, though weight assignment can introduce subjectivity. A notable research gap emerged around the integration of SAW DSS with advanced educational technologies and its application across diverse cultural contexts. Future research avenues include refining the SAW method with real-time feedback and AI integration. In conclusion, as education evolves, tools like the SAW DSS provide invaluable insights, necessitating continuous adaptation to meet dynamic educational needs.

This is an open-access article under the [CC BY-NC-SA](https://creativecommons.org/licenses/by-nc-sa/4.0/) license.



Corresponding Author:

Cecep Kustandi

Universitas Negeri Jakarta, Jakarta, Indonesia; cecep_kustandi@unj.ac.id

1. INTRODUCTION

Education, as a cornerstone of societal development, has undergone significant transformations over the years (Bozkurt & Ruthven, 2017; Kaplan & Uzunboylu, 2015; Santrock, 2019). In the current era, often referred to as the Information Age, education has been profoundly influenced by the rapid advancement of technology and the ubiquity of information (Majid, Ali, Rahim, & Khamis, 2012; Rais, Aryani, & Ahmar, 2018). Today's learners have access to a wealth of knowledge at their fingertips, thanks to the internet and digital technologies. The unprecedented level of information accessibility presents both advantages and disadvantages that necessitate careful consideration (Kirkorian, Wartella, & Anderson, 2008; Tomaz & David, 2015).

The Information Age has democratized education, making it more accessible to more people. Online, hybrid and personalized learning have transformed education, opening up new educational options and teaching methods (Ifdil et al., 2023; Kholifah, Irwanto, Ramdani, & Nurtanto, 2020; Tripathi,

2016). Technology has enabled new methods that have altered schooling. These innovative methods have transformed education using technology. These methods use technology to adapt to students' learning styles (Warschauer, 2007). Enhancing outcomes is essential to enhancing student learning experiences.

Within the realm of academic endeavors, it is frequently observed that students often encounter a profound sensation of being inundated because of the extensive reservoir of knowledge that is readily available to them. The presence of extraneous variables may pose challenges for individuals in maintaining their concentration and allocating sufficient attention to their academic pursuits. Considering the pervasive existence of disinformation, it is imperative to underscore the need of fostering critical thinking skills and cultivating digital literacy among students. Moreover, it is crucial to consider the significant ramifications of the digital divide, which amplifies discrepancies in the accessibility of digital technology and consequently worsens preexisting gaps in the provision of high-quality educational opportunities.

The topic of this paper delves into the utilization of a DSS (Doumpos & Zopounidis, 2010; Primasari, Wardoyo, & Sari, 2018; Verina, Fauzi, Nasari, Tanjung, & Iriani, 2019) within the context of a physics tutoring program. The focus of this investigation will be on the widely-utilized decision DSS technique known for its straightforward implementation and remarkable precision, namely Simple Additive Weighting (SAW) (Angelina et al., 2019; Rusdiyanto et al., 2020; Siahaan, Elviwani, Surbakti, Lubis, & Siahaan, 2017). The SAW approach is a valuable tool in educational contexts, as it allows for the ranking of options based on the cumulative weight of their criteria. This approach proves particularly beneficial when multiple criteria need to be considered simultaneously.

There is a lack of research examining the educational benefits of DSS integration. Even less study have focused in on the SAW approach of incorporating DSS in concrete educational programs. This work tries to address this knowledge gap by giving a complete case study of a Physics Tutoring Program that incorporated a DSS utilizing the SAW technique. This study's overarching purpose is to help educators and institutions better understand how and why DSS could be effective in the classroom, especially in the context of the Information Age, and to provide tangible insights and recommendations for doing so.

2. METHODS

Decision support systems, commonly referred to as DSSs, are of paramount importance in contemporary educational settings. Data processing programs are designed with the primary objective of facilitating decision-making processes. As experience researchers, we engage in the meticulous analysis of extensive data sets to derive meaningful insights and generate valuable recommendations aimed at enhancing classroom instruction and fostering optimal student development.

DSS can be described as a synergistic combination of data, analytical tools, and computational procedures. The primary objective of this system is to empower users by equipping them with the requisite information and models that enable them to make well-informed decisions. Within the domain of education, the incorporation of DSS presents a promising avenue for exploring diverse facets of student performance analysis, forecasting learning outcomes, and tailoring educational content to meet the distinct requirements of each student.

Simple Additive Weighting (SAW) approach is a widely recognized and extensively employed decision-making strategy within the realm of Decision Support Systems (DSS). Experience research is a methodical way to assess and rank various alternatives based on their weighted criteria. The SAW approach encompasses a systematic process that can be aptly shown in the accompanying Figure 1.

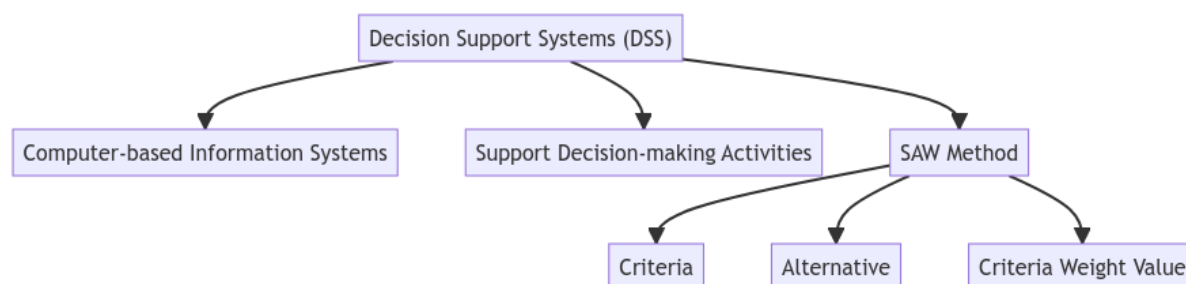


Figure 1. SAW Method process

SAW Method as below:

- a. Identify Criteria: List all decision-making criteria.
- b. Determine Alternatives: Identify decision-making options.
- c. Assigning Weight Values Criteria: Based on its importance in decision-making, weight each criterion numerically. Weights usually equal 1.
- d. Score Each Alternative: Score each alternative for each criterion. This score indicates the alternative's criterion compliance.
- e. Calculate Weighted Sum: Multiply each alternative's score by the criterion's weight. Add all alternatives' weighted scores.
- f. Rank Alternatives: Sort alternatives by weighted score. The highest-scoring option is best.

SAW technique helps make decisions by systematically evaluating various options against weighted criteria.

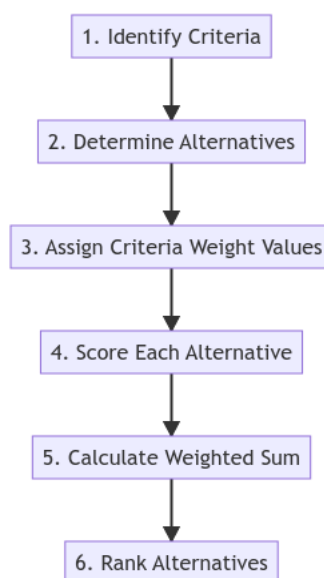


Figure 2. SAW Step by Step Procedure

The SAW technique multiplies each alternative's value by the criterion's weight. The results are then summed up for each alternative, and the alternative with the highest total is considered the best choice. By integrating SAW method into a Physics Tutoring Program, educators can make data-driven decisions to enhance student learning experience and outcomes. The first step in adopting the Simple Additive Weighting (SAW) approach in the case study is defining the criteria and alternatives.

Table 1. Criteria for Physics Tutoring Program

ID	Criteria Name
C1	Student Engagement
C2	Comprehension Levels
C3	Practical Application
C4	Feedback Scores

Mermaid diagrams are used to visualize Table 1 criteria.

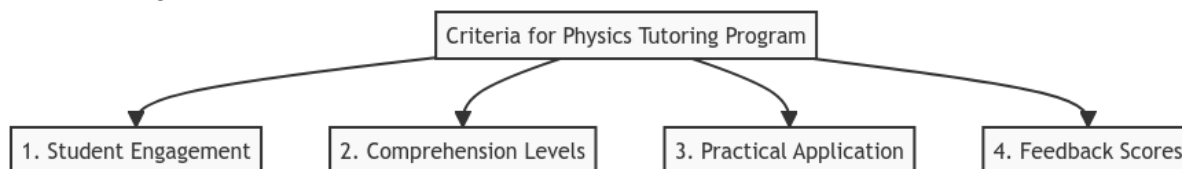


Figure 3. Visualization for Criteria

Table 2 below presents data about the Alternative for Physics Tutoring Program.

Table 2. Alternative for Physics Tutoring Program

ID	Alternative Name
A1	Traditional Lectures
A2	Interactive Simulations
A3	Hands-on experiments
A4	Group Discussions.

Figure 4 illustrates the alternative:

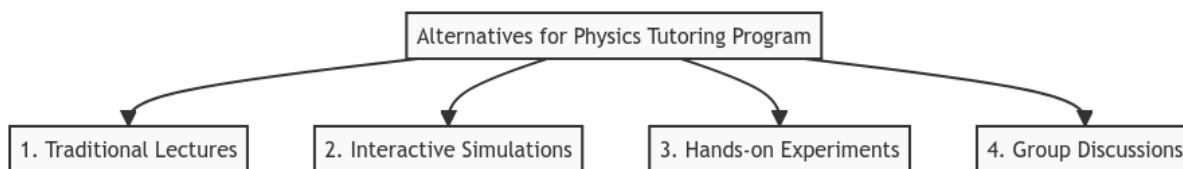


Figure 4. Diagram Alternative value

For the effective application of the SAW method in the Physics Tutoring Program, it's important to assign appropriate weights to each criterion. These weights represent the significance or importance of each criterion in the decision-making process. Here are the weights assigned to the identified criteria:

Table 3. Weights for each criterion

ID	Criteria Name	Weight Value
C1	Student Engagement	0.4
C2	Comprehension Levels	0.3
C3	Practical Application	0.2
C4	Feedback Scores	0.1

Description:

- a. Student Engagement (0.4): Given a weight of 40%, this criterion is deemed highly significant. Engaging students is crucial for effective learning, especially in a subject like physics where concepts can be abstract.

- b. Comprehension Levels (0.3): With a weight of 30%, understanding the core concepts is essential for students to apply their knowledge in real-world scenarios.
- c. Practical Application (0.2): Assigned a weight of 20%, this criterion emphasizes the importance of students being able to apply theoretical knowledge in practical situations, such as labs or experiments.
- d. Feedback Scores (0.1): Given the lowest weight of 10%, feedback scores are still vital as they provide insights into areas of improvement and student satisfaction.

The sum of the weights is 1 (or 100%), ensuring that the total significance is distributed among the criteria. These weights will be utilized in the subsequent steps of the SAW method to evaluate and rank the teaching methods or resources in the Physics Tutoring Program.

3. FINDINGS AND DISCUSSION

The next step in the Simple Additive Weighting (SAW) method is to score each alternative for each criterion. Let's assume we have the following scores for each alternative for each criterion.

Table 4. Value Each Alternative in Criterion

Criteria / Alternatives	Student Engagement	Comprehension Levels	Practical Application	Feedback Scores
Traditional Lectures	7	8	6	7
Interactive Simulations	9	7	8	8
Hands-on Experiments	8	6	9	7
Group Discussions	8	7	7	8

The scores in the table range from 1 to 10, with 1 indicating the least effectiveness or suitability and 10 indicating the highest. These scores are subjective and are based on evaluations, feedback, and expert opinions. Description of each score:

- a. 1-3: Poor performance or suitability for the criterion.
- b. 4-6: Average performance or suitability.
- c. 7-8: Good performance or suitability.
- d. 9-10: Excellent performance or suitability.

Each value in Table 4 can be described below:

- a. Traditional Lectures:
 - 1) Student Engagement (7): Traditional lectures score a 7 because, while they are effective in delivering content, they might not be as engaging as interactive methods. However, a well-delivered lecture can still capture students' attention.
 - 2) Comprehension Levels (8): Lectures, when delivered effectively, can provide clear explanations, leading to good comprehension.
 - 3) Practical Application (6): Traditional lectures are more theoretical, so they score average in terms of practical application.
 - 4) Feedback Scores (7): Based on feedback, students find lectures beneficial, but they also express a desire for more interactive sessions.
- b. Interactive Simulations:
 - 1) Student Engagement (9): Simulations are highly engaging as they allow students to visualize and interact with physics concepts.
 - 2) Comprehension Levels (7): While simulations aid understanding, they might not cover the depth of some topics.
 - 3) Practical Application (8): Simulations provide a practical feel, though they aren't a replacement for real-world experiments.

- 4) Feedback Scores (8): Students generally provide positive feedback for simulations due to their interactive nature.
- c. Hands-on Experiments:
 - 1) Student Engagement (8): Experiments are engaging as students get hands-on experience.
 - 2) Comprehension Levels (6): While experiments are practical, the theoretical understanding might need reinforcement.
 - 3) Practical Application (9): Experiments score high in this criterion as they are the epitome of practical application.
 - 4) Feedback Scores (7): Students appreciate experiments but also highlight the need for clear instructions and safety measures.
- d. Group Discussions:
 - 1) Student Engagement (8): Group discussions are engaging as students actively participate and share ideas.
 - 2) Comprehension Levels (7): Discussions can clear doubts and deepen understanding, but they rely on the group's collective knowledge.
 - 3) Practical Application (7): Discussions can touch upon practical scenarios, but they are more about sharing experiences and insights.
 - 4) Feedback Scores (8): Students value discussions as they promote collaborative learning and peer feedback.

The scores are a representation of how each teaching method or resource fares against the criteria. They provide insights into the strengths and weaknesses of each alternative, aiding in the decision-making process.

The next step is calculate the weighted scores for each teaching method or resource (alternative) based on the scores received for each criterion and the weights assigned to those criteria.

$$\text{Weighted Score (Alternative)} = \sum_{i=1}^n (\text{Score}_i \times \text{Weight}_i)$$

Where:

- Score_i is the score given to the alternative for the i^{th} criterion
- Weight_i is the weight assigned to the i^{th} criterion
- n is the total number of criteria

Based on the formula above, the calculation can be seen below:

1. Traditional Lectures:
 Weighted Score (Traditional Lectures)
 $= (7 \times 0.4) + (8 \times 0.3) + (6 \times 0.2) + (7 \times 0.1)$
 $= 2.8 + 2.4 + 1.2 + 0.7$
 $= 7.1$
2. Interactive Simulations:
 Weighted Score (Interactive Simulations)
 $= (9 \times 0.4) + (7 \times 0.3) + (8 \times 0.2) + (8 \times 0.1)$
 $= 3.6 + 2.1 + 1.6 + 0.8$
 $= 8.1$
3. Hands-on Experiments:
 Weighted Score (Hands-on Experiments)
 $= (8 \times 0.4) + (6 \times 0.3) + (9 \times 0.2) + (7 \times 0.1)$
 $= 3.2 + 1.8 + 1.8 + 0.7$
 $= 7.5$
4. Group Discussions:

$$\begin{aligned}
 & \text{Weighted Score (Group Discussions)} \\
 & = (8 \times 0.4) + (7 \times 0.3) + (7 \times 0.2) + (8 \times 0.1) \\
 & = 3.2 + 2.1 + 1.4 + 0.8 \\
 & = 7.5
 \end{aligned}$$

The calculation result can be seen in table 5 below:

Table 5. Alternative Result

Criteria / Alternatives	Weighted Score for Student Engagement	Weighted Score for Comprehension Levels	Weighted Score for Practical Application	Weighted Score for Feedback Scores	Total Weighted Score
Traditional Lectures	$7 \times 0.4 = 2.8$	$8 \times 0.3 = 2.4$	$6 \times 0.2 = 1.2$	$7 \times 0.1 = 0.7$	7.1
Interactive Simulations	$9 \times 0.4 = 3.6$	$7 \times 0.3 = 2.1$	$8 \times 0.2 = 1.6$	$8 \times 0.1 = 0.8$	8.1
Hands-on Experiments	$8 \times 0.4 = 3.2$	$6 \times 0.3 = 1.8$	$9 \times 0.2 = 1.8$	$7 \times 0.1 = 0.7$	7.5
Group Discussions	$8 \times 0.4 = 3.2$	$7 \times 0.3 = 2.1$	$7 \times 0.2 = 1.4$	$8 \times 0.1 = 0.8$	7.5

After calculating the weighted sum for each alternative, the final step is to rank the alternatives based on their total weighted sum. The alternative with the highest weighted sum is ranked first, indicating it's the most suitable or effective choice based on the given criteria and weights.

Table 6. Ranking

Rank	Alternative	Total Weighted Sum
1	Interactive Simulations	8.1
2	Hands-on Experiments	7.5
3	Group Discussions	7.5
4	Traditional Lectures	7.1

Description:

- Interactive Simulations are ranked first, making it the most effective teaching method or resource for the Physics Tutoring Program based on the given criteria and weights.
- Hands-on Experiments and Group Discussions both have the same weighted sum, ranking them equally in second place. This suggests that both methods have their merits and can be equally effective in certain scenarios.
- Traditional lectures score fourth, suggesting there may be better options.

This ranking aids educators and decision-makers. The rapid transition from traditional sectors to an economy based on the proliferation of information technology is a hallmark of the Information Age, also known as the Digital Age. Access to knowledge, digital communication, and technical improvements have all played significant roles in altering several fields, including education, in the modern day. The starting point of the Information Age ushered forth a new era in the field of education. Digital platforms providing e-learning, virtual classrooms, and multimedia-rich content are now supplementing and, in some cases, replacing traditional chalk-and-board classrooms. Worldwide, educational institutions have used Learning Management Systems (LMS) to support distance learning, organize student information, and encourage group work in the school (He, Xu, & Kruck, 2014; Saptani, 2017; Sirathanakul & Amnuywattanakul, 2015).

Learning is becoming more accessible to people of varying financial statuses and geographic regions thanks to digital learning platforms, which is one of the many benefits of education in the information era. Students can now learn in whatever environment best suits their needs. Online education platforms may be able to tailor their lessons to the needs of individual students by employing complex analytic and algorithmic processes. Students can get a broader understanding of the world and sharpen their problem-solving skills by working together across boundaries utilising digital tools for collaborative learning. Digital resources may be easily distributed and reused once they have been created, lowering the cost of education and expanding its reach.

Difficulties and factors include the "digital divide," which refers to the fact that while technological advancement has been rapid, not everyone has had access to it. The disparity in access to technology between urban and rural areas and between industrialised and developing countries may contribute to existing education disparities. Due to the abundance of information available online, students need to develop their capacity for critical thinking and sound judgment. Data Protection and Security Issues includes data privacy, cyberbullying, and other online concerns are becoming increasingly apparent as online learning becomes the norm. Information obtained online must be accurate and trustworthy, therefore quality assurance is essential. The growth of online learning options has made it more challenging to maintain good standards of education.

It is essential to provide students with the tools they will need to compete in the job market of the Information Age. In today's competitive job market, it's not enough to know your way around a computer; you also need soft skills like adaptability, critical thinking, and a hunger for knowledge. Educators, politicians, and institutions must collaborate to make the most of the opportunities and overcome the challenges presented by the Information Age if education is to remain relevant, inclusive, and influential in this era of rapid change.

The SAW DSS, like every research approach, has its drawbacks. Although weight assignment is objective, subjectivity can enter the equation. Subjectivity can distort results. The SAW technique focuses on static analysis, hence it does not account for changing criteria and alternatives. Our study found a research gap on SAW DSS (Spatial Augmented Reality Decision Support Systems) integration with modern educational technology. Despite advances in AI-driven teaching systems and virtual reality, SAW DSS integration has not been explored. It is also crucial to examine how cultural or demographic factors affect SAW weights and scores. Dynamic SAW model development could inform future study. Real-time feedback could adjust these models' weights and ratings. This would improve SAW technique by making decision-making more responsive and accurate. AI could improve Simple Additive Weighting (SAW) by assigning weights or refining criteria. Cross-cultural research using the SAW DSS (Satisfaction Affecting Weight Decision Support System) can also help comprehend different educational environments. This method ensures its relevance and efficacy across cultures.

4. CONCLUSION

In the extensive research into DSS in education, it was found that the Simple Additive Weighting (SAW) method was particularly helpful when focusing on the field of physics. Research shows that interactive simulations are effective in the classroom. Immersive and engaging technology is what makes these simulations possible. The research showed that the benefits of group discussions and hands-on experiments for experiential learning and collaborative conversation were similar. When we incorporated interactive elements into lectures, they quickly rose to become the fourth most successful method of instruction. Our study work benefited substantially from SAW DSS. The quantitative and scientific approach of this methodology ensures that decisions are made without bias. Using quantitative and statistical methods eliminates human biases. The SAW method's ability to accommodate a wide variety of criteria and options has earned it much acclaim. Due to its adaptability, it can be used in a wide variety of contexts. Because of the system's ease of use, it can be used even by those who are unfamiliar with DSS. In conclusion, instruments like the SAW DSS offer useful insights

into the changing face of education in the information era. Refinement and adaptation are essential to meeting learners' and educators' changing requirements.

REFERENCES

- Angelina, Surbakti, R. D., Simamora, R. S., Cendana, E., Sitanggang, D., Banjarnahor, J., & Turnip, M. (2019). Application Selection Lending Houses Subsidized by the Method of AHP and SAW. *Journal of Physics: Conference Series*, 1230, 012082. <https://doi.org/10.1088/1742-6596/1230/1/012082>
- Bozkurt, G., & Ruthven, K. (2017). *Classroom-based professional expertise : a mathematics teacher ' s practice with technology*. 309–328. <https://doi.org/10.1007/s10649-016-9732-5>
- Doumpos, M., & Zopounidis, C. (2010). A multicriteria decision support system for bank rating. *Decision Support Systems*. <https://doi.org/10.1016/j.dss.2010.07.002>
- He, W., Xu, G., & Kruck, S. E. (2014). Online IS Education for the 21st Century. *Journal of Information Systems Education*, 25(2), 106.
- Ifdil, I., Situmorang, D. D. B., Firman, F., Zola, N., Rangka, I. B., & Fadli, R. P. (2023). Virtual reality in Metaverse for future mental health-helping profession: an alternative solution to the mental health challenges of the COVID-19 pandemic. *Journal of Public Health (United Kingdom)*, 45(1), E142–E143. <https://doi.org/10.1093/pubmed/fdac049>
- Kaplan, A., & Uzunboylu, H. (2015). Assessment of the In-Service Training Programs of the Political Parties. *Procedia - Social and Behavioral Sciences*, 177, 464–474. <https://doi.org/10.1016/j.sbspro.2015.02.398>
- Kholifah, N., Irwanto, I., Ramdani, S. D., & Nurtanto, M. (2020). Vocational skills learning model strategies during covid-19. *Journal of Physics: Conference Series*, 1700(1), 1–8. <https://doi.org/10.1088/1742-6596/1700/1/012092>
- Kirkorian, H. L., Wartella, E. A., & Anderson, D. R. (2008). Media and young children's learning. *The Future of Children*, 18(1), 39–61. <https://doi.org/10.1353/FOC.0.0002>
- Majid, M. S. Z. B. A., Ali, M. M. B. A., Rahim, A. A. B. A., & Khamis, N. Y. B. (2012). The Development of Technical English Multimedia Interactive Module to Enhance Student Centered Learning (SCL). *Procedia - Social and Behavioral Sciences*, 67(November 2011), 345–348. <https://doi.org/10.1016/j.sbspro.2012.11.337>
- Primasari, C. H., Wardoyo, R., & Sari, A. K. (2018). Integrated AHP, Profile Matching, and TOPSIS for selecting type of goats based on environmental and financial criteria. *International Journal of Advances in Intelligent Informatics*, 4(1), 28–39. <https://doi.org/10.26555/ijain.v4i1.105>
- Rais, M., Aryani, F., & Ahmar, A. S. (2018). *The influence of the inquiry learning model and learning style on the drawing technique of students*. 20(1), 64–68.
- Rusdiyanto, R., Karman, J., Toyib Hidayat, A., Muli Peranginangin, A., Tambunan, F., & Hutahaean, J. (2020). Analysis of Decision Support Systems on Recommended Sales of the Best Ornamental Plants by Type. *Journal of Physics: Conference Series*, 1566(1). <https://doi.org/10.1088/1742-6596/1566/1/012047>
- Santrock, J. W. (2019). Life-span development, 7th ed. In *Life-span development, 7th ed*. McGraw-Hill Higher Education.
- Saptani, D. A. (2017). Teachers ' Perception towards the Use of Quipper School in Teaching English. *Advances in Social Science, Education and Humanities Research*, 82(Conaplin 9), 233–235.
- Siahaan, M. D. L., Elwiwani, Surbakti, A. B., Lubis, A. H., & Siahaan, A. P. U. (2017). Implementation of Simple Additive Weighting Algorithm in Particular Instance. *International Journal of Scientific Research in Science and Technology*, 3(6), 442–447.
- Sirathanakul, S., & Amnuywattanakul, T. (2015). The E-Learning on Analysis of the Experimental Results by Using Graphs. *Applied Mechanics and Materials*, 804, 355–358. <https://doi.org/10.4028/www.scientific.net/AMM.804.355>
- Tomaz, V. S., & David, M. M. (2015). How Students' Everyday Situations Modify Classroom Mathematical Activity: The Case of Water. *Journal for Research in Mathematics Education*, 46(4), 455–

496. <https://doi.org/10.5951/jresematheduc.46.4.0455>
- Tripathi, H. (2016). Effectiveness of Blended Learning Using LMS-Edmodo in Teaching Economics at Higher Secondary Level. *The International Journal of Indian Psychology*, 3(3).
- Verina, W., Fauzi, M., Nasari, F., Tanjung, D. H., & Iriani, J. (2019). Decision Support System for Employee Recruitment Using Multifactor Evaluation Process. *2018 6th International Conference on Cyber and IT Service Management, CITSM 2018*. <https://doi.org/10.1109/CITSM.2018.8674277>
- Warschauer, M. (2007). The paradoxical future of digital learning. *Learning Inquiry*. <https://doi.org/10.1007/s11519-007-0001-5>