Decision Support System to Help Educational Institutions Determine the Best Learning Method

Inayatulloh
Information Systems Department
School of Information system
Bina Nusantara University
Jakarta, Indonesia 11480
Inay@ binus.ac.id

***Sugeng Riyanto**,
STIE Pertiwi
Bekasi , Indonesia
sr7752413@gmail.com

Meisyarah
MPDR Universitas Terbuka
Jakarta Indonesia
530061752@ecampus.ut.ac.id

Rizky Maulana
Department of Economics, Faculty of Economics and Management,
IPB University ,Bogor, Indonesia
rizky.maulana@apps.ipb.ac.id

Abstract

The learning method is a method used to support learning activities that are tailored to the learning objectives, student perspectives, technological support, and other very diverse factors. This condition makes it difficult for teachers or educational institutions to choose and decide the best learning method that will be used to support learning activities. Decision Support System is a computer system that is used to support decision making by considering assessment criteria and alternative solutions. Thus, the Decision Support System can be used by educational institutions to determine learning methods that are suitable for school conditions. The purpose of this research is to help the best educational institutions according to the conditions of schools, teachers and students by using the Decision Support System. The research method uses a qualitative approach through observations to educational institutions about the difficulty of determining learning methods that are in accordance with school needs. Literature studies are used to strengthen problem findings and identify alternative solutions with information technology.

Keywords
DSS, Learning Method, Education Institution

1. Introduction
Learning objectives can be achieved if all the supporting components can be implemented and one of the important factors supporting the achievement of learning objectives is the learning method. learning method is the whole series of presentation of teaching materials which includes all aspects before, during and after the learning carried out by the teacher as well as all related facilities that are used directly or indirectly in the teaching and learning process to achieve learning objectives (Puspita et al. 2019) (Aliyah et al. 2020) (Kioupi and Voulvoulis 2019).

Currently, there are many available learning methods used by educational institutions at different levels of education. The adoption of learning methods by educational institutions depends on the ability of educational institutions to understand which learning methods suit their needs. The problem is that the selection of learning methods is done manually which is not effective so that it has an impact on not achieving learning outcomes due to incorrectly determining the learning method used (Radha et al. 2020) (Hwang et al. 2021) (Abidi et al. 2018).

Decision Support System is a computer-based system that is used to assist decision makers in determining the best decision from several choices. This choice resulted from the determination of the criteria and decision alternatives that were part of the DSS. Thus, DSS can be used by educational institutions to select and determine the learning methods to be adopted to support the achievement of learning objectives. the research method uses a qualitative approach through observations about the difficulties of educational institutions in determining learning methods or models that suit their needs. Literature studies are used to find alternative solutions with an information technology approach and determine DSS as a solution.

2. Literature Review

2.1 Decision Support System

DSS is part of a computer software-based information system. Including knowledge management-based systems that are used to support decision-making within an organization or company. DSS can be regarded as a computer system that processes data into information to make decisions on specific problems. DSS is a system that aims to assist managers in making decisions by accessing most of the information generated from various related information systems involved in the organization's business processes, such as office automated systems, transaction processing systems, and so on (Simionesei et al. 2020) (Dimarescue et al. 2022) (Suryanto et al. 2018).

The purpose of DSS, among others, is to help managers make decisions to solve problems, support manager judgment, and increase the effectiveness of a manager's decision making rather than its efficiency. However, DSS does not aim to replace the task of the manager, but to become a tool to help the manager himself. DSS is an implementation or concrete manifestation of decision-making theories that have been introduced earlier by sciences such as operations research and management science (Pranjic 2018) (Constantiou et al. 2019) (Ranganathaswamy and Amar 2021). DSS has an interactive way of working. If in the past when we were going to solve a problem, we had to calculate the minimum, maximum, or optimum value manually, then a DSS which is a natural progression of information reporting systems and transaction processing systems would help with these things. The workings of this DSS are defining existing problems, collecting applicable data and/or information, processing data into information in the form of graphic or written reports, and determining alternative paths that can be in the form of percentages (Sadegi et al. 2020) (Wei et al. 2020).

DSS uses a resume of information, exceptions, patterns, and analytical models. DSS will only help when we make decisions, but that does not mean we have to make decisions ourselves. Decision making begins with gathering useful information through raw data, documents, own knowledge, and/or business models to identify and solve problems and then make decisions (Langer et al. 2021) (Car 2018) (Mork et al. 2018). DSS software is often referred to as a DSS generator. This DSS generator contains modules for database, model, and management dialogs. This Database Management System (DBMS) module provides several things, such as: creation, interrogation, and maintenance for DSS DBMS. This module can find system databases that have been saved. DSS DBMS to solve the problem the data needed can come from internal or external databases. In an organization, internal data is generated by the system. External data comes from various sources such as newspapers, online data services, databases (finance, marketing, human resources (Ruban et al. 2021) (Cota et al. 2021) (Philips et al. 2021).

While the Model Management System (MMS) module is used to present the ability to create, maintain and manipulate in the form of mathematical models. This basic model features an electronic spreadsheet. This MMS stores and accesses the models that managers use to make decisions. Such models are used to design manufacturing facilities, analyze the financial health of an organization, forecast the demand for a product or service, and so on. Meanwhile, the dialogue model is used to attract the attention of users to have direct contact between users and computers in finding solutions. In addition to the DBMS, MMS and dialog models, other components or modules are available in DDS, namely supporting tools such as online help, diagrams, user-friendly interfaces, graphical analysis, error correction mechanisms, facilitating user interaction with the system. Figure 1 show basic DSS architecture (Liutvinavicius and Audrius 2015).

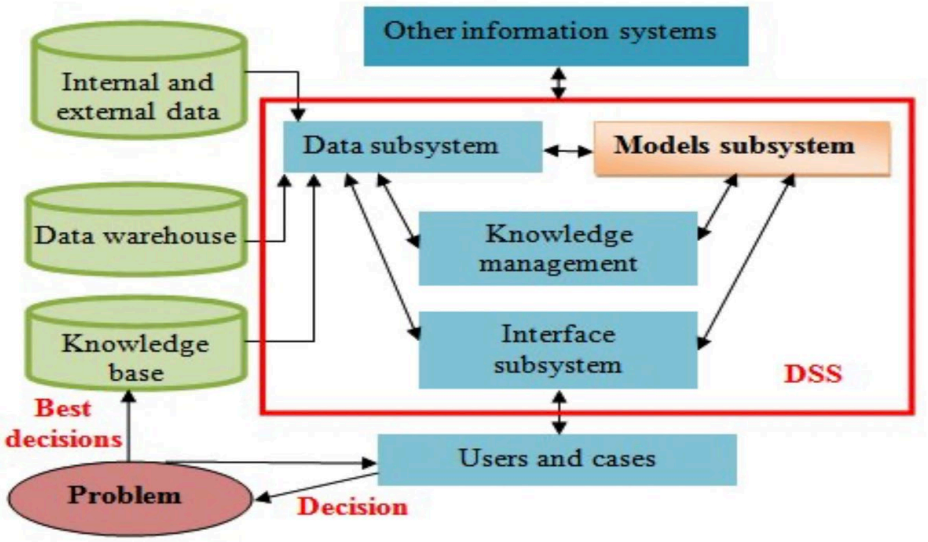

Figure 1. DSS Architecture (Liutvinavicius and Audrius 2015).

2.2 The Analytical Hierarchy Process

AHP is a decision support model. This decision support model will describe complex multi-factor or multi-criteria problems into a hierarchy, hierarchy is defined as a representation of a complex problem in a multi-level structure where the first level is the goal, followed by the factor level, criteria, sub-criteria, and so on down to the last level of alternatives. With a hierarchy, a complex problem can be broken down into groups which are then arranged into a hierarchical form so that the problem will appear more structured and systematic (Ghorbandazeh et al. 2018) (Zytoon 2020) (Ahmed et al 2019).

AHP is often used as a problem-solving method compared to other methods for the following reasons: A hierarchical structure, because of the selected criteria, to the deepest sub-criteria. Consider the validity up to the tolerance limit for the inconsistency of various criteria and alternatives chosen by the decision maker. The use of AHP is not only for government or private institutions but can also be applied for individual purposes, especially for research related to policies or the formulation of priority strategies. AHP is reliable because in AHP a priority is composed of various options which can be in the form of criteria that have been previously decomposed (structured) first, so that priority setting is based on a structured (hierarchical) and reasonable process. So, in essence AHP helps solve complex problems by compiling a hierarchy of criteria, assessed subjectively by interested parties and then draws various considerations to develop weights or priorities (Issa et al. 2022) (Karleusa et al. 2020) (Ishak et al. 2020). The main tool of AHP is a functional hierarchy with the main input being human perception. The existence of a hierarchy allows complex or unstructured problems to be broken down into sub-problems, then arrange them into a hierarchical form. Figure 2 show the AHP structure (Inayatulloh 2019)

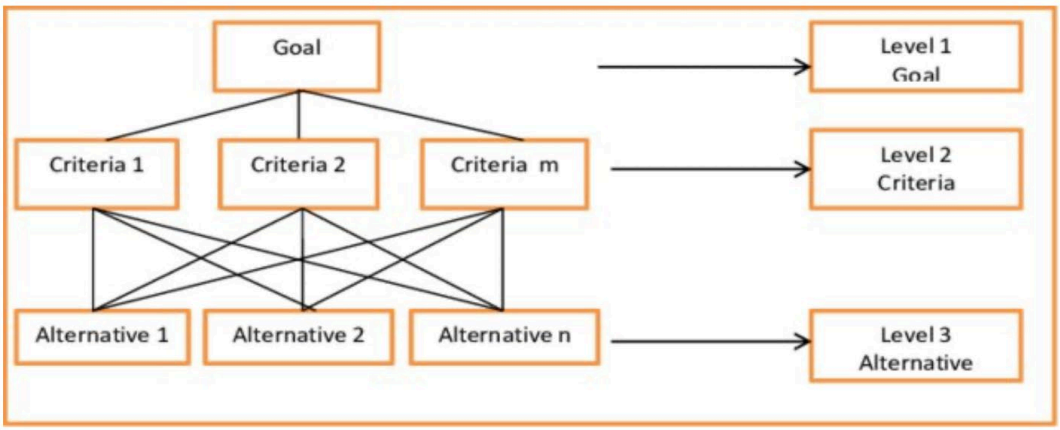

Figure 2. AHP structure (Inayatulloh 2019)

2.3 AHP Procedure

there are three main principles in problem solving in AHP, namely: Decomposition, Comparative Judgment, and Logical Consistency. Broadly speaking, the AHP procedure includes the following stages.

a. Decomposition of the problem Decomposition of the problem is the step where a predetermined goal is then systematically described into a structure that composes a series of systems until the goals can be achieved rationally. In other words, a complete goal, decomposed (broken) into its constituent elements (Promentila et al. 2018) (Improta et al. 2018) (Bulut and Okan 2018) (Chen 2021).

b. Assessment/weighting to compare elements When the decomposition process has been completed and the hierarchy has been well structured. Next, pairwise comparisons are assessed (weighting) on each hierarchy based on their relative importance (Lecesse et al. 2021).

c. Matrix Preparation and Consistency Test When the weighting process or filling out the questionnaires has been completed, the next step is the preparation of a paired matrix to normalize the weighting of the importance level for each element in their respective hierarchies. At this stage the analysis can be done manually or by using a computer program such as Expert Choice (Unver and Ibrahim 2021).

d. Priority setting in each hierarchy for each criterion and alternative, pairwise comparisons are necessary. The relative comparison values are then processed to determine the ranking of alternatives from all alternatives. Both qualitative criteria, as well as quantitative criteria, can be compared according to a predetermined assessment to produce weights and priorities. The weights or priorities are calculated by manipulating the matrix or by solving mathematical equations (Andreolli et al. 2022).

e. Synthesis of priorities. The synthesis of priorities is obtained from the result of multiplying local priorities with the priorities of the relevant criteria at the top level and adding them to each element in the level that is affected by the criteria. The result is a combination or better known as global priority which can then be used to assign local priority weights to elements at the lowest level in the hierarchy according to the criteria (Afnain et al. 2021).

f. Decision making/decision. Decision making is a process in which the best alternatives are selected based on the criteria.

3. Methods

Figure 3 explains the research method. Various learning methods that have differences based on conditions, environment, students, teachers and other factors create confusion for education providers to determine the best learning method according to their conditions. This condition initiated the research and strengthened the findings of the problem by conducting observations and interviews with actors at educational institutions. After finding the

difficulty of educational institutions in determining the right learning method, the research continued to look for alternative solutions based on information technology through literature studies. After exploring the literature, the Decision Support System is the right solution for educational institutions to determine the best learning method.

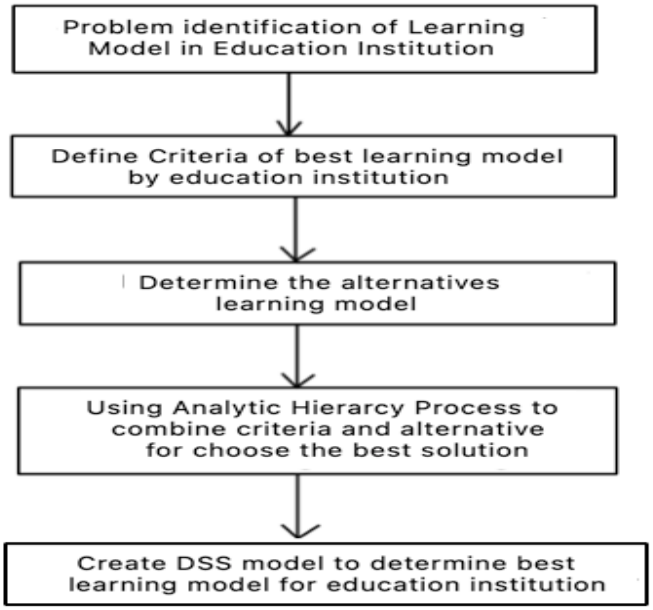

Figure 3. Research method.

4. Results and Discussion

Figure 4 show the proposes model. This model describes several components that support the adoption of DSS and AHP to determine the best learning model, namely

a. Alternative learning models are available types of learning models that have been used by other educational institutions. Some types of learning models include Learning Management System and Content Management, blended learning, Hybrid learning, discovery learning, Inquiry learning, problem-based learning. The availability of information on the type of e-learning with all detailed information explaining the supporting factors is an alternative for educational institutions to choose a learning model. This alternative learning model becomes part of the Analytic Hierarchy Process.
b. The second part of this model is the criteria for selecting the e-learning model. Based on observations and literature studies, the criteria for selecting an e-learning model are based on student satisfaction, effectiveness and efficiency of the learning process, quality of teaching materials and quality of instructors. These criteria will be part of the Analytic hierarchy Process.
c. The analytical hierarchy process used in this model has several stages. The first stage is the construction hierarchy of the selection criteria for learning models and alternative learning models. The second stage is Pairwise comparison of the learning model selection criteria with alternative learning models. The third stage is to give the relative weight of each criterion and alternative selection of e-learning models. After each criterion and alternative learning model is given a relative weight, then this relative weight is given a score and overall weight. The final stage of the AHP is to check the consistency of the previous calculation results.
d. The outputs of DSS and AHP are alternative learning models with scores on each learning model. The score of each alternative learning model will appear in the dialogue manager so that the user can choose a learning model based on the highest score from the learning model.

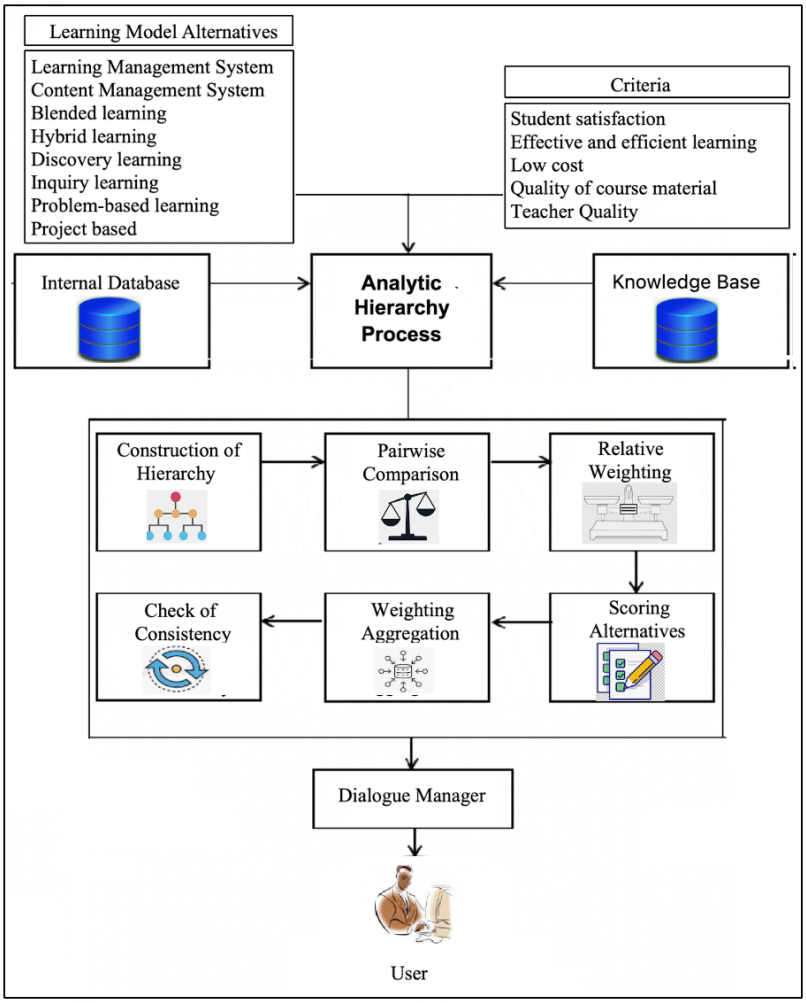

Figure 4. DSS for Learning Model in Education Institution

5. Conclusion

The implementation of DSS for educational institutions to determine the right learning model to support the learning process in their institutions will help educational institutions based on the priority scale of several predetermined criteria. The resulting alternative learning model does not absolutely have to be used because basically DSS only helps decision makers make choices from several available options and the final decision rests with the decision maker. DSS helps decision makers develop a hierarchy of criteria and give weight to each component and in the end will offer alternative learning methods that have been arranged based on the highest score.

References

Abidi, Syed Muhammad Raza, et al. "Prediction of confusion attempting algebra homework in an intelligent tutoring system through machine learning techniques for educational sustainable development." *Sustainability* 11.1 (2018): 105.

Afnain, Junita Pristi Nur, et al. "A Smart Decision Tool Based on AHP Method in e-Reporting Change Management Request." *2021 Fourth International Conference on Vocational Education and Electrical Engineering (ICVEE)*. IEEE, 2021.

Ahmed, Mohd, et al. "Decision support model for design of high-performance concrete mixtures using two-phase AHP-TOPSIS approach." *Advances in Civil Engineering* 2019 (2019).

Andreolli, Francesca, et al. "An AHP model for multiple-criteria prioritization of seismic retrofit solutions in gravity-designed industrial buildings." *Journal of Building Engineering* 45 (2022): 103493.

Aliyyah, Rusi Rusmiati, et al. "The perceptions of primary school teachers of online learning during the COVID-19 pandemic period: A case study in Indonesia." *Journal of Ethnic and Cultural Studies* 7.2 (2020): 90-109.

Bulut, Emrah, and Okan Duru. "Analytic Hierarchy Process (AHP) in maritime logistics: theory, application and fuzzy set integration." *Multi-Criteria Decision Making in Maritime Studies and Logistics*. Springer, Cham, 2018. 31-78.

Chen, Toly. "A diversified AHP-tree approach for multiple-criteria supplier selection." *Computational Management Science* 18.4 (2021): 431-453.

Car, Nicholas J. "USING decision models to enable better irrigation Decision Support Systems." *Computers and Electronics in Agriculture* 152 (2018): 290-301.

Constantiou, Ioanna, Arisa Shollo, and Morten Thanning Vendelø. "Mobilizing intuitive judgement during organizational decision making: When business intelligence is not the only thing that matters." *Decision Support Systems* 121 (2019): 51-61.

Cota, Manuel Pérez, Carlos Manuel Oliveira Alves, and Miguel Ramón González Castro. "MLV-Viewer: Universal Decision Support System." *International Conference on Software Process Improvement*. Springer, Cham, 2021.

Dijmărescu, Irina, et al. "Neuromanagement decision making in facial recognition biometric authentication as a mobile payment technology in retail, restaurant, and hotel business models." *Oeconomia Copernicana* 13.1 (2022): 225-250.

Ghorbanzadeh, Omid, et al. "Sustainable urban transport planning considering different stakeholder groups by an interval-AHP decision support model." *Sustainability* 11.1 (2018): 9.

Liutvinavičius, Marius, and Audrius Lopata. "Knowledge Based Modeling of Financial Decision Support Systems." *BIR-WS 2015. Joint Proceedings of the BIR 2015 Workshops and Doctoral Consortium co-located with 14th International Conference on Perspectives in Business Informatics Research (BIR 2015), Tartu, Estonia, August 26-28, 2015. Ser.: CEUR Workshop Proceedings. Vol. 1420. ISSN 1613-0073*. University of Tartu, 2015.

Hwang, Gwo-Jen, Sheng-Yuan Wang, and Chiu-Lin Lai. "Effects of a social regulation-based online learning framework on students' learning achievements and behaviors in mathematics." *Computers & Education* 160 (2021): 104031.

Improta, Giovanni, et al. "Use of the AHP methodology in system dynamics: modelling and simulation for health technology assessments to determine the correct prosthesis choice for hernia diseases." *Mathematical biosciences* 299 (2018): 19-27.

Inayatulloh. "Decision Support System for Badan Ekonomi Kreatif Indonesia." *2019 International Conference on Information Management and Technology (ICIMTech)*. Vol. 1. IEEE, 2019.

Issa, Usama, et al. "Hybrid AHP-Fuzzy TOPSIS Approach for Selecting Deep Excavation Support System." *Buildings* 12.3 (2022): 295.

Ishak, Aulia, et al. "Decision Support System for Selection and Assessment of Solid Waste Processing Technology from Oil Palm Industry using Analytical Hierarchy Process (AHP)." *IOP Conference Series: Materials Science and Engineering*. Vol. 1003. No. 1. IOP Publishing, 2020.

Karleuša, Barbara, Nino Krvavica, and Igor Ružić. "Selection of Appropriate Coastal Protection Structure Using AHP Method." *Environmental Sciences Proceedings*. Vol. 2. No. 1. Multidisciplinary Digital Publishing Institute, 2020.

Kioupi, Vasiliki, and Nikolaos Voulvoulis. "Education for sustainable development: A systemic framework for connecting the SDGs to educational outcomes." *Sustainability* 11.21 (2019): 6104.

Langer, Markus, Cornelius J. König, and Vivien Busch. "Changing the means of managerial work: effects of automated decision support systems on personnel selection tasks." *Journal of business and psychology* 36.5 (2021): 751-769.

Leccese, Francesco, et al. "Towards a holistic approach to indoor environmental quality assessment: Weighting schemes to combine effects of multiple environmental factors." *Energy and Buildings* 245 (2021): 111056.

Mork, Paul Jarle, and Kerstin Bach. "A decision support system to enhance self-management of low back pain: protocol for the selfBACK project." *JMIR research protocols* 7.7 (2018): e9379.

Pranjić, Goran. "Decision making process in the business intelligence 3.0 context." *Ekonomska misao i praksa* 2 (2018): 603-619.

Puspitarini, Yanuari Dwi, and Muhammad Hanif. "Using Learning Media to Increase Learning Motivation in Elementary School." *Anatolian Journal of Education* 4.2 (2019): 53-60.

Promentilla, Michael Angelo B., et al. "Teaching Analytic Hierarchy Process (AHP) in undergraduate chemical engineering courses." *Education for Chemical Engineers* 23 (2018): 34-41.

Phillips-Wren, Gloria, Mary Daly, and Frada Burstein. "Reconciling business intelligence, analytics and decision support systems: More data, deeper insight." *Decision Support Systems* 146 (2021): 113560.

Radha, Rajapandian, et al. "E-Learning during lockdown of Covid-19 pandemic: A global perspective." *International journal of control and automation* 13.4 (2020): 1088-1099.

Ranganathaswamy, M. K., and Amar Shankar. "Decision-Making Model of Agriculture." *International Journal of Modern Agriculture*10.2 (2021): 2987-2995.

Ruban, Nikolay Yu, et al. "Software and hardware decision support system for operators of electrical power systems." *IEEE Transactions on Power Systems* 36.5 (2021): 3840-3848.

Simionesei, Lucian, et al. "IrrigaSys: A web-based irrigation decision support system based on open source data and technology." *Computers and Electronics in Agriculture* 178 (2020): 105822.

Suryanto, Tulus, Robbi Rahim, and Ansari Saleh Ahmar. "Employee recruitment fraud prevention with the implementation of decision support system." *Journal of Physics: Conference Series*. Vol. 1028. No. 1. IOP Publishing, 2018.

Sadeghi-Niaraki, Abolghasem, Mohammadreza Jelokhani-Niaraki, and Soo-Mi Choi. "A volunteered geographic information-based environmental decision support system for waste management and decision making." *Sustainability* 12.15 (2020): 6012.

Unver, Saliha, and Ibrahim Ergenc. "Safety risk identification and prioritize of forest logging activities using analytic hierarchy process (AHP)." *Alexandria Engineering Journal* 60.1 (2021): 1591-1599.

Wei, Lijun, et al. "A decision support system for urban infrastructure inter-asset management employing domain ontologies and qualitative uncertainty-based reasoning." *Expert Systems with Applications* 158 (2020): 113461.

Zytoon, Mohamed A. "A decision support model for prioritization of regulated safety inspections using integrated Delphi, AHP and Double-Hierarchical TOPSIS approach." *IEEE Access* 8 (2020): 83444-83464.

Biographies

Inayatulloh SE. MMSI, CDMS.CSCA is a lecturer at Bina Nusantara University, School of Information System Jakarta Indonesia and also a doctoral candidate of computer science, experienced in managing systems in the retail, automotive, convection and education industries. research domain in e-learning, e-business, e-commerce, cloud computing, IoT and block chain technology.