Turkish Journal of Computer and Mathematics Education Vol.12 No.10 (2021), 2278 -2285

Research Article

The Analytical Hierarchy Process of Decision Support Systems in Choosing Learning Models

Zulfi Azhar[1], Wakhinuddin[2], Waskito[3], Jalius Jama[4] , Hansi Effendi[5] , Mukhlidi Muskhir[6]

[1]Information System, STMIK Royal, Kisaran, Indonesia
[2]Faculty of Engineering, Universitas Negeri Padang, Padang, Indonesia
[3]Faculty of Engineering, Universitas Negeri Padang, Padang, Indonesia
[4]Faculty of Engineering, Universitas Negeri Padang, Padang, Indonesia
[5]Faculty of Engineering, Universitas Negeri Padang, Padang, Indonesia
[6]Faculty of Engineering, Universitas Negeri Padang, Padang, Indonesia

Article History Received: 10 January 2021; Revised: 12 February 2021; Accepted: 27 March 2021; Published online: 28 April 2021

Abstract : Learning model basically it was form of learning that was described from beginning to the ending that was typically presented by the teacher. With words another, the learning model was a wrap or frame of the application of an approach, method, and learning techniques. The achievement of a teacher's learning goal required a model learning. The learning model used by the teacher must be able to foster students' abilities for various learning objectives. learning models could help educators to be able to develop academic potential in the cognitive and intellectual realms of their students. Various innovations were needed in the teaching and learning process to produce a conducive teaching and learning situation learning objectives could be achieved. The learning process was planned and implemented as a system, the learning process would occur when students interact with the environment designed and prepared by the teacher and it was more effective when using methods, strategies, approaches, and models, appropriate and efficient learning. In selecting the learning model at STMIK Royal Kisaran, there are several criteria and alternatives that have been selected in this study. From several criteria and alternatives, it is necessary to use a method that is able to perform calculations to obtain a solution. Several criteria and alternatives need to get the highest priority value which must be preceded by the implementation in addition to the ranking priority below. In selecting the learning model in this study using the Analytical Hierarchy Process (AHP) method. Where this method could analyze with several criteria and alternatives in selecting the best learning model. that were determined through the calculation process

Keywords: Analytical Hierarchy ProcessAlternativeCriteriaLearning Models

1. Introduction

Learning model: basically it is form of learning that is described from beginning to the ending that is typically presented by the teacher. With words another, the learning model is a wrap or frame of the application of an approach, method, and learning techniques. With regard to models learning, presenting 4 (four) groups learning models, including: a social interaction model; information processing model; personal-humanistic model and behavior modification model. The achievement of a teacher's learning goal requires a model learning. The learning model used by the teacher must be able to foster students' abilities for various learning objectives[1]. During its development, the learning model has many variations, many creative learning models have the potential to improve students' abilities in thematic learning[2]. Learning models are of many kinds or types, and there is no learning model that is suitable for all situations and conditions, and a model used in certain learning or certain topics must have several advantages and limitation[3]. learning models can help educators to be able to develop academic potential in the cognitive and intellectual realms of their students[4]. various innovations are needed in the teaching and learning process to produce a conducive teaching and learning situation learning objectives can be achieved[5]. the learning process is planned and implemented as a system, the learning process will occur when students interact with the environment designed and prepared by the teacher, and it is more effective when using methods, strategies, approaches, and models, appropriate and efficient learning[6]. The ability of the lecturer is one of the considerations in choosing a learning model in carrying out the learning process. Students' abilities need to be considered so that lecturers can see the intellectual abilities of their students by using the right learning model. The number of students can be used in determining the learning model, it will be more efficient to use the lecture and question and answer method compared to other methods in the learning model. In delivering the type of material to students, it is very important to pay specific attention and time can influence the lecturer in determining the learning model. Facilities also influence the determination of the method of observation / practice in the learning

model. The learning process will produce quality learning, so an educator needs the ability to apply a learning model according to the needs in the classroom that can improve the quality of the learning process itself. Learning theory ones supports MBL-fb development is konekivism, social cognitive, information processing, constructivist cognitive and social constructivist[7]. There are four categories that are important to consider in the model learning, namely information models, personal models, interaction models, and behavior models. Model teaching that has been developed and tested for its applicability by education experts by classifying the learning model in the four groups[8]. In selecting the learning model at STMIK Royal Kisaran, there are several criteria and alternatives that have been selected in this study. From several criteria and alternatives, it is necessary to use a method that is able to perform calculations to obtain a solution. Several criteria and alternatives need to get the highest priority value which must be preceded by the implementation in addition to the ranking priority below. In the decision support system, the best selection process can use several criteria and several alternatives. Using analysis with several criteria and alternatives determined through a calculation process with more detailed knowledge in arranging a complex reality into the main elements, divided into parts in a gradual hierarchical manner using the analytical hierarchy process method[10][11][12][13][14][15][16][17][18][19][20][21][22][23][24][25][26].

2. Research method

2.1 Decision Support Systems

Decision Support Systems can also be interpreted as computer systems that process data into information to make decisions from specific semi-structured problems[27]. The Decision Support System (DSS) is more shown to support management in carrying out analytical work in situations that are less structured and with less clear criteria. A DSS is not intended not to automate decision making, but rather provides interactive tools that allow decision makers to do a variety analysis using available models[28].

2.2 Analytical Hierarchy Process (AHP)

Analytic Hierarchy Process (AHP) is a method of measurement through pairwise comparisons and relies on the judgments of experts to derive priority scales. To make a good decision, the decision maker must know and define: the problem, the need and purpose of the decision, the criteria and sub criteria to evaluate the alternatives, the alternative actions to take, and stakeholders and groups affected[26][29][30][31]. AHP is simple, flexible, accurate and easy to understand, its process relies on mathematical and logical reasoning to arrive at a decision making[32]

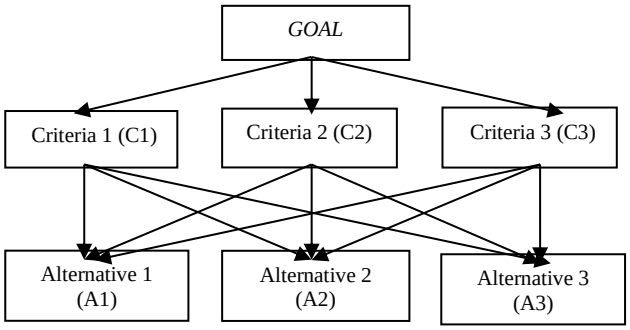

Figure 1. Structure of the Analytical Hierarchhy Process (AHP)

2.3 AHP Procedure

The steps in the AHP method include:a). Defines the problem; b). Determines the priority of the element; c). Synthesis and d). Measure consistency[10].

2.3.1 Calculate Consistency Index (CI)

$$CI = \frac{[\lambda \max - n]}{n-1}$$

Note :

n = number of elements

λmaks = maximum eigenvalues of the pairwise comparisons matrix

2.3.2 Calculate the Consistency Ratio (CR)

$$CR = \frac{CI}{RI}$$

Note:

CR = Consistency Ratio,
CI = Consistency Index,
RI = Random Index

2.3.3. Check the consistency of the hierarchy

If the score is more than 10%, then the data judgment must be corrected. However, if the consistency ratio (CI / IR) is less or equal to 0.1, (CR < 0,1) then the calculation results can be declared correct.

CR < 0,1

3. Results and analysis

3.1. Problem analysis

Data are collected on the STMIK Royal Kisaran campus by using a questionnaire form given to students. The question form is designed according to a matrix or table of influencing goals and criteria. Data filling involving students to provide an overview of the data they have experienced so far by using a number of data forms. Forms didsi according to what they had learned in class and in the computer lab. The data in the assessment questionnaire were collected then processed and analyzed the data.

3.2. Selection criterias

Several criteria were taken based on the results of the assessment that influenced the selection of learning models, namely : The nature of the material to be taught (C1), The objectives to be achieved in learning (C2), The ability level of students (C3), Lesson hours (C4), Learning environment (C5) and Available supporting facilities (C6).

Table 2. Criteria Calculation

Criteria	C1	C2	C3	C4	C5	C6
C1	1	5	3	4	4	4
C2	0,2	1	3	3	3	3
C3	0,333	0,333	1	5	5	5
C4	0,25	0,333	0,2	1	3	3
C5	0.25	0.333	0,2	0,333	1	3
C6	0,25	0,333	0,2	0,333	0,333	1
Total	2,283	7,333	7,6	13,667	16,333	19

Table 3. Normalization Criteria

Criteria	C1	C2	C3	C4	C5	C6	Total
C1	0,438	0,682	0,395	0,293	0,245	0,211	2,263
C2	0,088	0,136	0,395	0,220	0,184	0,158	1,180
C3	0,146	0,045	0,132	0,366	0,306	0,263	1,258
C4	0,109	0,045	0,026	0,073	0,184	0,158	0,596
C5	0,109	0,045	0,026	0,024	0,061	0,158	0,425
C6	0,109	0,045	0,026	0,024	0,020	0,053	0,279
Total	1	1	1	1	1	1	6

Table 4. Priority and Ranking

Criteria	Nilai Priority	Priority (Persentage)	Rangking
C1	0,377	37,7	1
C2	0,197	19,7	3
C3	0,210	21	2
C4	0,009	0,9	6
C5	0,071	7,1	4
C6	0,046	4,6	5
Total	1	100	

From table 4, the priority and ranking results are obtained. Where criterion 1 (C1) is the main priority criterion in some of the criteria taken. And criterion 1 (C1) is the best result criteria from several other criteria by calculating matrix pairs. The results of priority and ranking will be tested using Ratio numbers Hierarchical consistency (CR) <0,1 the calculation becomes correct.

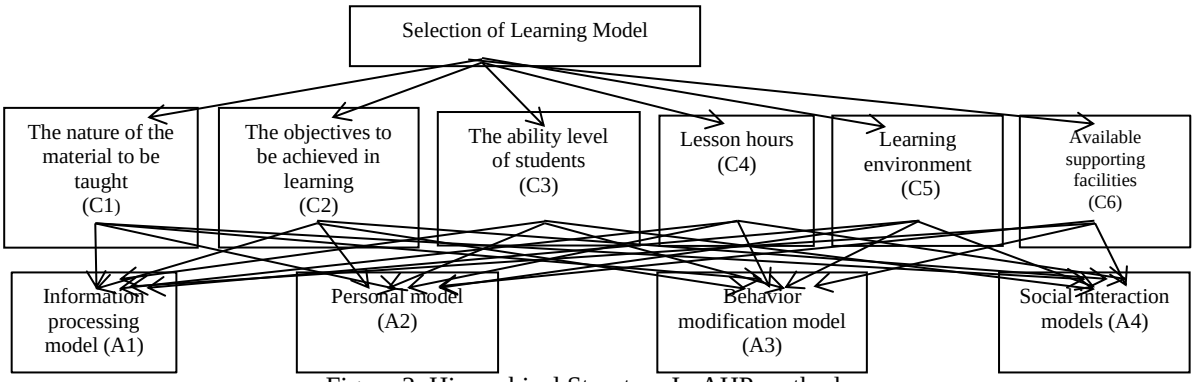

Figure 2. Hierarchical Structure In AHP method

Table 5. Random Index (RI)

ı	1	3	4	5	6	7	8	9	1	1	1	1	1	1
	, 2								0	1	2	3	4	5
I	0	0	0	1	1	1	1	1	1	1	1	1	1	1
I		,58	,90	,12	,24	,32	,41	,45	,49	,51	,48	,56	,57	,59

3.2.1Assessment of the consistency index on the criteria

The hierarchical consistency rate is more than 10%, the data assessment must be repeated. Ratio numbers Hierarchical consistency (CR) <0.1 the calculation becomes correct.

$CR = \frac{CI}{\text{IR}}$

where CR = Consistency Ratio

CI = Consistency Index

RI = Random Index

CI= $\frac{[\lambda \max - n]}{\text{n}-1}$

where n = total elements

λmaks = the maximum eigenvalue of the comparative matrix in pairs

The maximum λ value of the sum of the multiplications in the synthes matrix column proportional to the criteria in table 2 in the priority column in table 4. Then the eigenvalues the maximum to look for is:

$\lambda maks = (2{,}283 * 0{,}377) + (7{,}333 * 0{,}197) + (7{,}6 * 0{,}210) + (13{,}667 * 0{,}009) + (16{,}333 * 0{,}071) + (19 * 0{,}046)$

λmaks = 6,411

CI= $\frac{(6{,}411-6)}{6-1}$ = 0,082104602

Determination of the RI value from the number of criteria (n) in table 5. The number of criteria is 6, the RI value = 1,24.

Then the CR value = $CR = \frac{0{,}0101751279}{1{,}24}$ = 0,066213389

The result of CR value = 0,066213389 is eligible, CR < 0,1. It can be explained that the determination of the criteria that influence the choice of learning model is stated to be consistent / correct.

3.3 Selection alternatives

In the alternative comparison matrix with the selected criteria, namely Learning Objectives (C1). The alternatives in choosing the learning model are: Information processing model (A1), Personal model (A2), Behavior modification model (A3) and Social interaction model (A4).

Table 6. Alternative Calculations

Alternative	A1	A2	A3	A4
A1	1	3	0,333	0,333
A2	0,333	1	0,333	0,2
A3	3	03	1	0,333
A4	3	5	3	1
Total	7,333	12	4,667	1,867

Table 7. Normalization Alternatives

Alternative	A1	A2	A3	A4	Total
A1	0,136	0,250	0,071	0,179	0,636
A2	0,045	0,083	0,071	0,107	0,307
A3	0,409	0,250	0,214	0,179	1,052
A4	0,409	0,417	0,643	0,536	2,004
Total	1	1	1	1	4

Table 8. Priority and Ranking

Alternative	Priority	Priority (Persentage)	Rangking
A1	0,159	15,9	3
A2	0,077	7,7	4
A3	0,263	26,3	2
A4	0,501	50,1	1
Total	1	100	

From table 8, the priority and ranking results are obtained. Where alternative 4 (A4) is the main priority criterion in some of the alternative taken. And alternative 4 (A4) is the best result alternative from several other alternative by calculating matrix pairs. The results of priority and ranking will be tested using Ratio numbers Hierarchical consistency (CR) <0,1 the calculation becomes correct.

3.3.1Assessment of the consistency index on the alternative

The results of the maximum eigenvalues (λmaximum), table 6 by adding up the multiplication results of the number in the alternative comparison matrix column with the priority column in table 8.

The results of the maximum eigenvalues are:

$$\lambda maks = (7{,}333 * 0{,}159) + (12 * 0{,}077) + (4{,}667 * 0{,}263) + (1{,}867 * 0{,}501)$$

λmaks = 4,251

$$\text{CI} = \frac{(4{,}251-4)}{4-1} = 0{,}083790284$$

Determination of the RI value, from the number of alternative elements (n). The number of alternative elements is 4, then n = 4, the number RI = 0,9. For the CR value,

$$CR = \frac{0{,}083790284}{0{,}9} = 0{,}093100315.$$

The result of CR value = 0,093100315 is eligible, CR < 0,1. It can be explained that the determination of the criteria that influence the choice of learning model is stated to be consistent / correct.

The final result of this test is that the selection of learning model based on the criteria The nature of the material to be taught (C1) is the fourth alternative (A4), namely Social interaction model which is selected according to the selected criteria.

Table 9. Description and Ranking of Criteria

Criteria	Description	Rangking
C1	The nature of the material to be taught	1
C2	The objectives to be achieved in learning	2
C3	The ability level of students	3
C4	Lesson hours	4
C5	Learning environment	5
C6	Available supporting facilities	6

Table 10. Description and Ranking of Alternative

Alternative	Description	Rangking
A4	Social interaction	1
A3	model	2
A1	Behavior modification	3
A2	model	4
	Information processing model	
	Personal model	

In table 9, the results obtained state that in selecting the best learning model using the first criterion (C1) as the most important criterion as a priority in shaping the objectives of the learning model in addition to several other criteria based on ranking. In table 10, the results obtained state that in selecting the best learning model using the fourth alternative (A4) as the most important alternative as a priority in shaping the objectives of the learning model in addition to several other alternatives based on its ranking.

4. Conclusion

Analytical hierarchy process method is a method that can analyze by calculating the matrix in pairs more quickly and accurately. This calculation can generate priorities and rankings against criteria and alternatives so that one can get priority solutions which implementation should prioritize in determining the selection of learning models at STMIK Royal Kisaran.

References

1. G. Istiningsih, E. M. L.A, and E. Prihalina, "Pengembangan Model Pembelajaran 'Promister' untuk Meningkatkan Hasil Belajar Wayang Pandhawa Pada Siswa Sekolah Dasar," *J. Holistika*, 2018.
2. N. I. Cintia, F. Kristin, and I. Anugraheni, "PENERAPAN MODEL PEMBELAJARAN DISCOVERY LEARNING UNTUK MENINGKATKAN KEMAMPUAN BERPIKIR KREATIF DAN HASIL BELAJAR SISWA," *Perspekt. Ilmu Pendidik.*, 2018, doi: 10.21009/pip.321.8.
3. A. Asyafah, "MENIMBANG MODEL PEMBELAJARAN," *TARBAWY Indones. J. Islam. Educ.*, 2019, doi: 10.17509/t.v6i1.19459.
4. N. R. Mitasari, "MODEL PEMBELAJARAN EDUTANIMENT TERHADAP PERKEMBANGAN KOGNITIF SISWA SEKOLAH DASAR," *J. Cakrawala Pendas*, 2018, doi: 10.31949/jcp.v4i1.698.
5. T. Pangajuanto, "PENINGKATAN KOMPETENSI MENIMBANG DENGAN NERACA ANALITIS MELALUI MODEL PEMBELAJARAN TEAM ASSISTED INDIVIDUALIZATION (TAI) PADA SISWA KELAS X KI A SMK NEGERI 2 SUKOHARJO SEMESTER 1 TAHUN PELAJARAN 2019/2020," *INKUIRI J. Pendidik. IPA*, 2020, doi: 10.20961/inkuiri.v9i1.41409.

6. A. Abdullah, "PENDEKATAN DAN MODEL PEMBELAJARAN YANG MENGAKTIFKAN SISWA," *EDURELIGIA; J. Pendidik. AGAMA Islam*, 2018, doi: 10.33650/edureligia.v1i2.45.
7. Asmendri and M. Sari, "Analisis Teori-Teori Belajar pada Pengembangan Model Blended Learning dengan facebook (MBL-FB)," *Nat. Sci. J.*, vol. Volume 4, pp. 604–615, 2018.
8. J. Mirdad, "Model-Model Pembelajaran (Empat Rumpun Model Pembelajaran)," *J. Pendidik. dan Sos. Islam*, vol. 2, no. 1, pp. 1–10, 2020.
9. Z. Azhar and M. Handayani, "ANALISIS FAKTOR PRIORITAS DALAM PEMILIHAN PERUMAHAN KPR MENGGUNAKAN METODE AHP," *J. Manaj. Inform. dan Sist. Inf.*, 2018, doi: 10.36595/misi.v1i2.38.
10. Z. Azhar, "Analisis Pemilihan Mata Kuliah Praktek Menggunakan Metode AHP," *Pros. Semin. Nas. Ris. Inf. Sci.*, 2019, doi: 10.30645/senaris.v1i0.126.
11. Z. Azhar, "Faktor Analisis Prioritas Dalam Pemilihan Bibit Jagung Unggul Menggunakan Metode AHP," *Semin. Nas. Teknol. Komput. Sains ...*, 2020.
12. R. A. Suherdi, R. Taufiq, and A. A. Permana, "Penerapan Metode AHP dalam Sistem Pendukung Keputusan Kenaikan Pangkat Pegawai Di Badan Kepegawaian Dan Pengembagan Sumber Daya Manusia Kota Tangerang," *Sintak*, 2018.
13. I. A. Susila and R. Taufiq, "Penerapan Metode Analytical Heirarchy Process (Ahp) Dalam Sistem Pendukung Keputusan (Spk) Pemensiunan Pada Badan Kepegawaian Dan Pengembangan Sumber Daya Manusia Kota Tangerang," *Pros. SINTAK 2018*, 2018.
14. R. Umar, A. Fadlil, and Y. Yuminah, "Sistem Pendukung Keputusan dengan Metode AHP untuk Penilaian Kompetensi Soft Skill Karyawan," *Khazanah Inform. J. Ilmu Komput. dan Inform.*, 2018, doi: 10.23917/khif.v4i1.5978.
15. I. Rijayana and L. Okirindho, "Sistem Pendukung Keputusan Pemilihan Karyawan Berprestasi Berdasarkan Kinerja Menggunakan Metode Analityc Hierarcy Process," *Semin. Nas. Inform.*, 2012.
16. A. Fauzi and T. Hidayatulloh, "Penilaian Kinerja Karyawan Pada PT. Telecom Visitama Menggunakan Metode Analytical Hierarchy Process," *Indones. J. Comput. Inf. Technol.*, 2017.
17. D. Desyanti, "SISTEM PENDUKUNG KEPUTUSAN PEMILIHAN KARYAWAN TELADAN MENGGUNAKAN METODE ANALITICY HIERARCY PROCESS (AHP)," *INOVTEK Polbeng - Seri Inform.*, 2016, doi: 10.35314/isi.v1i1.127.
18. S. Sudarto, "Pemanfaatan Analytical Hierarchy Process (AHP) sebagai Model Sistem Pendukung Keputusan untuk Pemilihan Karyawan Berprestasi," *J. SIFO Mikroskil*, 2011.
19. I. Eva Solita Pasaribu, "Sitem Pendukung Keputusan Promosi Jabatan Karyawan Dengan Metode Analytycal Hierarchy Process (AHP) Studi Kasus Pada PT.Selular Global Net Medan," *Teknol. Dan Sist. Inf.*, 2015.
20. "Sistem Pendukung Keputusan Seleksi Calon Karyawan Berdasarkan Hasil Tes Psikologi Kepribadian Menggunakan Metode Ahp (Studi Kasus Di Kalimasada)," 2014, doi: 10.30873/ji.v14i1.509.
21. M. H. SA, "SISTEM PENDUKUNG KEPUTUSAN REKRUTMEN KARYAWAN DI PT INDO BERAS UNGGUL MENGGUNAKAN METODE ANALYTICAL HIERARCHY PROCESS (AHP)," *KOMPUTA*, 2014.
22. K. Makkasau, "PENGGUNAAN METODE ANALYTIC HIERARCHY PROCESS (AHP) DALAM PENENTUAN PRIORITAS PROGRAM KESEHATAN (STUDI KASUS PROGRAM PROMOSI KESEHATAN)," *J@TI UNDIP J. Tek. Ind.*, 2013, doi: 10.12777/jati.7.2.105-112.
23. Z. Azhar, "PENERAPAN METODE ANALYTICAL HIERARCHY PROCESS DALAM PEMILIHAN BIBIT JAGUNG UNGGUL," *JURTEKSI (Jurnal Teknol. dan Sist. Informasi)*, 2020, doi: 10.33330/jurteksi.v6i2.528.

24. Z. Azhar, "Analisis Faktor Prioritas dalam Pemilihan Mata Kuliah Praktek pada Prodi Sistem Informasi Menggunakan Metode AHP," *Digit. Zo. J. Teknol. Inf. dan Komun.*, 2020, doi: 10.31849/digitalzone.v11i1.3393.
25. Z. Azhar and J. Hutahaean, "Penerapan Metode Analytical Hierarchy Process Dalam Pemilihan Tempat Cafe di Kisaran," *Build. Informatics, Technol. Sci.*, 2020, doi: 10.47065/bits.v2i2.560.
26. R. D. F. S. M. Russo and R. Camanho, "Criteria in AHP: A systematic review of literature," in *Procedia Computer Science*, 2015, doi: 10.1016/j.procs.2015.07.081.
27. D. Andayati, "Sistem Pendukung Keputusan Pra-Seleksi Penerimaan Siswa Baru (Psb) on-Line Yogyakarta," *J. Teknol.*, 2010.
28. W. R. Susila and E. Munadi, "Penggunaan Analytical Hierarchy Process Untuk Penyususunan Prioritas Proposal Penelitian," *Inform. Pertan.*, 2007.
29. A. A. Longaray, J. De Deus Rodrigues Gois, and P. R. Da Silva Munhoz, "Proposal for using AHP method to evaluate the quality of services provided by outsourced companies," in *Procedia Computer Science*, 2015, doi: 10.1016/j.procs.2015.07.083.
30. Y. Han, Z. Wang, X. Lu, and B. Hu, "Application of AHP to road selection," *ISPRS Int. J. Geo-Information*, 2020, doi: 10.3390/ijgi9020086.
31. A. Altamirano-Corro and R. Peniche-Vera, "Measuring the institutional efficiency using dea and ahp: The case of a mexican university," *J. Appl. Res. Technol.*, 2014, doi: 10.1016/S1665-6423(14)71606-2.
32. N. Sael, T. Hamim, and F. Benabbou, "Implementation of the Analytic Hierarchy Process for student profile analysis," *Int. J. Emerg. Technol. Learn.*, 2019, doi: 10.3991/ijet.v14i15.10779.