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Automation Model Development for School Reaccreditation of Early Childhood Education

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As stated in the Research and Development Objectives 2020-2024 by BSKAP, it was agreed on the need to implement a correct and credible quality monitoring and evaluation system. For Primary and Secondary Education, it is determined that 100% of education units will carry out Competency Assessment (AK) and Character Surveys (SK) starting in 2021 by first developing and preparing relevant measuring tools along with indicators of AK-SK readiness in the future, its implementation in 2021 while trying implement the overall accreditation process automation policy. Therefore, performance assessment in these units requires other proxies of learning indicators which are considered to have functions equivalent to competency assessments and character surveys. Instead of direct field visits, if correct, mathematical modeling can be performed to derive measurement proxies derived from the PPA or IPV variables or a combination of both. Automation modeling has been applied to approximately 5,000 school samples by applying three alternative methods, namely Principal Component Analysis (PCA), Partial Least Square (PLS) and Confirmatory Factor Analysis (CFA). PCA modeling was successfully used on 49 predictors without a response variable (Y); ii) PLS modeling was successfully applied to 49 predictors involving response variables; iii) CFA modeling has been successfully carried out on PPA and IPV one by one, because the combined modeling has not succeeded in producing an adequate model in the form of goodness of fit.

Keywords: accreditation, assessments, early childhood education, statistical modeling

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INTRODUCTION

Considering the structure suggested by Indicator Tree of Quality Guaranty for Early Childhood, Primary, and Secondary Education, the arrangement of education quality report from education unit level to regency/municipal and to higher level should basically consider the dimensions of education quality guaranty involving: (1) The improvement of learning outcome quality and relevance; (2) the more evenly distribution of high-quality education (learning access and outcome); (3) the improvement of teacher and educational staff's performance quality and competency; (4) the improvement of learning process quality and relevance; and (5) the participative, transparent, and accountability education management Muhdi et al., (2020);National Academies of Sciences and Medicine, (2016);Essa & Burnham, (2019).

Referring to the objective of research and development in 2020-2024 point number 3 (objective #3) suggested by Agency for Education and Book Research Development, the implementation of a right and credible system is required to monitor and to evaluate the quality (Huber & Helm, 2020). For Primary and Secondary Education, it decides that 100% of educational unit should implement Competency Assessment (Indonesian: *Asesmen Kompetensi* or AK) and character survey (Indonesian: *Survey Karakter* or SK) since 2021 and developing and preparing a relevant measuring instrument first, along with the indicator of AK-SK readiness around its implementation in 2021 while trying to implement the policy of accreditation process automation comprehensively (Dewanti et al., 2020).

For Early Childhood and Non-Formal Education (PAUD and PNF), but Equality Education Program of Packages A, B, C (equivalent to Elementary School, Junior High School, Senior High School) in the Community Learning Activity Process, other unit does not implement competency assessment and character survei (Eadie et al., 2021). Thus, the performance assessment in these units needs other learning indicator proxies considered having function equivalent to competency assessment and character survey, to describe the learning performance representing the characteristics of Early Childhood and Non-Formal Education (Melasalmi & Husu, 2019).

This accreditation automating activity for Early Childhood Education is basically initiated to explore the extent to which the function of digital visitation can replace that of direct field visitation activity – if the mathematic modeling can be actually made to obtain the measurement proxy deriving from PPA and IPV variables or the combination of both Kurniah et al., (2019) ;Szente, (2020)

(1) This proposal of accreditation automation development aims to describe the development of accreditation automation in the attempt of implementing reaccreditation to PAUD and PNF education unit, the accreditation certificate period of which has been expired;

(2) The automation development as mentioned in point (1) in practice requires only the unit that will be reaccredited to input the data and/or the indicator of certain performance through entry format prepared into accreditation automation database

application, and then the function of accreditation assessment is taken over by the application, thereby the extension of accreditation certification can be given;

(3) The accreditation extension certificate as mentioned in point (2) can be granted if the input of data and/or new performance of an educational unit indicates the consistency or the increased proxy of learning quality of the unit compared with that in the previous accreditation period. If there is an indication of the decreased proxy of learning quality, the unit should attend reaccreditation assessment;

(4) This article is intended to give a description on the development of accreditation automation model as an alternative accreditation procedure without the need for visiting the educational unit directly.

Reaccreditation Automation as an Alternative Assessment

Considering the strategic plan of 2021-2024, the accreditation of 2021 targeted 44,767 educational units, with estimated budget of IDR 81 billions. Comparatively, it targeted 35,750 educational units in 2019 with IDR 217 billions. The accreditation automation for PAUD and PNF units is an attempt of dealing with the challenge about the obligation of developing a right credible system to monitor and to evaluate quality according to the strategic plan target of 2021-2024 Istiqomah, (2017);Husna & Sugito,(2021);Maghfiroh et al., (2020)

In the attempt of improving the efficiency of the achievement of education quality guaranty function result in 2021, the National Accreditation Agency for Early Childhood and Non-Formal Education devised the development of accreditation automation system as an alternative to the business process of accreditation assessment activity for PAUD and PNF units (Redondo et al., 2020). For reaccreditation purpose, the units are required only to input annual data or performance indicator through standard format that has been prepared in Accreditation Automation Database application. The function of accreditation assessment is furthermore taken over by the application; thus the extension of accreditation certificate can be granted, when the new performance data inputted by the units provides feasibility consistency index or the improved quality of learning compared with the previous one Melasalmi & Husu, (2019);Cusinato et al., (2020).

If there is an indication of decreased performance, the unit will be the target of accreditation. In addition to implementing the reaccreditation according to accreditation period and level, accreditation can also be done in the educational units that applying for reaccreditation because the units have taken certain attempt of improving the learning quality and perceive that their accreditation level is better than the one they have today.

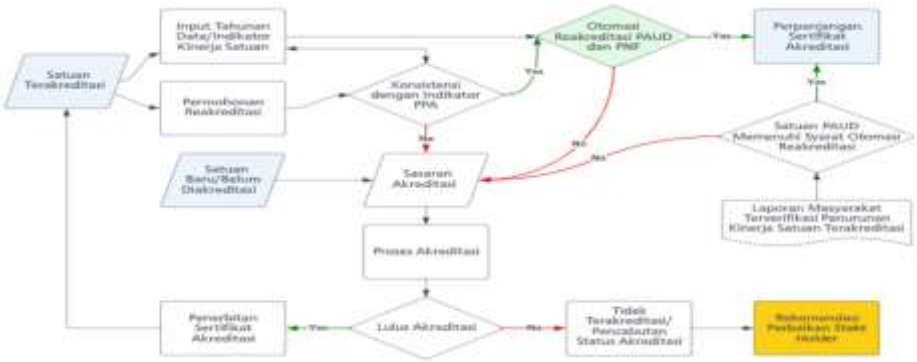


Figure 1
Flowchart of reaccreditation automation for PAUD and PNF
Source: Adapted from Ka's presentation. BSKAP at National Coordination Meeting for BAN PAUD and PNF January 2020

Accreditation can also be done in the presence of report filed by the users of educational units' service about the incompatibility of accreditation level the educational unit providing educational service to their learning quality. The three groups will be the target of accreditation along with other unaccredited units that will pass through accreditation process and mechanism with the final alternative of passing successfully and being certificated or non-accredited with recommended improvement, or furthermore the revocation of accreditation status for the educational units considered non-prospective to continue their educational service.

Reaccreditation automation is a web-based algorithmic application used to predict the result of accreditation assessment; thus, the extension of accreditation certificate based on its feasibility level can be given to PAUD and PNF units (Karolyi et al., 2021). The function will occur if new data or performance indicator inputted by educational unit to provide feasibility consistency index or the increased or the decreased feasibility of learning implementation compared with the previous one. Data mining often called *Knowledge Discovery in Database* (KDD) is an activity involving data collection, data utilization, and data interaction model design to find the regular pattern or relation between data entity usually called *pattern recognition* (Osman et al., 2018)

The example shown in Figure 2 indicates that the dashboard-monitoring report of accreditation automation output can be multifaceted report or multifaceted report in a single display. This multifaceted report gives an opportunity of reporting very general things (e.g. Accreditation Quota achieved per province), the achievement of SNP substantive (e.g. Statistic Descriptive of SNP per cluster) or a comprehensive study on certain cluster (e.g. the achievement of Accreditation Output for PAUD, including either accreditation level or grade in each type of PAUD unit or PAUD unit wholly (in pie diagram), and even the phenomenal analytical study on the achievement of standard using certain statistic feature (*spider-web*) (García-Rudolph et al., 2021).

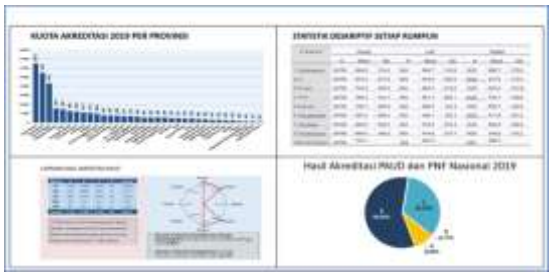


Figure 2
Dashboard report model of accreditation output for PAUD and PNF 2019

The *dashboard monitoring*-format report can also be used as an administrative report on the progress of activity in the form as shown in Figure 3. This report can be the one on the supervision of accreditation activity implementation monitoring in BAN-P in 34 provinces, the aggregate report of which can be reported at national level to BAN PAUD and PNF (Hamka et al., 2019). The period of supervision report can be in certain period of time (quarterly and annually) involving: supervision of the work target achievement, weekly progress supervision, quarterly progress supervision, annual progress supervision per cluster, and accreditation achievement supervision based on the achievement of unit number per location that has been specified first. The model of administrative reporting on the achievement of activity target in the form of supervision can be combined into more detail form referring to the criteria of activity achievement; thus, the activity target can be achieved based on the measure (Wilson et al., 2019).

Figure 3
Dashboard report model 2: Supervision on accreditation implementation for PAUD and PNF

The format of dashboard monitoring report as shown in Figure 4 can be the profile of individual educational units or based on the result of accreditation assessment. The result of assessment consists of Accreditation Prerequisite Assessment (PPA, a new term for EDS-PA) as the proxy of compliance indicator or minimum requirement based on 8 Standard National Education (Indonesian: *Standard Nasional Pendidikan*, thereafter called SNP) that should be complied with in organizing the learning activity, and the result of Visitation Assessment Instrument (IPV, called IPA previously) as the proxy of performance indicator, constituting the result of assessment on the learning performance

of an educational unit in certain aspects referring to certain criteria based on the relevant educational unit cluster (Kurniah et al., 2019b); (Hibana & Surahman, 2021); (Cochran et al., 2020).

Figure 4
Dashboard report model of educational unit individual profile

Considering the example of dashboard monitoring report format shown in Figure 4, the profile of individual educational units is presented in the following aspects: (1) proportion of teaching material achievement and time taken to achieve the material; (2) the comparison between the feasible level of minimum learning requirement achieved in the first assessment (PPA-1) and the achievement of second assessment (PPA-2); (3) the achievement of each SNP compared with the group's average achievement (e.g. at regency/municipal level); (4) the satisfaction of student parent as the users of educational service in the unit (Surahman, 2022).

METHOD

Procedure of Developing Reaccreditation Automation

Reaccreditation automation is a web-based algorithmic data-mining application that can be used to predict the result of accreditation assessment to enable the granting of accreditation certificate extension based on feasibility level to PAUD and PNF units. The term *data mining* is often used to refer to the attempt of mining data in the attempt of finding the conceptual essence of data findings supporting the policy. Thus, it is the processes of finding data relation and of presenting it in understandable manner in order to be the rationale of decision making and policy making.

Data mining is a process of using statistic, mathematic, artificial intelligence, or machine learning techniques to extract and to identify useful information and knowledge relevant to the function of big data from a variety of big data (Tougui et al., 2020). *Data mining* develops rapidly due to the big need for added value of a large-scale database that is accumulated along with the more rapid information technology growth. *Data mining* often called *Knowledge Discovery in Database* (KDD) is an activity involving data collection, data utilization, and data interaction model design to find out the pattern of regularity of the relation between data entities commonly called *pattern recognition* ((Hassanien et al., 2020). *Data mining* is a process of finding meaningful relation,

pattern, and tendency, with a function of large-scale database using statistic and mathematic modeling and testing (Albahri et al., 2020)

Implementation Stage

The procedure of developing PAUD-PNF Accreditation Database is a series of implementation steps based on at least three reasons. Firstly, in the development of data mining, one of data sources used is the database resulting from piloting PAUD and PNF accreditation in 2020 conducted in 5000 educational units including PAUD, LKP, and PKBM in 34 provinces. Secondly, it is expected that the development of accreditation automation gives BAN PAUD-PNF an opportunity of developing an assessment system equivalent to National Assessment (called National Exam previously) that has not touched yet the PAUD unit (Won & Adriany, 2020). Thirdly, there is an importance of developing Accreditation Automation for PAUD and PNF through developing Quality Report (Score-Card) of PAUD and PNF at educational, regency/municipal levels, and higher levels, based on the mapping of Indicator Tree of Quality Guaranty for PAUD as suggested by the Primary and Secondary Education Office of the Ministry of Education and Culture (Education Quality Guaranty Task Force Team of the Ministry of Education and Culture, December 2020) (Sukmayadi & Yahya, 2020).

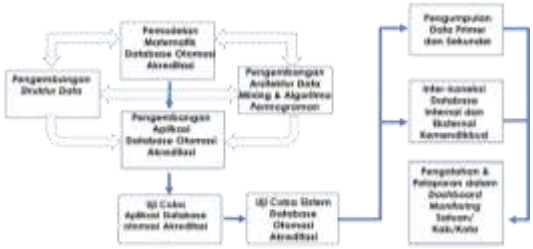


Figure 5
Procedure of developing PAUD-PNF reaccreditation automation

The procedure of implementing the development of accreditation automation for PAUD and PNF is represented as follows:

1. Mathematic Modeling of Reaccreditation Automation

An output of accountable Reaccreditation Automation, viewed from quality guaranty policy aspect, is the presence of reference for the measurement of PAUD-PNF assessment equivalent to AK-SK for the Primary and Secondary Education Office that expectedly can provide the output of reaccreditation automation development. Thus, mathematic modeling is needed to find the measurement construct conceptually supporting the quality guaranteeing policy, and empirically representing the accreditation assessment of PAUD and PNF. The modeling methods used in this research were, among others, *Principal Component Analysis* (PCA), *Partial Least Square* (PLS) and *Confirmatory Factor Analysis* (CFA) (Hair et al., 2020)

2. Data Structure Development

The Development of data structure will technically relate directly to the characteristics of the relation between individual data variable entities that can derive from primary and

secondary data. Nevertheless, if the proxy of learning or institutional quality indicator will be constructed in a mathematic modeling constituting the combination of two or more variables, the development of data structure should adapt flexibly to the result of composite index conceptually constructing the new meaning of entity as a measure.

3. The Development of Data Mining Architecture & Programming Algorithm

The development of data mining architecture is adjusted with the initial asset of database resulting from the Piloting Accreditation for PAUD and PNF in 2020 conducted in 5000 educational units including PAUD, LKP, and PKBM in 34 provinces. *Data mining* is a method of extracting data to make the data reducible according to the substantive purpose of analysis and study. In addition, *data mining* using certain algorithm can generate data variable that is implicit previously and change it into important variable with special character (G. Nguyen et al., 2019).

4. The development of Reaccreditation Automation application

The function of application resulting from the development of *data mining* architecture and programming algorithm is, among others, to monitor the development of Accreditation Automation Database application from unit level. Thus, the unit is required merely to input annual data or performance indicator into digital format that has been prepared online. Furthermore, the function of accreditation assessment is taken over by the application; thus, the extension of accreditation certificate can be granted to the unit, as long as there is a feasible consistency index or an improved learning quality, compared with the previous one. If there is an indication of decreased performance, the unit will be the target of accreditation (AbouEisha et al., 2019).

5. Reaccreditation Automation Application Trial

The trial to examine the functions of reaccreditation automation application and data mining that expectedly can reduce the data variables into essential component and expose important variables into a measure equivalent to AK-SK is done optimally, involving the implementation of procedure using algorithm needed in the programming.

6. Reaccreditation Automation System Trial

This system trial is the follow-up of application trial stage, involving all secretariat staffs of BAN-P in 34 provinces, including the management of Sispena database in the units affiliated with BAN-P entirely, that should be controlled for their accreditation extension status and annual time-series data, in order to be inputted into data mining analysis of reaccreditation automation (Barua & Mondal, 2019).

7. Primary and Secondary Data

The collection of new primary data had just been possible to be conducted in 2021, if the implementation of PAUD and PNF accreditation assessment is designed prospectively for 2021-2024. An idea to develop banking item for the assessment of PAUD-PNF accreditation can be an alternative to the development of new question items to arrange accreditation set.

8. Interconnection between Internal and External Database of Ministry of Education and Culture

The point relating directly to the policy is how to connect the benefit of data to the educational policy distributed in various governmental sectors. Therefore, the interconnection of database between sectors is desirable in the function of big-data. Database interconnection is still limited to Dapodik and EMIS (Kemenag or Ministry of Religion) only today, the interconnection to Dukcapil's database is still being studied by Pusdatin; thus, in turn when we want to conduct *data mining* study thematically in certain age and occupation group, *cross-reference-database* will be helpful (Yang, 2019).

9. Processing and Reporting in Dashboard Monitoring

The dimensions of education quality guaranty are, among others: (1) the improvement of quality and the relevance of learning outcome; (2) the more even distribution of high-quality education (learning access and outcome); (3) the improvement of teacher and educational staff quality (performance and competency); (4) the improved quality and the relevance of learning process; and (5) the manifestation of participative, transparent and accountable education management. To arrive at the more specific type of data, those dimensions are elaborated into at most 3 indicator levels. The processing and the reporting of PAUD and PNF data in the form of dashboard monitoring at unit level can more likely be done in the micro indicators of quality guaranty such as dimensions 4 and 5 (H. Nguyen et al., 2020).

a. Artificial Neural Network (ANN)

Artificial intelligence, cognitive model, and neural network are an information processing paradigm inspired by the way by which biological nervous system processes data. Artificial intelligence and cognitive modeling try to simulate several properties of biological neural network. In artificial intelligence, the artificial neural network has been applied successfully to voice identification, image analysis, and adaptive control (H. Nguyen et al., 2020).

Digital computer operates through executing the instruction in the memory with processor device. On the other hand, the origin of neural network is based on the attempt of modeling information processing in biological system. In contrast to digital computer, the neural network computation does not separate memory from processing. The nervous network theory functions to identify better how the cerebral neuron works and to give rationale to the attempt of creating artificial intelligence.

Accreditation Automation (OA) is a web-based data mining application, the alternative design of which will use classification algorithm. This algorithm imitates the work mechanism of Artificial Neural Network (ANN). This algorithm maps the input data in the input layer into the target in output layer through neurons in the hidden layer. The input data is feed forward, connected by the input weights that have previously been initialized randomly toward the neuron in hidden layer to be processed later using activation function. Furthermore, the data processed in hidden layer is connected by

hidden weights to neurons in the output layer. The output obtained is then compared with the targeted data to find error rate. If the error rate obtained is less than the target error, the propagation process will cease. However, if the error is still more than the target error, backward propagation process is done by updating the weight.

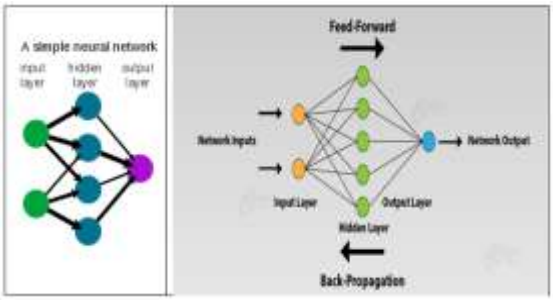


Figure 6
Example of classification algorithm neural network architecture
Source: (Toraman et al., 2020)

Basically, neural network is a neuron circuit or node functioning to solve problem. Viewed from artificial intelligence aspect, the connection of biological neuron is modeled as weight. Positive weight reflects the connection of stimulation, while the negative one indicates the connection of restriction. All inputs are modified using certain weighing method to control the output amplitude with a certain interval of value outputs.

Artificial neuron network can be used for predictive modeling, adaptive data control, and practicable application through data collection. The design of algorithm procedure is divided into two main processes: practice and trial. Before these two processes are implemented, the division of data should be prepared first for practical and trial data. The artificial neural network algorithm can be applied to solve a variety of computation problems, (e.g. for case classification, identification, prediction, and detection). This algorithm is intended to find the formulation to map input value toward the output value (Adi Pamungkas, 2020).

FINDINGS

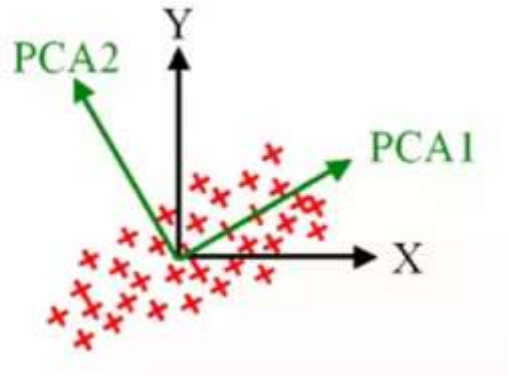
a. Principal Component Analysis (PCA)

1. Principal component analysis (PCA) is a multivariate statistic method. The concept of PCA is to prepare a linear combination of the variable association of a data and thereby the association of variables in a data becomes smaller but has larger variance or remains to be able to maintain much information contained in the association of early data variable (Johnson & Wichern, 2007). PCA is also an approach usually used in machine learning, particularly in *unsupervised learning*. (James et al., 2013).

2. The *principal component analysis* (PCA) equation model is as follows:

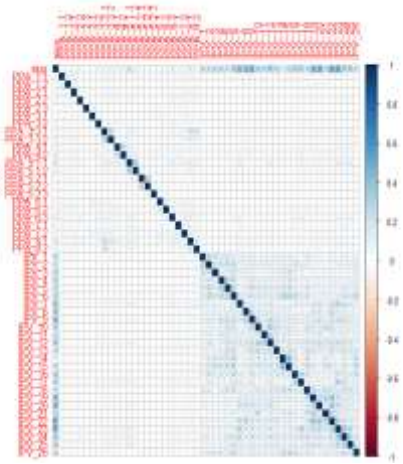
$Z_1=a_1' X=a_{11} X_1+a_{12} X_2+\cdots+a_{1p} X_p$

$Z_2=a_2' X=a_{21} X_1+a_{22} X_2+\cdots+a_{2p} X_p$
$Z_n=a_n\text{^}' X=a_{n1} X_1+a_{n2} X_2+\cdots+a_{np} X_p$



PCA is used to reduced the dimension of a data association, to explore the position of data object (clustering), and to deal with colinearity problem in the data, particularly regression analysis (Mattjik & Sumertajaya, 2011).

In the accreditation automation, PCA concept is used to get new component resulting from the reduction of combined PPA and IPV indicators, consisting of 49 indicators.



From the result of PCA on the data, 20 (twenty) new components/factors are obtained, constituting the linear combination of 49 PPA and IPV indicators with total variance of 60% and the detail of component and indicator shown in the table below.

Table 1
The detail of component and indicator

Components	Standard deviation	Proportion of Variance	Cumulative Proportion
PC1	2.619	0.14	0.14
PC2	1.64118	0.05497	0.19499
PC3	1.29896	0.03443	0.22943
PC4	1.20975	0.02987	0.2593
PC5	1.16445	0.02767	0.28697
PC6	1.14408	0.02671	0.31368
PC7	1.1058	0.02496	0.33864
PC8	1.07915	0.02377	0.3624
PC9	1.05313	0.02263	0.38504
PC10	1.02946	0.02163	0.40666
PC11	1.02246	0.02134	0.428
PC12	1.01754	0.02113	0.44913
PC13	1.00826	0.02075	0.46988
PC14	0.99385	0.02016	0.49004
PC15	0.97606	0.01944	0.50948
PC16	0.96868	0.01915	0.52863
PC17	0.96293	0.01892	0.54755
PC18	0.95859	0.01875	0.5663
PC19	0.94759	0.01833	0.58463
PC20	0.93963	0.01802	0.60265

The following is the table of components and indicators selected through PCA.

Table 2
Components and indicators selected through PCA

Component	Indicator
PC1	
PC2	PPA_3.1,PPA_5.2.2
PC3	IPV_10,IPV_15,IPV_20,IPV_6
PC4	PPA_5.1.1
PC5	IPV_1,IPV_8
PC6	PPA_2.2,PPA_5.2.3
PC7	IPV_13,IPV_18,IPV_25,IPV_5,PPA_4.2
PC8	IPV_17,PPA_3.2
PC9	IPV_11,IPV_2,IPV_4,PPA_3.3.2,PPA_4.1
PC10	IPV_26,IPV_7,PPA_1.2,PPA_6.3
PC11	IPV_12,IPV_23,IPV_3,PPA_5.1.2
PC12	IPV_21
PC13	IPV_14,IPV_19,PPA_7.1,PPA_8.2
PC14	IPV_9,PPA_3.3.1,PPA_6.1,PPA_6.2
PC15	
PC16	IPV_16,PPA_8.1
PC17	IPV_24
PC18	IPV_22,PPA_5.2.1
PC19	PPA_7.2
PC20	PPA_1.1,PPA_2.1,PPA_2.3

From the table above, it can be seen that some components consist of PPA indicator only, some others consist of IPV indicator only, and still some others consists of the combination of the two.

To see the significance of a component containing PPA and IPV indicators, the example of PC9 and PC13 components are presented in the table below.

Table 3
The significance of a component containing PPA and IPV indicators

Component	Indicator	Notes
PC9	IPV 11	Educator facilitates the learning process to enable the child to understand receptive language
	IPV 2	Educator stimulates noble character to practice worship according to religion/creed they adhere to.
	IPV 4	Educator stimulates child to show gross motor skill.
	PPA_3.3.2	Learning Supervision
	PPA 4.1	Educator
PC13	IPV_14	Educator's ability of stimulating child in self control
	IPV_19	Educator provides various playing activity choices according to the development stage of child's interest
	PPA_7.1	Budget plan
	PPA_8.2	Child development report

b. Partial Least Square (PLS)

An alternative to the process of determining the component in Accreditation Automation Development is, among others, partial least square (PLS). The function of PLS is similar to principal component analysis (PCA) that reduces the dimension of variable association into new component with the dimension smaller than the origin date, but in the process of developing new component, PLS involves Y variable variance (response), different from PCA focusing only on X variable variance (predictor) regardless the Y variable variance (response) (Maitra & Yan, 2008)

Partial least square equation model:

$Z_1=a_1' X=a_{11} X_1+a_{12} X_2+\cdots+a_{1p} X_p$
$Z_2=a_2' X=a_{21} X_1+a_{22} X_2+\cdots+a_{2p} X_p$
$Z_n=a_n\text{^}' X=a_{n1} X_1+a_{n2} X_2+\cdots+a_{np} X_p$

The development of component conducted using PCA approach involving only X variable variance (predictor) does not ensure that the component can provide a good prediction of Y variable (response); thus, theoretically PLS more likely has better prediction approach than PCA does as it involves Y variable (response) in the component development. It also indicates the fundamental difference between PCA and PLS, in which PCA is the part of *unsupervised learning*, while PLS belongs to *supervised learning*. (James et al., 2013)

The result of PLS shows that using one component, the data variance of 64% can be obtained. Nevertheless, the linear combination created is more complex than PCA and there are many lost constructs and indicators (variables) in Accreditation Automation due to very massive reduction and of course lost construct substance and indicator.

Table 4
Constructs and indicators

	values	percentage	cumulative
v1	7.501808	15.00362	15.00362
v2	2.704476	5.408952	20.41257
v3	1.71183	3.42366	23.83623
v4	1.463851	2.927702	26.76393
v5	1.355812	2.711624	29.47555
v6	1.314373	2.628745	32.1043
v7	1.221646	2.443292	34.54759
v8	1.203215	2.40643	36.95402
v9	1.11581	2.23162	39.18564
v10	1.065483	2.130967	41.31661
v11	1.045935	2.091871	43.40848
v12	1.029585	2.05917	45.46765
v13	1.024922	2.049844	47.51749
v14	0.993732	1.987464	49.50496
v15	0.954419	1.908837	51.41379
v16	0.939636	1.879273	53.29307
v17	0.932773	1.865546	55.15861
v18	0.919485	1.83897	56.99758
v19	0.898434	1.796868	58.79445
v20	0.883465	1.76693	60.56138

The table below shows the components created through PLS. The components created have characteristics similar to PCA does in which some components contain PPA indicator only, some others contain IPV indicator only, and still some others contain the combined PPA and IPV indicators.

However, the composition of indicator contained in PCA is different from that in PLS, as shown in the table below.

Table 5
The composition of indicator contained in PCA

Component	Indicators
PC1	IPV_6,IPV_10,IPV_12,IPV_15
PC2	PPA_3.3.1,PPA_5.1.1,PPA_5.1.2,PPA_8.1
PC3	IPV_19,IPV_20
PC4	IPV_2,IPV_17
PC5	
PC6	PPA_5.2.1,PPA_5.2.2
PC7	IPV_1,IPV_8
PC8	
PC9	PPA_2.3,PPA_3.1,PPA_4.2
PC10	PPA_6.1
PC11	
PC12	PPA_2.2,PPA_5.2.3,PPA_6.3
PC13	PPA_4.1
PC14	
PC15	PPA_7.1
PC16	PPA_1.1,IPV_9,IPV_16
PC17	PPA_2.1,IPV_14
PC18	PPA_6.2,PPA_8.2,IPV_11
PC19	PPA_3.2
PC20	PPA_1.2

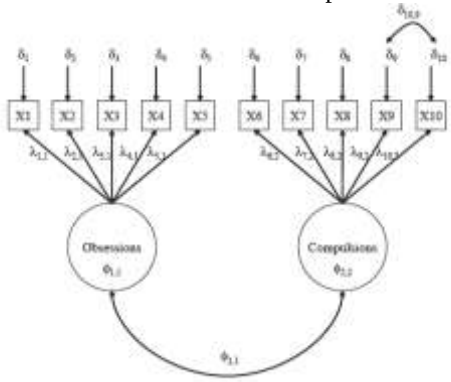
To see the significance of a component containing PPA and IPV indicators, the examples of PC6 and PC18 components are shown in the table below.

Table 6
The significance of a component containing PPA and IPV indicators

Component	Indicator	Notes
	PPA_1.1	Detection of child growth
PC16	IPV_9	Educator stimulates the child's logical, critical, and creative thinking ability
	IPV_16	Educator stimulates children to know and to love their state through state symbol and sign
PC13	PPA_6.2	Organization
	PPA_8.2	Child development report
	IPV_11	Educator facilitates the learning process to enable the child to understand receptive language

c. Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis (CFA) is the follow-up process conducted having passed through principal component analysis (PCA) or partial least square (PLS). CFA is a part underlying *structural equation modeling (*SEM) functioning to examine whether or not an indicator of measurement can represent its construct variable (Hair et al., 2010).



In contrast to *exploratory data analysis* (EDA) that classifies variables into construct or component based on statistical analysis such as *principal component analysis* (PCA), CFA is usually constructed based on preexisting theoretical foundation and then validates the indicators representing its construct variables. Evaluation of CFA model is measured using some criteria including, among others: *standardized root mean square residual* (SRMR) with *cutoff* less than 0.08, *root mean square error of approximation* less than 0.08 (RMSEA), *comparative fit index* (CFI) and Tucker-Lewis index (TLI) of 0.90 or higher (Hoyle, 2012).

CFA process is conducted in 2 scenarios: (1) full model in which PPA and IPV indicators are combined to be evaluated later using CFA; and (2) CFA is conducted in staging by prioritizing PPA and IPV evaluations. The result of evaluation on 2 scenarios is presented in the table below.

Table 7
The result of evaluation on 2 scenarios

Goodness of Fit	Cut off	Full Model	Staging PPA	Staging IPV
CFI	>0.9	0.719	0.73	0.828
TLI	>0.9	0.662	0.69	0.801
GFI	>0.9	0.892	0.95	0.948
AGFI	>0.9	0.865	0.94	0.932
RMSEA	<0.08	0.045	0.05	0.059

From the table above, it can be seen that the staging scenario has much better evaluation measures than the first scenario that combines PPA and IPV indicators.

PPA and IPV indicators that have been evaluated and reduced through CFA in order to be more concise are presented in the table below.

Table 8
PPA and IPV indicators

Standard	Indicator
STD1	X1.1,X1.2
STD2	X2.1
STD3	X3.3.1,X3.3.2
STD4	X4.1,X4.2
STD5	X5.1.1,X5.1.2,X5.2.3
STD6	X6.1,X6.2,X6.3
STD7	X7.1,X7.2
STD8	X8.1,X8.2

From the table above, it can be seen that out of … PPA indicators, having passed through CFA, the indicators are reduced into 17, while IPV indicators are reduced into 16 indicators as shown in the table below.

Table 9
IPV indicators

Number	IPV Indicator
1	B6
2	B7
3	B8
4	B9
5	B10
6	B12
7	B16
8	B17
9	B18
10	B19
11	B20
12	B21
13	B22
14	B23
15	B24
16	B25

d. Mechanism of Staging

1. The accreditation assessment in Early Childhood Education (PAUD) focuses on two main matters: firstly, the unit's compliance with minimum requirement to be met in implementing a learning activity based on 8 National Standards of Education. This compliance requirement is called the assessment of compliance aspect; secondly, the unit's performance in organizing early Childhood education based on learning components referring to the conceptual framework of early Childhood assessment, this assessment on learning performance is called the assessment of performance aspect.

2. The mechanism of staging for accreditation automation is conducted for two reasons: *firstly*, a mathematic modeling is required to obtain the proxy of unit quality that will be used in *dashboard-filter* to determine the educational units that can be certified through automation process; and secondly, the need for individual information on the variables of compliance and performance aspect assessment.

3. It is still desirable because PPA and IPV combined instrument model resulting from PCA (*Principal Component Analysis*) and CFA (*Confirmatory Factor Analysis*) indicates unfit model.

4. The mechanism of staging is an accreditation step starting with filling in the PPA instrument first (PPA stage). If the minimum score of PPA instrument has been achieved, it will be followed with the filling of IPV (IPV stage). The recommendation of automation technique in PPA stage is given as follows.

Figure 7
Recommendation of accreditation automation technique in PPA stage

5. In the accreditation automation using staging mechanism, the items contained in PPA and IPV instruments should be studied further to find the very important items based on weight size.

6. A consensus is achieved related to the need for CFA analysis for PPA instrument of PAUD unit using accreditation data of 2021 to find new weight of respective items.

7. A total of 15,262 data are used for CFA analysis on PPA instrument in PAUD educational unit. The validity of item is taken with threshold of 0.4.

8. The output of second-order CFA model for PPA instrument in PAUD educational unit is presented below.

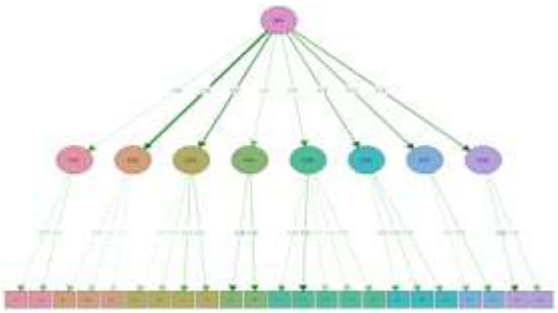


Figure 8
Second order CFA model fro PPA instrument in PAUD educational unit

Considering the data shown in the table above, the red row shows item validity less than 0.4, meaning that the items are not recommended to be used. Meanwhile, the yellow row (item X2.1) is considered as valid, despite loading factor less than 0.4. Eight (8) items are reduced from the number of items; there are totally 15 PPA items for PAUD educational unit.

9. The next step is CFA reanalysis on PPA instrument in PAUD educational unit with the reduced item number, 15 items. The Goodness of Fit (GOF) Comparison of the result of CFA analysis on PPA instrument in PAUD educational unit is presented in the table below.

Table 10
The goodness of Fit (GOF) comparison of the result of CFA analysis on PPA instrument in PAUD educational unit

GoF	CFA1	CFA2	Cut Off
CFI	0.73	0.90	> 0.9
TLI	0.69	0.88	> 0.9
GFI	0.95	0.98	> 0.9
AGFI	0.94	0.97	> 0.9
RMSEA	0.05	0.04	< 0.08

10. The Column CFA1 in Table 10 shows GOF of PPA instrument for PAUD with the items that have not been removed. Meanwhile, column CFA2 shows GOF of PPA instrument for PAUD with the removed items based on the approved threshold.

CONCLUSION

1. From the result of PCA, variance of 60% is obtained as the accumulation of 20 predictors coming from the combination of 49 PPA and IPV variables partitioned into model excluding response variable.

2. From the result of PLS, variance of 64% is obtained as the accumulation of 4 predictors coming from the combination of 49 PPA and IPV instruments partitioned into the model including response variable.

3. From the result of CFA, an adequate *Goodness of Fit* is obtained for each of PPA and IPV *full-sets*, but an adequate *Goodness of Fit* model is not obtained for the PPA and IPV combined model.

4. Some predictors show the association of PPA and IPV composite index with the quality of educational unit; thus, an opportunity of implementing accreditation automation is achieved for the certification of unit without the need for visitation.

5. The opportunity of automation as mentioned in point (4) requires the existence of PPA as the proxy of annual learning quality, constituting the minimum requirement of learning activity to be complied with by an educational unit in implementing the learning process based on 8 National Standard of Education (SNP) that can be functioned to be annual regency/municipal report all at once.

6. An opportunity of using IPV is obtained as an instrument of measuring performance once in five year using online assessment for the educational unit having PPA annual report as the function of time-series data control concerning the development of minimum requirement of learning activity that should be complied with by the unit.

7. From the result of CFA analysis, out of 23 PPA indicators, 6 items are found having PPA below the threshold (0.35). Therefore, the 17 items with weight higher than threshold can be the indicator of selection that should be filled in by PAUD educational unit for reaccreditation function.

8. The staging mechanism is recommended as one of reaccreditation automation step in which the fulfillment of PPA becomes the parameter of whether or not an educational unit should be visited by assessor using IPV.

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