An Empirical Study On Teacher Performance Analytics To Measure The Impact Of Environmental Factors By Using The Design Of Circularity Measurement Framework

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ABSTRACT

The aim of this research study is to consider the circularity measurement framework using the data analytics models to extract insights and understand how the environmental factors in the digital platform are influencing the teacher performance in the areas of:

1. Teaching-learning effectiveness
2. Expected student academic performance
3. Overall development of the school

Assessing the teacher performance using the circularity measurement framework and tools published by MDPI article is not a simple and direct technique. The circularity measurement framework and its applications have gained importance for businesses and industrial practitioners for getting the benefits from circular economy (CE). Thus, providing methods and tools to evaluate and enhance teacher performance—in the light of the circular economy—becomes a significant but still barely addressed topic. In addition, operational guidance for teachers, education designers, and academic administrators to improve their academic products, programs and service delivery in a circular economy context is missing. As a result, guidelines and suggestions for academic practitioners for the design and

development of new performance evaluation frameworks, tools and indicators aiming at measuring teaching delivery quality in a circularity performance framework are important.

Teaching is the heart of education, so the most important action required is to develop a circularity measurement framework using data analytics models to measure and predict the performance issues of teachers to improve education delivery and outcomes. (Önen & Sincar, 2019) Advanced statistical data analysis models using regressions, structured equation modelling, random forest, decision tree, etc will be used for extracting intelligence by finding out the significance and correlation of various factors influencing teacher performance as per the circularity measurement framework.

Based on the literature review, some of the circularity performance assessments methods used in the circular economy (CE) for measuring performance issues are Data Envelopment Analysis (DEA), Input-Output (I-O), Design for X (Dfx), Life Cycle Assessment (LCA), Life Cycle Inventory (LCI), Multi Criteria Decision Methods (MCDM), Social Network Analysis (SNA), Regression Model (RM), Sustainable Performance Assessment (SPA), Factor Analysis (FA), Balanced Score Card (BSC), Sensitivity Analysis (SA) etc.

The teacher performance data analytics models will help in assessing and measuring the impact how the environmental and related factors under various Teachers Performance Areas (TPAs), such as productive teaching techniques, students achievements, organized class management, inter-personal relations, institutional environment, classroom environment etc and related Teachers Performance Indicators (TPIs) using multiple data points for each of these TPAs in the continuous process of evaluating teachers throughout their educational and professional careers.

KEYWORDS

Circular Economy, Circularity Measurement Framework, Data Analytics Models, Teacher Performance Analytics, Teachers Performance Areas, Teachers Performance Indicators.

INTRODUCTION

This research study has examined the how the teacher's performance is influenced under the circular measurement framework by the various environmental factors categorised under

Teachers Performance Areas (TPAs) and Teachers Performance Indicators (TPIs). The dependant factor of teacher performance is derived based on the feedback received by self-appraisal, students and parents' feedback, review and feedback from supervisor, feedback from principal. The independent factors are collected based on the various data points from teachers' performance indicators under different categories of teacher's performance areas, i.e., productive teaching techniques, interpersonal relations, organized and structured class management, classroom environment, personal factors, institutional factors, students' performance etc. are used for building the data model to assess the significance and correlation of their influence on the performance areas of teachers.

After students, teachers are the next important stakeholders of an educational institution. The quality of teaching by the teachers in a school has a direct impact on the performance and overall growth of a student. Thus, in order to optimize the student performance, it is necessary to measure and analyse teacher's performance as well.

Teaching in a circular economy helps to generate changes in the classroom delivery by the teachers, focussing more on the environmental factors associated with the subject areas for strengthening the commitment to a sustainable growth amongst the student's community and society as a whole. The teachers teaching delivery methodology, content and other factors associated with the environment; influences the teachers' performance, which can be measured and suggestive improve areas will be highlighted by using analytical techniques.

By implementing teacher's performance analytics application in an academic institution using the circularity measurement framework; the students and parents will be benefitted.

- Assurance of high-level education and teaching delivery to the student
- Better and effective communication system
- Better understanding of the strengths and weaknesses of a student.

Benefits of implementing teacher's performance analytics to the teachers are:

- Self- evaluation to understand and identify their strong and weak points.
- Comparison with different teachers, their teaching techniques and its effect on the student performance

- Will have a better understanding of the students' capacity, grasping power and effective learning techniques

Benefits of implementing teacher's performance analytics to the school management are:

- Fewer drop-out rate and increase in admissions
- Attract good teachers
- Developing good quality of students to the circular economy of the country

Problem definition:

The environmental factors such as teaching and planning techniques of the teacher, communication skills, preparation of appropriate evaluation system, giving appropriate feedback etc. have an impact on the teacher's performance under the circularity measurement framework.

Problem Statement:

Data analytics techniques and statistical models were used to extract insight from the data corresponding to teachers' performance and various environmental factors and thus describe to analyse and predict the teacher's performance.

Data Collection and architecture:

Teachers' performance appraisal system is not very widely used in the academic institutions. thus, we need to develop a system to measure the teacher's performance, which is considered as the dependant variable in this research data model. The teacher's performance will be calculated upon the feedback received from the supervisor/HOD/Principal and ratings given by the teacher himself/herself. A questionnaire was designed to collect the data and accordingly the teacher performance rating was derived.

The proposed research models for finding out the environmental factors responsible for influencing the teacher performance using the circularity measurement framework was designed. The factors were classified under different Teacher Performance Areas (TPAs), each TPA has various Teacher Performance Indicators (TPIs) and each data related with each TPI were collected for this proposed research.

The various data points were collected from the school ERP system and also using questionnaires. Data as feedbacks were given by students and their parents using these questionnaires. This feedback is mapped to the data points defined in the TPA model.

Thus, these data points were considered as independent variables on which the analytical model was built for finding the significance and correlations.

Statistical Models:

1. Mutual-info regression model was used to build upon the dependent and independent variables, defined to obtain the significant factors from all the independent factors.
2. Correlation between the significant factors obtained and the dependent variable (Teacher Performance) was derived.
3. The percentage of correlation were obtained.
4. The findings are represented using various reports, graphs and dashboards.

Analytics Reporting using Dashboards:

The research findings from the statistical techniques were shown using various visualizations and dashboards by using following two use cases:

Use case-1: Teachers viewing their own performance.

Use case-2: School management viewing the teacher performance.

Hypotheses formulation

The following hypotheses were formulated for validating the research model to find out the significance and corelation of various factors under the circularity measurement framework.

H1: All factors under "Productive teaching technique" have significant correlation with the teacher's performance.

H2: All factors under "Student Achievement" have significant correlation with the teacher's performance.

H3: All factors under "Organized, Structured class management" have significant correlation with the teacher's performance.

H4: All factors under "Positive Interpersonal Relations" have significant correlation with the teacher's performance.

H5: All factors under "Employee Relationships" have significant correlation with the teacher's performance.

H6: All the factors under "Classroom Environment" have significant correlation with the teacher's performance.

H7: All the factors under "Personal Factors" have a significant correlation with the teacher's performance.

H8: All the factors under "Institutional Factors" have a significant correlation with the teacher's performance.

H9: There is significant correlation between teacher and student performances.

H10: There is significant correlation between teacher performance and student's retention.

H11: There is significant correlation between teacher performance and admission efficiency & school's revenue i.e., in other words maintaining financial stability.

Teachers Performance Areas (TPAs), Teachers Performance Indicators (TPIs) and Data Points

1. Productive teaching techniques

SN	Teacher Performance Indicators (TPI)	SN	Data Points	Data Range
1.1	Demonstrates effective planning skills	a.	Aligns carefully the functional classroom curriculum taught with the school organization's curriculum guide and the state course of study.	1 to 5
		b.	The classroom curriculum is appropriate for my child.	1 to 5
		c.	My teacher makes class work interesting.	1 to 5
		d.	The films and videotapes we watch help us learn about the subject we are studying.	1 to 5
		e.	I use films or videotapes for students to watch that help them learn about the subject they are studying.	1 to 5
		f.	I make class work interesting.	1 to 5
1.2	Implements the lesson plan effectively	a.	I ask questions in class to see if the students understand what has been taught.	1 to 5
		b.	My students and I discuss and summarize each	1 to 5

			lesson just studied	
		c.	I monitor student work, as they are doing it, to see if they understand the lesson.	1 to 5
		d.	My teacher asks questions to see if we understand what has been taught.	1 to 5
		e.	We discuss and summarize each lesson we have just studied	1 to 5
		f.	My teacher looks at our work, as we are doing it, to see if we understand the lesson.	1 to 5
		g.	My child is challenged.	1 to 5
1.3	Communicates effectively with the students	a.	Develops and maintains positive relations with students	1 to 5
		b.	The teacher provides verbal communication, which is clear, concise,positive and easy to understand.	1 to 5
		c.	The teacher helps motivate my child to workto my child's potential.	1 to 5
1.4	Prepares appropriate evaluation activities	a.	I give assignments related to the subject we are studying.	1 to 5
		b.	I assign homework that helps students to learn the subject being taught.	1 to 5
		c.	I make materials and worksheets for students to use.	1 to 5
		d.	My teacher gives assignments related to the subject we are studying.	1 to 5
		e.	My homework helps me to learn the subject being taught.	1 to 5
		f.	My teacher makes materials and worksheets for us to use.	1 to 5
		g.	I am satisfied with the process the teacher usesto evaluate my child's progress.	1 to 5
		h.	The teacher teaches my child in the mannerin which my child best learns	1 to 5
		i.	I like it when students ask questions.	1 to 5
		j.	My teacher likes it when we ask questions.	1 to 5
1.5	Provides students with appropriate evaluative feedback	a.	I return tests and assignments quickly.	1 to 5
		b.	My teacher returns tests and assignments quickly.	1 to 5
		c.	I give students feedback about their performance.	1 to 5
		d.	My teacher gives me feedback about my performance.	1 to 5
		e.	The teacher communicates openly, honestly, and frankly with my child and me.	1 to 5

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1.6	Display a thorough knowledge of curriculum and subject matter	a.	I am very knowledgeable about the subject(s) I teach.	1 to 5
		b.	I tell the class about library/media materials that will help themlearn about the subject they are studying, when appropriate.	1 to 5
		c.	My teacher tells the class about library/media materials that will help us learn about the subject we are studying, when appropriate.	1 to 5
		d.	My teacher knows a lot about this subject.	1 to 5
		e.	I encourage students to look at problems in new waysand to find new ways to solve problems.	1 to 5
		f.	My teacher encourages us to look at problems in new ways andfind new ways to solve problems.	1 to 5
		g.	I tell students how they can use what they already have learned to learn new things.	1 to 5
		h.	My teacher tells us how we can use what we have already learned to learn new things.	1 to 5
1.7	Selects learning content congruent with the prescribed curriculum			1 to 5
1.8	Provides opportunities for individual differences			1 to 5
1.9	Ensures student time on task	a.	I am available to help students during class time and other times during the day.	1 to 5
		b.	My teacher is available to help me during class time and other times during the school day.	1 to 5
1.10	Sets high expectations for student achievements	a.	The teacher holds a high expectation for my child's learning.	1 to 5

2. **Student achievements**

SN	Teacher Performance Indicators (TPI)	SN	Data Points	Data Range
2.1	Demonstrates	a.	Cooperates with parents in the best	1 to 5

evidence of student's academic growth			interest of the student.	
		b.	The teacher keeps me informed of classroom activities and student progress.	1 to 5

3. Organized, structured class management

SN	Teacher Performance Indicators (TPI)	SN	Data Points	Data Range
3.1	Demonstrates evidence of personal organization	a.	I use a variety of classroom activities and resources.	1 to 5
		b.	I am well organized.	1 to 5
		c.	My teacher uses a variety of classroom activities and resources.	1 to 5
		d.	My teacher is well-organized.	1 to 5
		e.	My teachers' classroom is orderly and safe.	1 to 5
3.2	Establishes and maintains discipline	a.	I maintain discipline in my classroom.	1 to 5
		b.	My teacher maintains discipline in our classroom.	1 to 5
		c.	Discipline and educational programs are administered fairly and consistently in the classroom.	1 to 5
		d.	The teacher treats all students fairly regardless of gender, race and ethnicity.	1 to 5
3.3	Organizes students for effective instruction	a.	I have students work in different groups depending uponthe activity in which they are involved.	1 to 5
		b.	We work in different groups depending upon the activity in which we are involved.	1 to 5

4. Positive Interpersonal relations

SN	Teacher Performance Indicators (TPI)	SN	Data Points	Data Range
4.1	Demonstrates effective interpersonal relationships	a.	Develops and maintains positive relations with students.	1 to 5
		b.	Willingly shares successful teaching techniques/materials.	1 to 5
		c.	Develops and maintains positive relations with colleagues.	1 to 5

		d.		1 to 5
		e.	Conducts self in professional manner.	1 to 5
		f.	The teacher shares information with me in an understandable, friendly, non-threatening manner.	1 to 5

5. Employee relationships

SN	Teacher Performance Indicators (TPI)	SN	Data Points	Data Range
5.1	Demonstrates employee responsibilities	a.	The teacher is available to meet with me about my child.	1 to 5
		b.	The teacher responds to my communications in a timely manner.	1 to 5
		c.	Attendance in school	1 to 5
		d.	Attendance in classroom	1 to 5
5.2	Support school regulations, programs and policies			
5.3	Assumes responsibilities outside the classroom as they relate to school	a.	Willingly accepts additional responsibilities.	1 to 5

6. Classroom environment

SN	Teacher Performance Indicators (TPI)	SN	Data Points	Data Range
6.1	Positive classroom environment	a.	Provides positive classroom environment.	1 to 5
		b.	Maintains a positive attitude.	1 to 5
		c.	The teacher creates a feeling of unity and enthusiasm in the classroom.	1 to 5
		d.	The teacher encourages understanding and cooperation.	1 to 5

7. Personal factors

SN	Teacher Performance Indicators (TPI)	SN	Data Points	Data Range
7.1	Personal and home factors	a.	Age	1 to 5

		b.	Gender	0 or 1
		c.	Nationality	0 or 1
		d.	Experience	1 to 5
		e.	Qualification	1 to 5
		f.	Family Income	1 to 5
		g.	Number of family members staying currently with the teacher	1 to 2

8. Institutional Factors

| SN	Teacher Performance Indicators (TPI)	SN	Data Points	Data Range
8.1	Maintenance of positive school culture	a.	Individual accomplishments of teachers and students are acknowledged and appreciated	1 to 5
		b.	Transparency, honesty, respect, and gratitude define interrelationships.	1 to 5
		c.	Faculty connections are convivial, cooperative, and creative, and all personnel is expected to high-quality standards.	1 to 5
		d.	Students and staff members feel mentally and psychologically protected, and the school's rules and resources encourage student safety.	1 to 5
		e.	Effective leadership is projected and any leadership issues are addressed collectively, with involvement from faculty, students, and parents.	1 to 5
		f.	All students as well as teachers receive equitable access to educational facilities, learning opportunities and any assistance/facility they may require.	1 to 5
		g.	All students are treated equally.	1 to 5
		h.	There is no ambiguity in communication by the teachers and/or supervisor and Principal.	1 to 5

Data Analytics Research Findings

Various statistical techniques were used for analyzing the data and extracting intelligence from the various data sets. For testing the defined hypotheses, statistical techniques of collinearity and fitting of linear regression have been used.

Collinearity: In statistical terms, collinearity means the existence of a linear relationship between the given two variables. In this study, we use this technique to determine how much

percentage does each Academic Performance Areas and Academic Performance Indicators affect the Student Performance.

Linear regression: This is a linear approach to modelling the dependent variable (*here*, Student Performance) with the other independent or explanatory variables

1. Dashboard 1: Teachers Performance
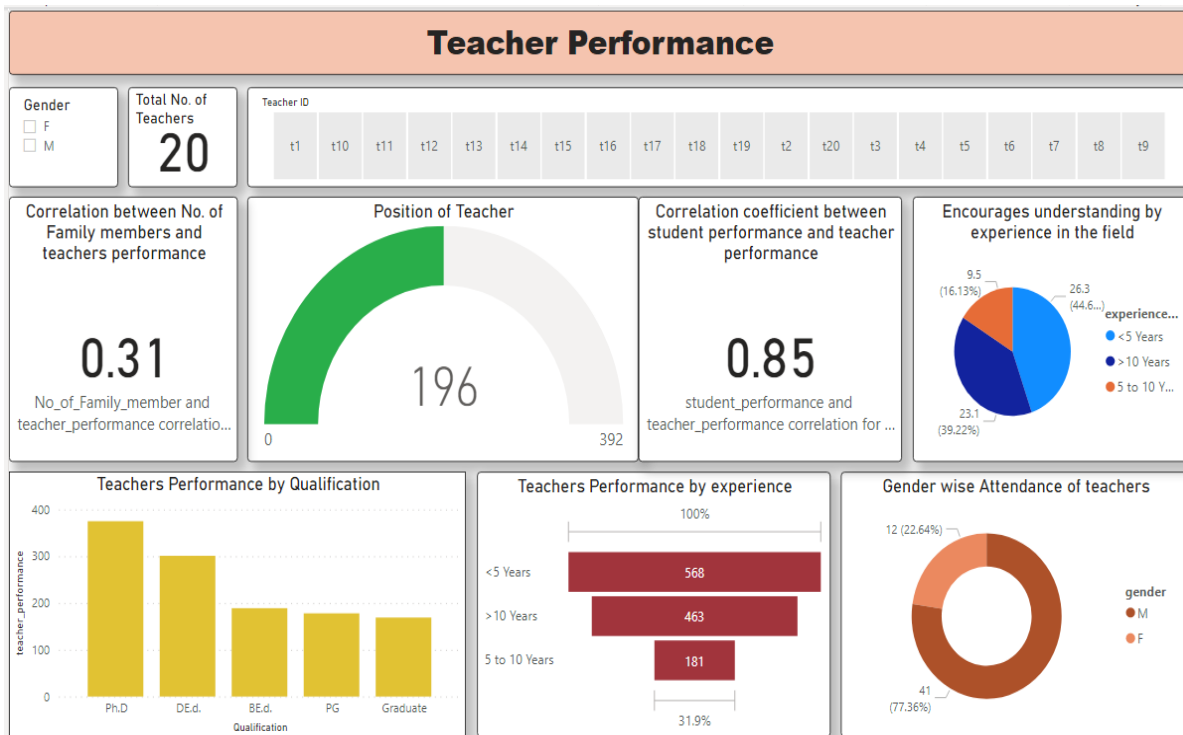
2. Dashboard 2: Analytical Findings (Factors contribution in teacher performance for Class A)

Analytical Findings (Factors Contribution in Teacher Performance for Class A)
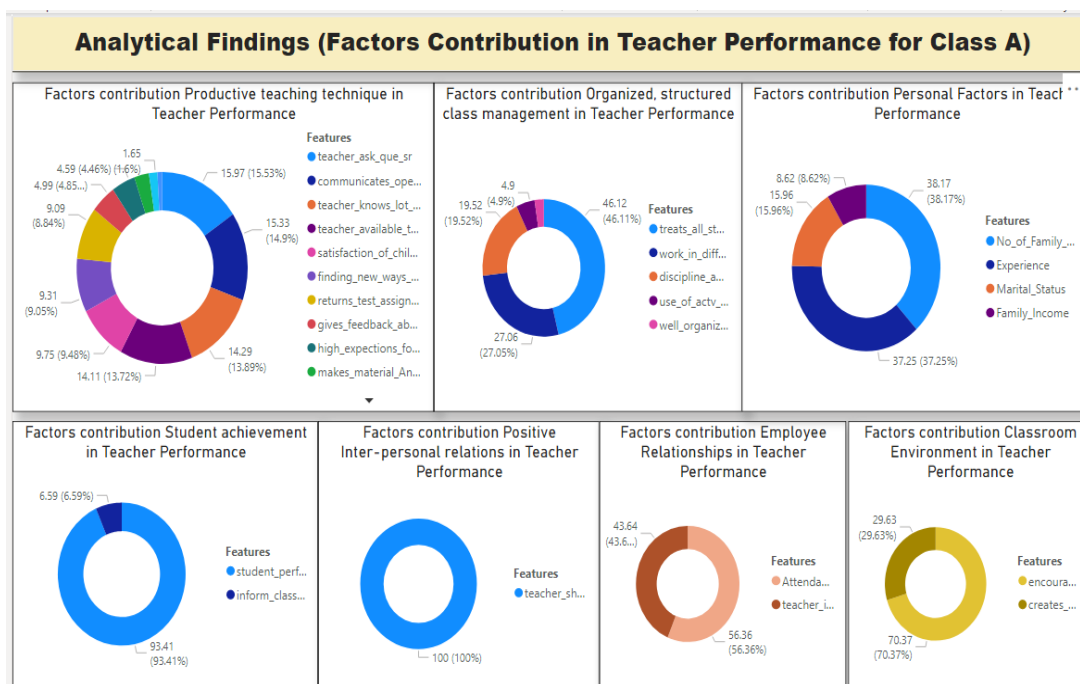
3. **Dashboard 3: Analytical Findings (Factors contribution in teacher performance for Class B)**

Analytical Findings (Factors Contribution in Teacher Performance for Class B)
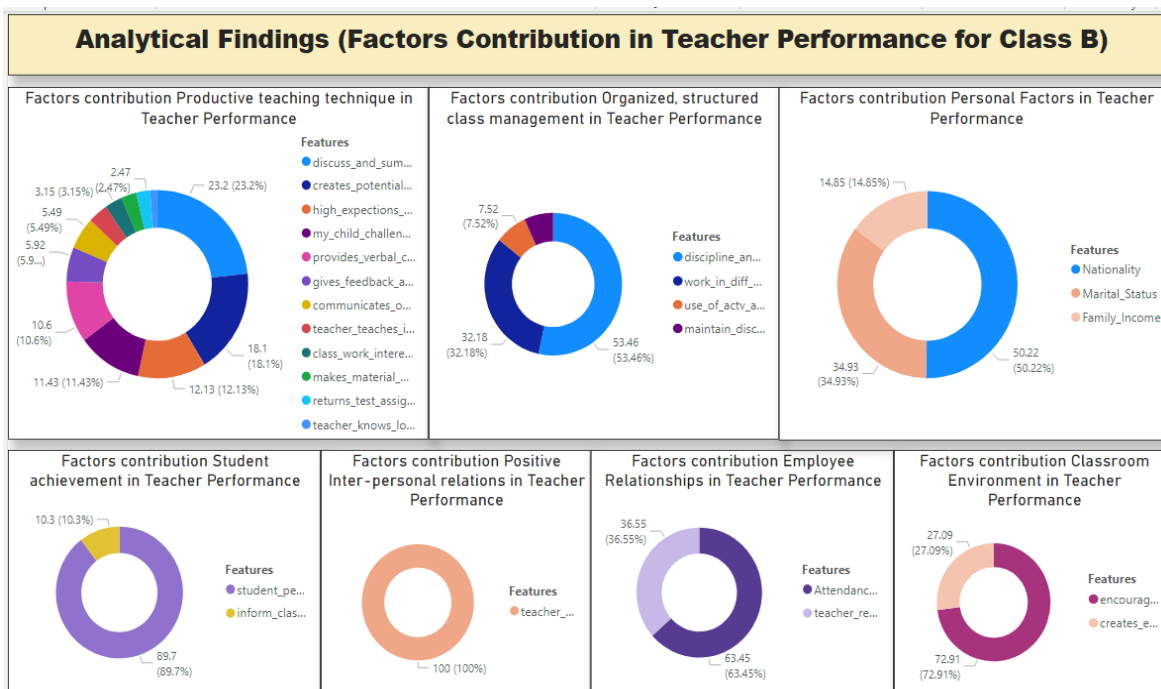
CONCLUSION

The applications of Data analytics techniques help the educational institutions in analysing various data points related with teachers' performance attributes considering the institutional,

academic and non-academic activities, collected from various internal and external data sources. The statistical data analytics techniques are used on the datasets for extracting hidden insights and predict students' performance at various stages during the academic year.

Academic institutions may use the above data analytics models to measure and predict the teacher's performance for improvement of teaching learning processes by using measurable targets.

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