International Journal of Advance and Innovative Research
Volume 13, Issue 1 (XVIII): January - March 2026
ISSN 2394 - 7780

ANALYSIS OF TEACHERS' PREPAREDNESS FOR TECHNOLOGY-INTEGRATED TEACHING USING FUZZY DEMATEL METHOD

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ABSTRACT
Technology has changed how we teach and learn in today's educational environment. Digital tools such as smart boards, learning management systems, online assessments and AI-based applications have created new opportunities for interactive and personalized learning. However, simply introducing technology into classrooms does not guarantee better outcomes. The real success of digital education depends on how prepared teachers are to use these tools effectively and confidently. This study focuses on understanding what makes teachers ready for technology-based teaching. It examines five important areas that influence digital readiness.

These key areas are: their technical skills, their teaching ability, the support they get from their Institutions, their personal confidence and the quality of their training. By surveying teachers and using a specialized mathematical model named Fuzzy DEMATEL method to analyze the results, the research identifies which of these factors matter most and how they influence one another. The findings provide a clear roadmap for educational institutions and policymakers in where to invest their time and money to ensure improvement in education quality through technology.

Keywords: Technology, teachers, adaptation, factors, influence, Fuzzy Dematel.

"*Technology will not replace great teachers but technology in the hands of great teachers can be transformational*."— George Couros

INTRODUCTION
Technology has transformed the education system by introducing innovative methods of teaching and learning. Digital tools such as online learning platforms, smart classrooms, virtual simulations and educational applications have made learning more interactive, flexible and student-centered. These advancements allow teachers to deliver content more effectively and help students access knowledge anytime and anywhere. However, the successful use of technology in education mainly depends on how ready teachers are to use it. Teachers' readiness includes their knowledge of technology, ability to use digital tools, positive thinking towards technology and their willingness to learn new teaching methods. Proper training, support from the institution, availability of necessary resources and regular learning opportunities help teachers become more confident and comfortable in using technology. When teachers are ready and comfortable using technology, it improves the quality of teaching. It makes students more interested in learning and helps them understand better. Therefore, it is very important to understand and improve teachers' preparedness so that technology can be used effectively in education.

LITERATURE REVIEW
Si et al. (2018) reviewed 346 research papers on DEMATEL published between 2006 and 2016. They grouped the studies into different types such as classical DEMATEL, fuzzy DEMATEL, grey DEMATEL, ANP-DEMATEL and other hybrid methods to understand how the method is used in decision-making problems. Their review showed that Fuzzy DEMATEL is the most popular extension because it helps deal with uncertainty in expert opinions. It has been widely used in areas like supply chain management, healthcare and manufacturing to study cause–effect relationships.

Hajiyan and Badakhshan (2020) developed a combined DEMATEL–Fuzzy ANP method to select the best suppliers especially by focusing on IT security factors such as encryption, access control and vulnerability management under uncertain conditions. First, DEMATEL is used to study the cause–effect relationships between different criteria. It shows which factors strongly influence others, such as how data breaches can affect many security aspects. Then Fuzzy ANP is applied to give importance (weights) to each factor using expert opinions expressed in linguistic terms. This helps in ranking suppliers more accurately. This combined method works better than using a single method alone because it considers both relationships and priorities.

Arunfred and Bini Marin (2025) studied how ready management teachers are to use AI-based smart teaching tools such as intelligent tutoring systems and chatbots in higher education. The study surveyed faculty members of SRM Institute to understand their awareness, adaptability and challenges. It found that teachers face issues like low knowledge of AI, resistance to change and lack of institutional support. These factors affect teaching

ISSN 2394 - 7780

quality and student engagement. The results show that teachers have moderate readiness. They see AI as useful for improving efficiency but they need proper training. The study also highlights that AI should be used carefully with human supervision.

FACTORS INFLUENCING TEACHERS' PREPAREDNESS:
Several factors influence teachers' preparedness, which are as follows:

- Technological competence – Ability to use technology properly
- Professional training – Learning through training programs
- Institutional support – Support from Institution
- Teachers' attitudes and beliefs - Teachers' thinking and feelings about using technology
- Self-efficacy - Confidence in their own ability to use technology

RESEARCH OBJECTIVES:
1. To identify key factors influencing teachers' preparedness for technology-based teaching.
2. To analyze the causal relationships among these factors using Fuzzy DEMATEL method.
3. To determine the most influential and dependent factors affecting teachers' preparedness.
4. To suggest strategies for improving technology integration in education.

RESEARCH METHODOLOGY:

Research Design:
The study uses quantitative data with Fuzzy DEMATEL method to find out which factors affect teachers' preparedness and how they influence each other.

Factors Identification:
Based on literature review and expert's opinion, the following factors are considered:

F1: Technological Competence

F2: Professional Training

F3: Institutional Support

F4: Teachers' attitudes and beliefs

F5: Teachers' Self-Efficacy

Data Collection:
Quantitative data are collected by giving simple questionnaires to college teachers. Teachers or experts give their opinions by rating how much one factor affects another using simple scale levels such as

- No Influence (NI)
- Very Low Influence (VL)
- Influence (I)
- High Influence (HI)
- Very High Influence (VHI)

These scale levels are changed into fuzzy numbers for analysis.

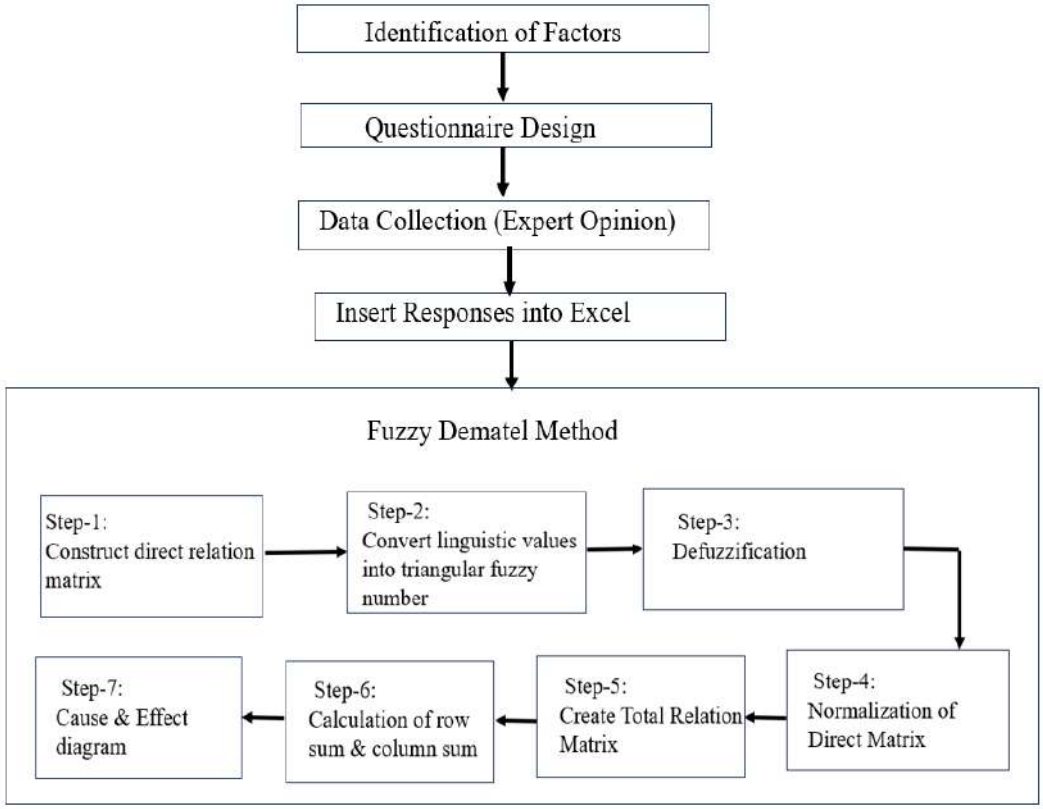
Fuzzy DEMATEL Methodology:
The Fuzzy DEMATEL (Decision Making Trial and Evaluation Laboratory) method combines the normal DEMATEL method with fuzzy set theory to handle uncertainty in decision-making.

It is used when experts give opinions in words like "low", "medium" or "high" instead of exact numbers. These opinions are not exact and may be unclear. So, Fuzzy DEMATEL converts these vague words into fuzzy numbers to make the analysis more accurate and realistic.

The Fuzzy DEMATEL method is used to analyse complex cause-effect relationships among factors.

ISSN 2394 - 7780

Steps in Data Analysis:



Factors are classified into:

- Cause Group (Influencing Factors)
- Effect Group (Influenced Factors)

Abbreviation	Number	Linguistic preference	Corresponding Triangular Fuzzy Numbers (TFNs)
NI	0	No influence	(0, 0, 0.25)
VL	1	Very Low influence	(0, 0.25, 0.5)
I	2	Influence	(0.25, 0.5, 0.75)
HI	3	High influence	(0.5, 0.75, 1)
VHI	4	Very high influence	(0.75, 1, 1)

DATA ANALYSIS:

Matrix of pairwise influence between factors:

Effect Group / Cause Group	F1	F2	F3	F4	F5
F1	NI	HI	NI	I	HI
F2	VHI	NI	NI	HI	VHI
F3	HI	HI	NI	VHI	HI
F4	VHI	I	NI	NI	VHI
F5	HI	VHI	NI	I	NI

Effect Group / Cause Group	F1	F2	F3	F4	F5
F1	0	3	0	2	3
F2	4	0	0	3	4
F3	3	3	0	4	3
F4	4	2	0	0	4
F5	3	4	0	2	0

ISSN 2394 - 7780

Fuzzy Matrix:

Effect Group / Cause Group	F1	F2	F3	F4	F5
F1	(0, 0, 0.25)	(0.5, 0.75,1)	(0, 0, 0.25)	(0.25, 0.5, 0.75)	(0.5, 0.75, 1)
F2	(0.75, 1, 1)	(0, 0, 0.25)	(0, 0, 0.25)	(0.5, 0.75, 1)	(0.75, 1, 1)
F3	(0.5, 0.75, 1)	(0.75, 1,1)	(0, 0, 0.25)	(0.75, 1, 1)	(0.5, 0.75, 1)
F4	(0.75, 1, 1)	(0.25, 0.5, 0.75)	(0, 0, 0.25)	(0, 0, 0.25)	(0.75, 1, 1)
F5	(0.5, 0.75,1)	(0.75, 1,1)	(0, 0, 0.25)	(0.25, 0.5, 0.75)	(0, 0, 0.25)

Matrix of Fuzzy values converted into crisp values (Defuzzification):

Criteria	F1	F2	F3	F4	F5
F1	0.033333	0.733333	0.033333	0.5	0.733333
F2	0.966667	0.033333	0.033333	0.733333	0.966667
F3	0.733333	0.966667	0.033333	0.966667	0.733333
F4	0.966667	0.5	0.033333	0.033333	0.966667
F5	0.733333	0.966667	0.033333	0.5	0.033333

Direct Relation Matrix (A):

Criteria	F1	F2	F3	F4	F5	SUM
F1	0.03333	0.73333	0.03333	0.5	0.73333	2.033333
F2	0.96667	0.03333	0.03333	0.73333	0.96667	2.733333
F3	0.73333	0.96667	0.03333	0.96667	0.73333	3.433333
F4	0.96667	0.5	0.03333	0.03333	0.96667	2.5
F5	0.73333	0.96667	0.03333	0.5	0.03333	2.266667

Maximum Value = 3.433333

Normalised Direct Relation Matrix (X):
This matrix is obtained by dividing each entry of matrix A by the maximum value 3.433333.

Criteria	F1	F2	F3	F4	F5
F1	0.00971	0.21359	0.00971	0.14563	0.21359
F2	0.28155	0.00971	0.00971	0.21359	0.28155
F3	0.21359	0.28155	0.00971	0.28155	0.21359
F4	0.28155	0.14563	0.00971	0.00971	0.28155
F5	0.21359	0.28155	0.00971	0.14563	0.00971

Total Relation Matrix(T): $\mathbf{T = X\,(I - X)^{-1}}$

Criteria	F1	F2	F3	F4	F5
F1	0.415201	0.541318	0.029021	0.419088	0.584556
F2	0.739173	0.469123	0.03423	0.544006	0.739173
F3	0.84877	0.827038	0.041654	0.724176	0.84877
F4	0.697445	0.555544	0.032298	0.343941	0.697445
F5	0.626283	0.624253	0.030954	0.449798	0.456928

Cause and Effect Relationship Table:

CRITERIA	Code	R	C	R-C	R+C	Identify
Technological Competence	**F1**	1.989184	3.326872	-1.33769	5.316055	EFFECT
Professional Training	**F2**	2.525704	3.017276	-0.49157	5.54298	EFFECT
Institutional Support	**F3**	3.290409	0.168157	3.122252	3.458566	CAUSE
Teachers' attitudes and	**F4**	2.326672	2.481008	-0.15434	4.80768	EFFECT

ISSN 2394 - 7780

beliefs						
Teachers' Self-Efficacy	**F5**	2.188215	3.326872	-1.13866	5.515087	EFFECT

Here R is sum of entries in each row and C is sum of entries in each column.

The criteria having highest value of R + C has higher relationship with other criteria. This means Professional Training is highly connected with other factors and plays a very important role in the system.

THRESHOLD VALUE:
In this study the threshold value is calculated by taking the average of all entries in the total relation matrix (T).

Thus, threshold value = 0.492807

It implies that the row heading of total relation matrix, have effect on the other factors which have value more than the threshold value.

Criteria	F1	F2	F3	F4	F5
F1	0.415201	**0.541318**	0.029021	0.419088	**0.584556**
F2	**0.739173**	0.469123	0.03423	**0.544006**	0.739173
F3	**0.84877**	**0.827038**	0.041654	**0.724176**	**0.84877**
F4	**0.697445**	**0.555544**	0.032298	0.343941	**0.697445**
F5	**0.626283**	**0.624253**	0.030954	0.449798	0.456928

IDENTIFYING THE DEGREE OF EFFECT:
Using the excel formula we measure the level of effect of one criterion on the other.

Min	0.541318
Average	0.685568
Higher	0.767169
Max	0.84877

Weak Effect
Medium Effect
Strong Effect

The above table values show the effect of one criterion on other.

CAUSE & EFEECT DIAGRAM:

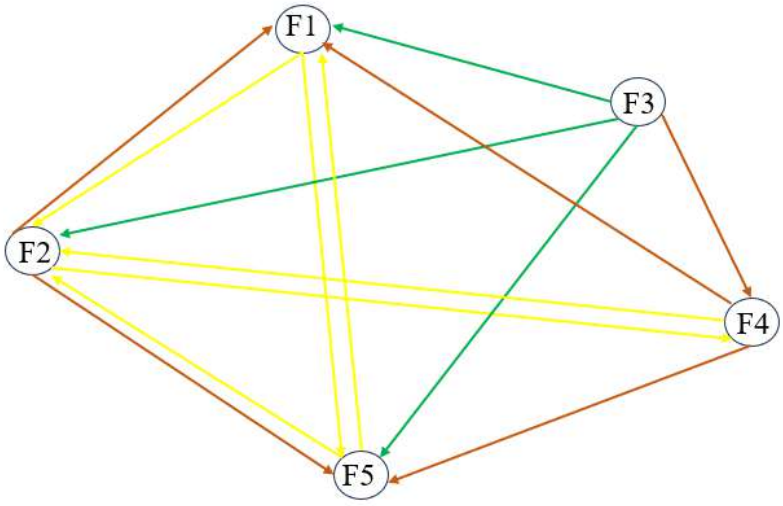


Diagram shows that-

Yellow Arrow: Weak effect

Orange Arrow: Medium effect

Green Arrow: Strong effect

ISSN 2394 - 7780

RESULTS AND DISCUSSION:

The results of the Fuzzy DEMATEL analysis show that Institutional Support (F3) is the most important factor in the system. It strongly influences other factors such as Technological Competence (F1), Professional Training (F2), Teachers' Attitudes and Beliefs (F4) and Teachers' Self-Efficacy (F5). This means that when the institution provides proper support, infrastructure, guidance and encouragement, it positively affects teachers in many ways.

The analysis also shows that Technological Competence (F1) is influenced by other factors also. It depends on institutional support, professional training, teachers' confidence and their attitudes. Therefore, technological competence is a dependent factor. Similarly, teachers' self-efficacy is influenced by training, attitudes and institutional support.

The study suggests that Support from the institution and the availability of facilities like internet and digital tools are key to improving teachers' preparedness for technology-based teaching. When institutions provide proper facilities, training opportunities and motivation, teachers develop better skills, stronger confidence and more positive attitudes toward using technology.

The results of the study will help institutions to plan better training programs and make better education policies.

IMPLICATIONS OF THE STUDY:

- This study helps institutions to improve training programs for teachers.
- It helps government and education planners to make better plans for digital education.
- It improves the quality of teaching by using technology.
- It helps in the successful use of digital education programs.

CONCLUSION

Technology-based teaching has become essential in modern education systems. However, successful implementation depends on teachers' preparedness to integrate technology into teaching practices. This study evaluates teachers' preparedness using the Fuzzy DEMATEL approach to identify key influencing factors and their causal relationships. The findings will provide valuable information for improving teacher training and promoting effective digital learning environments.

FUTURE SCOPE

In future research, studies can be done to see how teachers from different subjects (like Mathematics, Commerce, Science, Arts etc.) or different education levels (like school teachers, college teachers or university teachers) are different in using technology or in their preparedness for digital teaching. Other decision-making methods can also be used along with Fuzzy DEMATEL to get better and more detailed results.

REFERENCE

1. G. Zhao, R. Irfan Ahmed, N. Ahmad, C. Yan, and M. S. Usmani, "Prioritizing critical success factors for sustainable energy sector in China: A DEMATEL approach," Energy Strateg. Rev., vol. 35, no. November 2020, p. 100635, 2021, doi: 10.1016/j.esr.2021.100635.
2. H. Hajiyan and P. Badakhshan, "A DEMATELFuzzy ANP Hybrid Method for Supplier Selection Based on IT Security Factors," no. December, 2020.
3. Seker, S., Zavadskas, E. K. (2017). Application of Fuzzy DEMATEL method for analyzing occupational risks on construction sites. Sustainability, 9(11): 2083. https://doi.org/10.3390/su9112083.
4. Nguyen, H.D., Macchion, L. (2023). A comprehensive risk assessment model based on a fuzzy synthetic evaluation approach for green building projects: The case of Vietnam. Engineering, Construction and Architectural Management, 30(7): 2837-2861. https://doi.org/10.1108/ecam-09-2021-0824.
5. Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial intelligence in education: Promises and implications teaching and learning. Center for Curriculum Redesign. https://curriculumredesign.org/wp-content/uploads/AI-in-Education-Promises-and-Implications.pdf.
6. N. Arunfred, & V. Bini Marin,. (2025). Teacher Readiness and Perceptions Towards AIbased Smart Teaching Tools. Journal of Ethics in Higher Education, 6.2, 323–339. https://doi.org/10.26034/fr.jehe.2025.8432.

ISSN 2394 - 7780

7. Gabus A. and Fontela E., World Problems, An Invitation to Further Thought within The Framework of DEMATEL, 1972, Battelle Geneva Research Centre, Geneva, Switzerland.
8. Vijaykumar Chhaganlal Makwana, Vijay P. Soni and Manoj Sahni (January 2022), Fuzzy Number – A New Hypothesis and Solution of Fuzzy Equations, Mathematics and Statistics 10(1):176-186, DOI:10.13189/ms.2022.100116