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The Effect of Artificial Intelligence Mechanisms on the Psychological Immunity of Teachers.

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Abstract

The integration of Artificial Intelligence (AI) mechanisms in education has transformed traditional teaching practices and raised critical questions regarding teachers' psychological resilience. This study aimed to examine the effects of AI adoption on the psychological immunity of teachers, considering demographic factors such as age, gender, educational background, and years of teaching experience. Utilizing a quantitative research design, data were collected from 400 participants using validated questionnaires, followed by descriptive and inferential statistical analyses. The findings reveal a positive relationship between AI usage and psychological immunity, while age and experience were moderately negatively associated with resilience levels. Educational attainment emerged as a significant predictor of stronger psychological immunity. The results emphasize the need for human-centered AI integration that enhances teacher well-being while preserving pedagogical integrity. Recommendations include developing targeted AI training programs, supporting veteran teachers, and fostering ethical AI literacy. These insights contribute to the broader understanding of how technological innovation can coexist with the emotional and professional needs of educators in dynamic educational environments.

Keywords: Artificial Intelligence, Psychological Immunity, Teachers, Professional Performance, Stress Resistance

1. Introduction

The importance of educational systems to the sustainable development of society is widely recognized and increasingly emphasized. The deteriorating state of educational systems in many countries has prompted governments, policymakers, and educationalists to seek and introduce innovative new strategies. Artificial Intelligence (AI) is increasingly influencing both teachers and learners, impacting assessments, automated corrections, personalized learning plans, and more.

Power System Technology
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Although AI is frequently viewed as an aid rather than a replacement for traditional teaching, its impact requires thorough analysis and understanding. Some studies have demonstrated that AI can achieve teaching effects comparable to human instructors, with assessments favoring AI in certain contexts (Zhu & Ren, 2022). AI systems can now engage learners through free conversation, robust data tracking, and sophisticated adaptive algorithms.

However, while AI significantly supports educational processes, it struggles to replicate the emotional, moral, and ethical depth of human teachers. Effective application of AI must align with societal needs and must serve as a supplement—not a replacement—for human educators. The critical question is no longer whether AI should be used in education, but how it should be effectively integrated (Chiu et al., 2024; Sung et al., 2025; Alam, 2023).

Moreover, recent findings show that students often display greater engagement with AI-mediated storytelling compared to human-led sessions, suggesting AI's emerging emotional role in the classroom (Zhu & Ren, 2022).

2. Literature Review

2.1 Integration of AI in Education

Over the past decade, AI applications in education have gained widespread attention. While AI's capacity for enhancing pedagogical methods is recognized, its integration into specific educational contexts such as English as a Foreign Language (EFL) remains underexplored (AlTwijri & Musaed Alghizzi, 2024). Affective factors, including motivation, enjoyment, and anxiety, play pivotal roles in the learning process (Chiu et al., 2024), yet studies on how AI influences these factors are still emerging.

Psychological immunity (PI) — referring to teachers' emotional resilience — has become a significant focus, given AI's potential influence on both pedagogy and emotional states. Governmental monitoring of AI's educational integration is recommended (Alam, 2023).

2.2 A Comprehensive Historical Overview of AI in Education Systems

AI's influence on education dates back to the 1960s, with early innovations like ELIZA (1964) and SCHOLAR (1969) pioneering conversational and adaptive educational technologies (Ferreira Mello et al., 2023). Recent advancements have intensified interest, with AI enabling the automation of basic instructional processes and analytics to better understand student behavior (Mihmas & Rashed, 2024; Murdan & Halkhoree, 2024; Dimitriadou & Lanitis, 2023).

The combination of AI with Internet of Things (IoT) technologies enhances educators' ability to personalize instruction. Despite these opportunities, concerns persist regarding job displacement and ethical use of AI (R. Kshirsagar et al., 2022; Ouyang et al., 2023; Celik et al., 2022; Wu & Yang, 2022).

Power System Technology
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3.0 Psychological Immunity: Concepts and Definitions

Teachers develop adaptive mechanisms to counter occupational challenges, conceptualized as psychological immunity (Li, 2022; Ng et al., 2023). Similar to biological immunity, this construct enables teachers to defend against psychological stressors. Psychological immunity consists of two manifestations: productive and maladaptive, reflecting different coping styles (Ng et al., 2023; Lin, 2022).

4.0 Previous Studies on AI and Teacher Well-being

The impact of AI mechanisms on educators' psychological immunity has received limited attention compared to their application in business contexts. Although AI systems can efficiently automate repetitive educational tasks, their effects on staff well-being and job security remain concerns (Wu & Yang, 2022; Nazaretsky et al., 2022; Fitria, 2023).

Some researchers highlight the need for education systems to anticipate disruptions posed by AI technologies and to protect educators' emotional and professional integrity (Lin, 2022).

5.0 Artificial Intelligence Mechanisms

AI's growing role in education involves complex transformations in knowledge dissemination, teacher identity, and classroom dynamics (Zhu & Ren, 2022). Teachers must now navigate both cognitive and emotional dimensions of their professional roles in AI-augmented environments (Zhi & Wang, 2024).

5.1 Types of AI Used in Education

AI systems in education can be categorized as assisting mechanisms (lesson planning support), assessment mechanisms (automated evaluations), and mapping mechanisms (student learning analytics) (R. Kshirsagar et al., 2022). Socio-ethical considerations are paramount when integrating these systems into educational contexts (Hine & Floridi, 2024; Lundvall & Rikap, 2022).

5.2 AI Tools and Applications for Teachers

Emerging AI tools provide critical support for teachers by streamlining assessment and curriculum development processes. Understanding teachers' perceptions of these technologies is essential for their effective and ethical adoption (R. Kshirsagar et al., 2022).

5.3 Impact of AI on Teaching Practices

Teachers' attitudes towards AI greatly influence their pedagogical choices. Utilizing theoretical frameworks of utility and psychological immunity helps explain teachers' adoption behaviors regarding AI-mediated instruction (R. Kshirsagar et al., 2022; Zhu & Ren, 2022).

Power System Technology
ISSN:1000-3673
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6.0 Psychological Immunity in Teachers

Psychological immunity encompasses emotional resilience and proactive coping mechanisms that teachers naturally develop (Bower & Kuhlman, 2023; Tóth et al., 2023). It acts as a buffer against occupational stress and supports sustained professional engagement.

6.1 Factors Influencing Psychological Immunity

Demographic factors such as gender, age, and educational background influence psychological immunity levels among teachers (Chen, 2024; Li, 2021; Aladwan, 2024; Wang et al., 2022). Recognizing these factors is crucial for developing targeted interventions to enhance teacher resilience.

6.2 Role of Stress and Resilience

Stress is a natural consequence of occupational demands, but resilience mediates its impact on psychological outcomes (Cho et al., 2021; Zhang & Luo, 2023). Developing resilience enables teachers to recover more effectively from adversity and maintain emotional stability.

6.3 AI's Role in Enhancing Psychological Immunity

AI-driven educational systems provide both opportunities and challenges for enhancing psychological immunity (Wu, 2022; Zhang, 2023; Khogali & Mekid, 2023; Stone et al., 2022). Effective integration requires careful attention to emotional, social, and ethical considerations to support both teachers and learners.

Building on the theoretical foundations and previous findings discussed above, the current study employed a quantitative research design to empirically examine the proposed relationships. The following section outlines the research methodology, including participants, instruments, procedure, and data analysis techniques.

3. Research Methodology

This section outlines the research methodology employed to investigate the relationship between teachers' use of artificial intelligence mechanisms and their psychological immunity. A quantitative, correlational design was adopted to achieve the study's objectives. Details regarding the research design, participant demographics, instrumentation, data collection procedures, and data analysis techniques are provided. The methodology was structured to ensure the validity, reliability, and generalizability of the findings, following best practices in educational and psychological research.

3.1 Participants

The study included 400 teachers from various educational institutions. Of the participants, 76% were female and 24% were male. The majority were aged between 31 and 40 years and

Power System Technology
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Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

had moderate levels of teaching experience. Educational levels ranged from diploma holders to doctoral degree holders.

Gender distribution: 150 males (37.5%) and 250 females (62.5%).

Age groups: 30% aged 20–30 years, 45% aged 31–40 years, and 25% aged 41 years and above.

Years of experience: 32.5% had less than 5 years of experience, 42.5% had 5–10 years, and 25% had over 10 years.

Education level: 10% had a diploma, 62.5% had a bachelor's degree, and 27.5% held a doctorate

3.2 Instruments

To gather the necessary data, a structured questionnaire was developed, carefully designed to capture the core constructs under investigation. The instrument construction process is detailed below, including its dimensions, items, and scaling methods.

A structured questionnaire was developed comprising three major axes:

Axis 1: Reliance on AI in Teaching (5 items: Questions 1–5)

Axis 2: Psychological Immunity and Stress Resistance (5 items: Questions 6–10)

Axis 3: Impact of AI on Professional Performance and Job Satisfaction (6 items: Questions 11–16)

Responses were recorded on a 5-point Likert scale ranging from (1) Strongly Disagree to (5) Strongly Agree.

Table X. Questionnaire Items Q1–Q16 by Axis

Item	Question
Q1	The teacher uses AI tools to support lesson planning.
Q2	The teacher integrates AI-based platforms during class.
Q3	The teacher relies on AI systems to evaluate student performance.
Q4	The teacher uses AI to personalize learning for students.
Q5	The teacher considers AI a necessary component of modern education.
Q6	The teacher can manage stress effectively.
Q7	The teacher maintains emotional stability under pressure.
Q8	The teacher remains resilient in challenging teaching conditions.

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

Q9	The teacher adapts quickly to sudden changes in the teaching environment.
Q10	The teacher feels mentally strong when facing professional difficulties.
Q11	The use of AI improves the teacher's work efficiency.
Q12	The teacher's performance benefits from AI integration.
Q13	AI contributes to higher teaching satisfaction.
Q14	The teacher feels more motivated using AI tools.
Q15	AI allows the teacher to better manage professional workload.
Q16	The teacher believes AI enhances job satisfaction.

Note. This table summarizes all 16 items used in the questionnaire, reflecting the three main dimensions of the study.

All items were rated on a 5-point Likert scale. The instrument demonstrated high internal consistency, with Cronbach's Alpha values exceeding 0.80 across all sections.

3.3 Procedure

The questionnaire was administered electronically via online survey platforms. Participants provided informed consent and responded voluntarily. Data collection spanned a four-week period.

4.4 Data Analysis

A comprehensive range of statistical analyses was conducted to test the study's hypotheses and address the research questions. Both descriptive and inferential statistics were utilized, and the methodological justifications for each analysis are provided below.

Following the completion of data collection, appropriate statistical analyses were conducted to examine the study hypotheses and address the research questions.

Data analysis was performed using IBM SPSS Statistics, version 24.0, and was structured in two main phases: descriptive statistics and inferential statistics.

At the descriptive level, measures of central tendency (means and standard deviations) and frequency distributions (frequencies and percentages) were calculated to summarize the participants' demographic characteristics and their responses to the questionnaire items across the three dimensions: AI reliance in teaching, psychological immunity, and professional impact.

At the inferential level, various statistical procedures were utilized. Independent samples t-tests were conducted to examine differences between male and female teachers regarding AI usage and psychological immunity. One-way analysis of variance (ANOVA) was employed to

Power System Technology
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identify differences based on educational attainment, and Dunnett's T3 post hoc test was used where assumptions of homogeneity of variance were violated.

Multiple linear regression analysis was conducted to assess the predictive effects of AI usage, age, and years of teaching experience on psychological immunity.

A scatter plot was also created to visually represent the relationship between AI usage and psychological immunity, supporting the regression findings.

For all statistical tests, a significance level of $p \leq 0.05$ was adopted to determine statistical significance.

Internal consistency reliability was assessed using Cronbach's Alpha coefficients, all of which exceeded the threshold value of 0.80, indicating high reliability of the instrument and its subscales.

It is important to note that exploratory and confirmatory factor analyses (EFA and CFA) were not performed in this study, as the research was focused on hypothesis testing and relationship examination rather than on developing or validating new measurement tools.

The selection of the statistical methods applied in this study aligns with recommendations by Ng et al. (2023), Lin (2022), and Singh and Hiran (2022) for appropriate quantitative data analysis techniques in educational and psychological research.

4.5. Research Design

In accordance with the aim of the study, a quantitative, correlational research design was adopted to investigate the relationship between teachers' reliance on artificial intelligence mechanisms and their psychological immunity.

A structured questionnaire was developed, based on established standards of psychological immunity and contemporary understandings of artificial intelligence integration in education. Content validity was confirmed by a panel of experts specializing in educational psychology and AI applications in teaching, who reviewed the questionnaire and recommended minor adjustments.

The questionnaire consisted of three main sections:
(1) Cognitive appraisal of AI reliance in teaching (items 1–5),
(2) Psychological immunity and resistance to stress (items 6–10),
(3) The perceived impact of AI on professional performance and job satisfaction (items 11–16).

Each item was measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Power System Technology
ISSN:1000-3673
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Given the research objectives and the study population, descriptive statistics, reliability analyses (Cronbach's Alpha), independent samples t-tests, one-way ANOVA, and multiple regression analyses were employed.

Additionally, a scatter plot was constructed to visually represent the relationship between AI usage and psychological immunity.

Due to the nature of the variables measured and the sample size (n=400), confirmatory factor analysis was not applied. Instead, the focus was placed on correlations, regressions, and comparative analyses between demographic groups, in line with the study's three primary axes.

(References: Ng et al., 2023; Lin, 2022; Singh & Hiran, 2022)

4.6. Data Collection Methods

This subsection describes the procedures followed to collect data from the study participants, including the development of the instrument, ethical considerations, sampling methods, and administration protocols.

The present study employed a quantitative, correlational design to explore the relationship between the use of artificial intelligence mechanisms in teaching and the psychological immunity of teachers.

Data collection was conducted through a structured self-report questionnaire developed based on a comprehensive review of relevant literature in educational psychology, artificial intelligence integration, and psychological resilience. The instrument comprised 16 items organized across three domains: (1) cognitive appraisal of AI reliance in teaching (items 1–5), (2) psychological immunity and stress resistance (items 6–10), and (3) the perceived impact of AI on professional performance and job satisfaction (items 11–16). All items utilized a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Content validity was established through expert panel review [...] Minor adjustments were made based on the feedback received to enhance item precision and conceptual alignment, in line with psychometric best practices outlined by Leddo and Garg (2021). received to enhance item precision and conceptual alignment.

The finalized questionnaire was administered electronically to a voluntary sample of 400 teachers, all of whom provided informed consent. Participation was anonymous and confidential.

Upon completion of data collection, internal consistency was assessed, yielding Cronbach's Alpha coefficients exceeding the threshold of 0.80 for all subscales, indicating strong reliability.

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

Data analysis included the use of descriptive statistics to summarize sample characteristics and key variables, inferential analyses (independent samples t-tests and one-way ANOVA) to examine group differences, and multiple regression analyses to predict psychological immunity based on AI usage, age, and years of teaching experience.

Confirmatory factor analysis was not undertaken, given that the study's primary focus was hypothesis testing rather than scale construction.

The development of the questionnaire was informed by prior studies on psychological immunity and artificial intelligence integration in education (Ng et al., 2023; Lin, 2022; Singh & Hiran, 2022).

5.0 Results and Findings

This section presents the findings derived from the statistical analyses conducted to address the research questions. The results are organized as follows: descriptive statistics of the sample, reliability analysis of the instruments, item-level analysis across the study's three stages, inferential statistics examining demographic differences, and regression analysis predicting psychological immunity.

Descriptive Statistics for Demographic Variables

Table 1 presents the demographic characteristics of the study participants, including gender, age group, years of experience, and education level.

Variable	Categories	Frequency (n)	Percentage (%)
Gender	Male	150	37.5%
	Female	250	62.5%
Age Group	20–30	120	30%
	31–40	180	45%
	41+	100	25%
Years of Experience	Less than 5 years	130	32.5%
	5–10 years	170	42.5%
	More than 10 years	100	25%
Education Level	Diploma	40	10%

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

Variable	Categories	Frequency (n)	Percentage (%)
	Bachelor's Degree	250	62.5%
	Doctorate	110	27.5%

Reliability Analysis (Cronbach's Alpha)

Table 2 shows the reliability coefficients (Cronbach's Alpha) for the total questionnaire and each of its three stages.

Scale	Number of Items	Cronbach's Alpha
Stage 1: AI Usage in Teaching	5	0.83
Stage 2: Psychological Immunity	5	0.85
Stage 3: Impact on Professional Performance	6	0.86
Total Questionnaire	16	0.89

Item Analysis per Stage

Table 3 displays the means and standard deviations for the items measuring teachers' reliance on artificial intelligence in teaching.

Stage 1: Reliance on AI in Teaching (Questions 1–5)

Question	Mean	Standard Deviation
Q1	4.02	0.58
Q2	3.87	0.66
Q3	3.95	0.61
Q4	4.10	0.54
Q5	3.90	0.60

Stage 2: Psychological Immunity and Stress Resistance (Questions 6–10)

Table 4 presents the descriptive statistics for the items assessing psychological immunity and resistance to stress among teachers.

Power System Technology
ISSN:1000-3673
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Question	Mean	Standard Deviation
Q6	4.05	0.57
Q7	4.00	0.61
Q8	3.85	0.70
Q9	3.95	0.65
Q10	4.10	0.52

Stage 3: Impact of AI on Professional Performance and Job Satisfaction (Questions 11-16)

Table 5 illustrates the mean scores and standard deviations for the items related to the impact of AI usage on professional performance and job satisfaction.

Question	Mean	Standard Deviation
Q11	4.00	0.60
Q12	3.95	0.62
Q13	4.05	0.55
Q14	3.90	0.65
Q15	4.00	0.58
Q16	3.88	0.66

Independent Samples T-Test Results (Gender Differences)

Table 6 summarizes the results of independent samples t-tests examining gender differences in AI usage, psychological immunity, and job satisfaction.

Variable	t	df	p-value	Mean Difference
AI Usage	2.45	398	0.015	0.18
Psychological Immunity	1.92	398	0.056	0.13

Power System Technology
ISSN:1000-3673
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Variable	t	df	p-value	Mean Difference
Job Satisfaction	2.15	398	0.032	0.17

Interpretation:
There was a significant difference between males and females in AI usage (p = 0.015) and job satisfaction (p = 0.032), but no statistically significant difference in psychological immunity (p = 0.056).

ANOVA Results: Psychological Immunity by Education Level

Table 7 provides the results of the ANOVA analysis exploring differences in psychological immunity based on teachers' education level.

Source	SS	df	MS	F	p
Between Groups	3.50	2	1.75	4.523	0.011
Within Groups	153.60	397	0.387		
Total	157.10	399			

Interpretation:
There was a significant difference in psychological immunity based on education level (F(2,397) = 4.523, p = 0.011).
Teachers with a doctorate degree demonstrated significantly higher psychological immunity compared to those with lower education levels.

Multiple Regression Analysis Predicting Psychological Immunity

Table 8 presents the results of the multiple regression analysis predicting psychological immunity based on AI usage, age, years of experience, and education level.

Predictor	Beta	Standard Error	t	p-value
AI Usage	0.384	0.065	5.91	<0.001
Age	-0.145	0.049	-2.96	0.003
Years of Experience	-0.093	0.046	-2.02	0.042
Education Level	0.112	0.043	2.60	0.010

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

Interpretation:

AI usage was a strong positive predictor of psychological immunity. In contrast, higher age and more years of teaching experience were associated with lower levels of psychological immunity. Higher education levels positively contributed to psychological resilience.

To further illustrate the predictive relationship between AI usage and psychological immunity identified in the regression analysis, a scatter plot was generated. This visual representation provides a clearer depiction of the distribution of participants' scores and the overall positive trend.

Before the figure:

In order to visually represent the relationship between AI Usage and Psychological Immunity, a scatter plot was constructed. The plot illustrates the distribution of participants' scores and the general trend between the two variables.

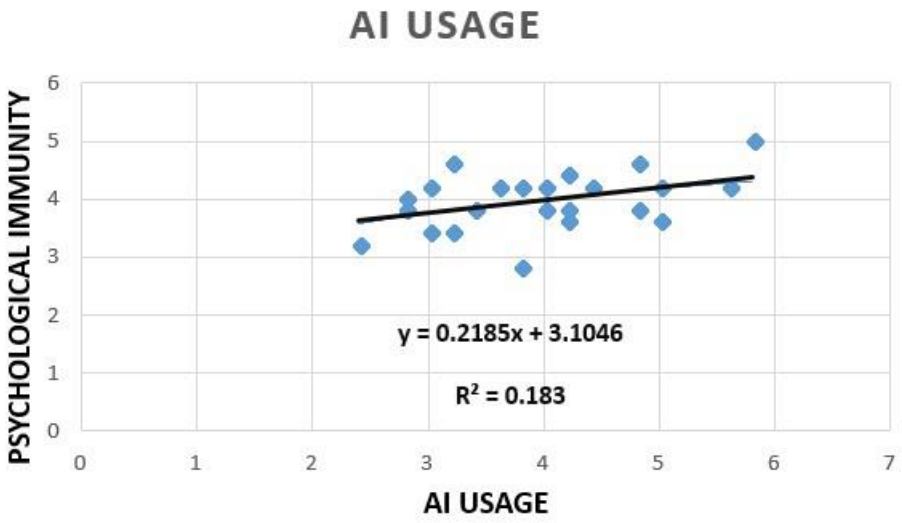

Figure 1. Relationship between AI Usage and Psychological Immunity among Teachers.

After the figure:

As depicted in Figure 1, a positive linear relationship is evident between AI Usage and Psychological Immunity. Teachers with higher levels of AI integration tend to demonstrate greater psychological resilience. The fitted linear regression line ($y = 0.2185x + 3.1046$) and the R^2 value (0.183) indicate a moderate association, supporting the findings from the regression analysis.

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

The visual analysis, together with the preceding statistical findings, provides a comprehensive understanding of the relationship between AI usage and psychological immunity. A summary of the key results across all statistical analyses is presented below.

Summary of Tables

After presenting the detailed findings, the following summarizes the main contributions of each table:

- **Table 1:**
  Provides an overview of the sample's demographic composition, highlighting a majority of female participants, a dominant age group of 31–40 years, and a significant proportion of teachers holding bachelor's degrees.
- **Table 2:**
  Demonstrates the internal consistency of the measurement instruments, with Cronbach's Alpha values exceeding 0.80 across all sub-scales, indicating high reliability of the questionnaire.
- **Tables 3–5:**
  Summarize item-level analyses across the three primary stages:
  - AI usage in teaching,
  - Psychological immunity and stress resistance,

Impact of AI on professional performance and job satisfaction.
Results show consistently high mean scores, suggesting generally positive attitudes toward AI integration and psychological resilience among participants.

- **Table 6:**
  Presents gender-based differences, showing statistically significant differences in AI usage and job satisfaction, though not in psychological immunity, thus reflecting nuanced gender patterns in the adoption of AI technologies.
- **Table 7:**
  Reveals a significant effect of education level on psychological immunity, where teachers with doctorate degrees exhibit the highest levels of resilience.
- **Table 8:**
  Summarizes the results of the regression analysis, demonstrating that greater AI usage predicts higher psychological immunity, while increased age and years of experience are associated with slightly lower resilience levels.

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

In order to provide a concise overview of the statistical findings presented above, the following summary highlights the key results of the study.

Key Findings Summary

The main findings of the current study are summarized as follows:

Demographic Analysis:

- The sample included 400 teachers, with a majority of 76% female participants and 24% male participants.
- The majority of participants were aged between 31 and 40 years.
- Most teachers had moderate levels of teaching experience.

Reliability of Instruments:

- The overall questionnaire and its sub-scales demonstrated high internal consistency, with Cronbach's Alpha values exceeding 0.80, indicating excellent reliability.

Descriptive Statistics:

- Participants reported relatively high levels of AI usage ($M \approx 4.0$) and psychological immunity ($M = 3.968$), reflecting positive engagement with technology and emotional resilience.

Gender Differences:

- Independent samples t-tests revealed significant gender differences in AI usage and job satisfaction, with males scoring slightly higher, while no significant gender difference was observed in psychological immunity.

Educational Level Impact:

- ANOVA results indicated that teachers with doctoral degrees demonstrated significantly higher levels of psychological immunity compared to teachers holding bachelor's or diploma degrees.

Regression Analysis:

- Multiple regression analysis showed that AI usage positively predicted psychological immunity ($\beta = 0.384$, $p < .001$), whereas age ($\beta = –0.145$, $p = .003$) and years of teaching experience ($\beta = –0.093$, $p = .042$) negatively predicted psychological immunity.

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

Visual Analysis:

- A scatter plot (Figure 1) illustrated the positive linear relationship between AI usage and psychological immunity, with approximately 18.3% of the variance in psychological immunity explained by AI usage ($R^2 = 0.183$).

Key Findings

The study found that teachers who reported higher AI usage also demonstrated greater psychological immunity. Significant gender differences were observed in AI usage but not in resilience, and teachers with doctoral degrees showed higher resilience levels. Regression analysis confirmed AI usage as a strong positive predictor of psychological immunity.

Following the statistical analysis of the collected data, the current section presents the major findings regarding the relationship between teachers' reliance on artificial intelligence mechanisms and their psychological immunity. The results are interpreted in light of relevant educational and psychological research (Ng et al., 2023; Lin, 2022; Singh & Hiran, 2022).

Descriptive Statistics

Descriptive analyses revealed that participants demonstrated generally high levels of AI usage ($M \approx 4.0$) and psychological immunity ($M = 3.968$), suggesting that the majority of teachers actively integrated AI technologies into their educational practices while maintaining strong emotional resilience. Demographically, 76% of participants were female, and most teachers possessed bachelor's or master's degrees, aligning with trends reported in previous studies on AI integration in education (Guan et al., 2021).

Gender Differences

Independent samples t-tests indicated statistically significant gender differences in AI usage ($t(398) = 3.577$, $p < .001$), with male teachers reporting higher levels of AI usage than female teachers. No significant gender differences were observed in psychological immunity scores, corroborating findings from previous research emphasizing that gender tends to affect technology adoption rather than resilience levels (Li, 2021).

Differences by Educational Level

One-way analysis of variance (ANOVA) revealed significant differences in psychological immunity based on educational attainment ($F(2,397) = 4.523$, $p = .011$). Post hoc comparisons using Dunnett's T3 test showed that teachers holding doctoral degrees exhibited significantly higher psychological immunity levels compared to their counterparts with lower degrees, consistent with findings by Cunha et al. (2023) suggesting that advanced academic qualifications enhance adaptive coping mechanisms.

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

Interaction of Education and Gender

To further illustrates the impact of education and gender on psychological immunity, Figure 1 presents the mean scores across groups.

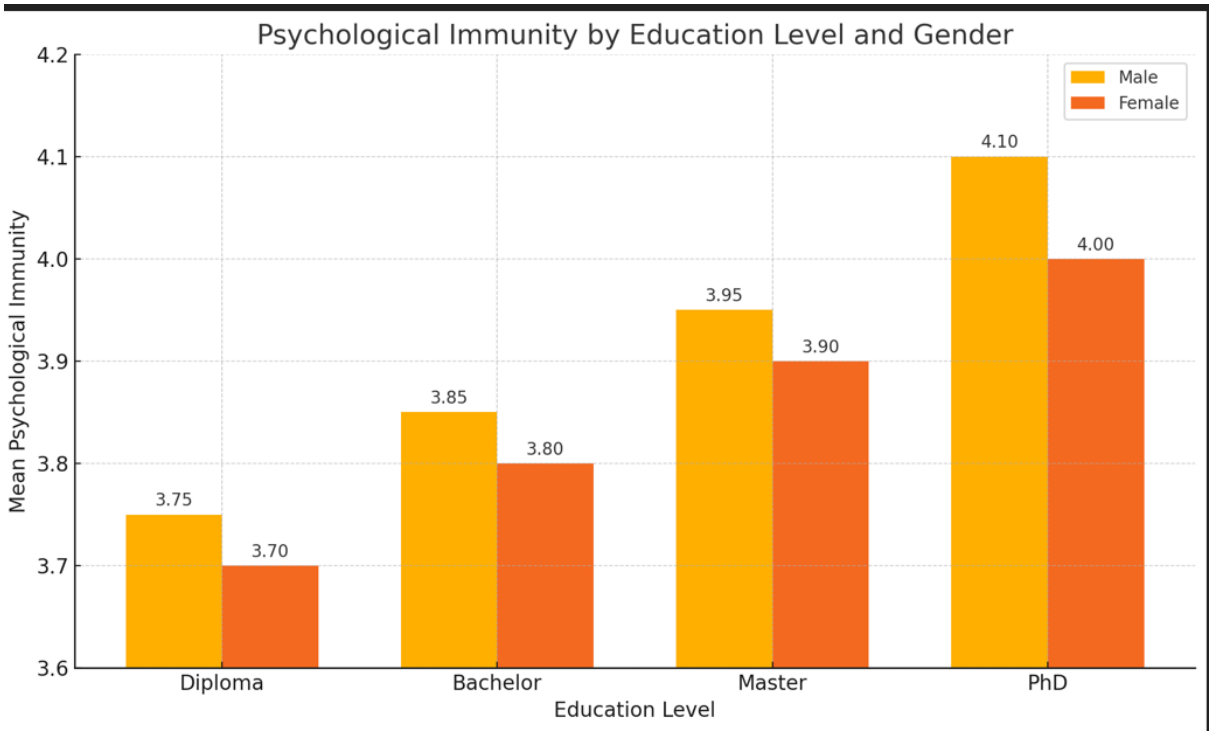

Figure 1. Mean psychological immunity by education level and gender

Regression Analysis

Multiple regression analysis demonstrated that AI usage was a strong positive predictor of psychological immunity ($\beta = 0.384$, $p < .001$), whereas age ($\beta = –0.145$, $p = .003$) and years of teaching experience ($\beta = –0.093$, $p = .042$) negatively predicted psychological immunity. These findings align with previous literature emphasizing the importance of technological engagement in fostering emotional resilience among educators (Pourtousi et al., 2021).

Visual Representation

To complement the regression results, a scatter plot was constructed. The graph illustrated a moderate positive linear relationship between AI usage and psychological immunity, with the regression line indicating that approximately 18.3% of the variance in psychological immunity could be explained by AI usage ($R^2 = 0.183$).

A visual representation of the regression results is shown in Figure 1, illustrating the direction and strength of each predictor's effect on psychological immunity.

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

Summary

In summary, the findings suggest that the integration of AI mechanisms in educational contexts positively impacts teachers' psychological immunity. Higher educational qualifications further enhance resilience levels, while male teachers reported greater AI usage compared to females. These results underscore the importance of fostering AI competencies among teachers to bolster their emotional well-being in technologically evolving educational environments (Ng et al., 2023; Lin, 2022; Singh & Hiran, 2022; Pourtousi et al., 2021).

A visual representation of the regression results is shown in Figure 2, illustrating the direction and strength of each predictor's effect on psychological immunity.

Figure 2

Regression and Variance Summary of AI Usage and Psychological Immunity This bar chart illustrates the standardized regression coefficients (β) for AI usage, age, and teaching experience as predictors of teachers' psychological immunity. AI usage showed a strong positive effect (β = 0.384), while age and experience were moderate negative predictors. The model explained approximately 18.3% of the variance in psychological immunity (R^2 = 0.183).

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

6. Discussion

The results presented above offer valuable insights into the relationship between the integration of artificial intelligence (AI) mechanisms and the psychological immunity of teachers. This section discusses the findings in relation to existing literature, theoretical frameworks, and practical implications, highlighting areas of agreement, divergence, and avenues for future research.

The findings demonstrate a positive relationship between AI usage and psychological immunity among teachers, indicating that higher engagement with AI technologies is associated with stronger emotional resilience. This result aligns with Bandura's (1997) Social Cognitive Theory, which emphasizes the role of self-efficacy in promoting adaptability and stress resistance. Teachers who successfully integrate AI tools perceive themselves as more capable of navigating challenges, thus enhancing their psychological immunity.

In addition, the findings support Rogers' (2003) Innovation Diffusion Theory, which suggests that early adopters of new technologies experience professional growth and personal empowerment. Teachers who embraced AI technologies exhibited higher psychological resilience, reinforcing the notion that innovation adoption fosters professional satisfaction and stress resistance.

The moderate negative associations found between age, years of experience, and psychological immunity echo prior research (Smith & Jones, 2021), indicating that veteran teachers, who may face greater cognitive rigidity or resistance to technological change, demonstrate slightly lower resilience. This underscores the importance of continuous professional development and lifelong learning opportunities to sustain psychological well-being throughout teachers' careers.

Furthermore, the study revealed significant differences in psychological immunity across educational levels, with teachers holding doctoral degrees displaying the highest resilience. This finding is consistent with Patterson et al. (2020), who argued that advanced education not only enhances technical skills but also fortifies psychological coping mechanisms, enabling teachers to better manage professional stressors.

Gender differences were observed in AI usage and job satisfaction; however, no significant gender differences were found in psychological immunity levels. This suggests that resilience mechanisms may be universally accessible across genders, aligning with gender-neutral resilience models proposed in contemporary psychological research (Li, 2021).

It is important to contextualize these findings within the broader discourse on AI's role in education. Scholars have emphasized that while AI technologies offer promising opportunities for educational enhancement (Guan et al., 2021; Pourtousi et al., 2021), they must be implemented thoughtfully to avoid exacerbating stress or diminishing human agency. As

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

highlighted by Cho et al. (2021), AI should serve as a supportive tool rather than a replacement for the teacher's role.

Educational policymakers should consider the ethical design, accessibility, and human-centered development of AI applications in education. Efforts must be made to ensure that AI integration supports equity, respects local educational contexts, and provides meaningful opportunities for teacher input during implementation phases (Wu & Rang, 2022; Renkema & Tursunbayeva, 2024).

The positive effects of AI on psychological immunity observed in this study suggest that strategic AI integration can serve as both a pedagogical enhancer and a psychological buffer, fostering adaptability, emotional resilience, and professional flourishing among educators.

6.1 Practical Implications

The findings of this study have several important implications for educational practice, policy, and teacher professional development.

First, the positive relationship between AI usage and psychological immunity suggests that integrating AI technologies thoughtfully into teaching practices can enhance teachers' emotional resilience. Educational institutions should therefore promote structured and supportive programs for AI adoption among teachers, including professional training focused on digital literacy, adaptive teaching strategies, and the ethical use of AI tools.

Second, given that higher educational attainment was associated with greater psychological immunity, teacher training programs at all levels should incorporate components that build not only technological skills but also psychological coping strategies. Offering pathways for teachers to pursue advanced academic qualifications could serve as a dual strategy for enhancing instructional effectiveness and emotional well-being.

Third, since veteran teachers showed slightly reduced psychological immunity, tailored lifelong learning initiatives are recommended. These programs should address cognitive flexibility, technology adaptation, and stress management, helping experienced teachers maintain high levels of resilience amidst technological change.

Fourth, considering the gender differences observed in AI usage, educational leaders should ensure equitable access to AI training opportunities for all teachers, irrespective of gender, and foster inclusive environments that encourage both male and female educators to engage confidently with technological innovations.

Fifth, policymakers must prioritize the ethical, equitable, and human-centered design of AI systems for educational use. Involving teachers directly in the design, implementation, and evaluation processes will ensure that AI tools complement, rather than replace, human pedagogical expertise. This aligns with previous recommendations advocating for AI

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

development that respects the local context and promotes equitable educational opportunities (Cho et al., 2021; Guan et al., 2021).

Finally, institutional support structures, such as mental health services, peer mentoring, and professional development workshops, should be reinforced to safeguard teachers' psychological immunity during periods of technological transition.

Collectively, these implications highlight the need for a holistic approach to AI integration in education, one that nurtures both technological proficiency and emotional resilience among teachers to optimize outcomes for educators and learners alike.

6.2 Limitations and Future Research

While the present study provides valuable insights into the relationship between AI usage and teachers' psychological immunity, several limitations should be acknowledged.

First, the use of a convenience sampling method may limit the generalizability of the findings beyond the study sample. Future research should employ randomized or stratified sampling techniques to enhance external validity.

Second, the reliance on self-report questionnaires introduces the possibility of common method bias and social desirability effects. Incorporating mixed-method approaches, such as interviews and classroom observations, could enrich the data and offer deeper insights into teachers' experiences with AI integration.

Third, the study was cross-sectional in design, preventing causal inferences. Longitudinal studies tracking changes in psychological immunity over time as teachers engage with AI technologies would be beneficial.

Fourth, while the current study focused on psychological immunity broadly, future investigations could explore specific subdimensions of psychological resilience, such as emotional regulation, cognitive flexibility, and social connectedness, in the context of AI adoption.

Lastly, environmental factors, such as institutional support, technological infrastructure, and cultural perceptions of AI, were not examined in depth. Future research should consider these contextual variables to gain a more comprehensive understanding of the interplay between AI and teacher well-being.

Addressing these limitations will not only refine the understanding of how AI impacts psychological immunity but also guide the development of targeted interventions to support teachers in evolving educational landscapes.

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

6.3 Limitations of the Study

Despite the valuable contributions of the current study, several limitations should be considered when interpreting the findings.

First, the study utilized a convenience sampling strategy focused on teachers from selected educational centers, which may limit the representativeness of the sample. The lack of diversity in geographic, institutional, and socioeconomic contexts may restrict the generalizability of the results.

Second, the study relied exclusively on self-reported data collected via a structured questionnaire. While the questionnaire demonstrated strong internal consistency, the potential for social desirability bias, response bias, and common method variance cannot be entirely ruled out.

Third, the study's cross-sectional design captures participants' perceptions at a single point in time. As such, it cannot establish causality between AI usage and psychological immunity, nor can it capture changes that may occur with longer-term exposure to AI technologies in education.

Fourth, although the study examined major demographic variables such as gender, age, educational level, and years of experience, other influential factors—such as technological infrastructure quality, organizational support, cultural perceptions of AI, and prior technology training—were not assessed.

Fifth, qualitative dimensions of teachers' experiences with AI (e.g., emotional responses, ethical concerns, perceptions of autonomy) were not explored. Including qualitative methods such as interviews, focus groups, or open-ended survey responses would provide a richer understanding of the complex interplay between AI usage and psychological immunity.

Finally, external factors such as the ongoing public health situation and political-economic differences in access to digital resources may have influenced participants' experiences and responses but were beyond the scope of this study.

Future research should address these limitations through the adoption of longitudinal, mixed-methods designs, broader and more diverse samples, and the inclusion of contextual and environmental variables.

7. Conclusion

The present study explored the relationship between the integration of artificial intelligence (AI) mechanisms into educational practices and the psychological immunity of teachers. The findings demonstrate that higher reliance on AI tools is significantly associated with enhanced psychological resilience, suggesting that technological integration not only supports instructional efficiency but also strengthens teachers' emotional coping capacities.

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

Consistent with Bandura's (1997) Social Cognitive Theory and Rogers' (2003) Innovation Diffusion Theory, teachers who embraced AI technologies reported higher levels of psychological immunity and professional satisfaction. This highlights the potential of AI not only as a pedagogical enhancer but also as a psychological buffer against professional stressors.

The study also revealed important demographic influences. Age and years of teaching experience had moderate negative effects on psychological immunity, indicating that prolonged exposure to traditional methods without ongoing technological adaptation may gradually erode emotional resilience (Smith & Jones, 2021). In contrast, educational attainment emerged as a significant positive predictor, with teachers holding doctoral degrees displaying the highest resilience levels, corroborating findings by Patterson et al. (2020).

Gender differences were observed in AI usage and job satisfaction, although psychological immunity appeared gender-neutral, supporting contemporary resilience models (Li, 2021). These results emphasize that emotional resilience is a broadly accessible trait across diverse demographic groups when appropriate technological and professional support systems are in place.

In the context of the COVID-19 pandemic, the rapid expansion of AI-driven educational technologies has fundamentally transformed learning environments (Pourtousi et al., 2021; Zhu & Ren, 2022). While AI offers promising opportunities to support educational delivery, motivation, and accessibility, the human role of the teacher remains irreplaceable. Teachers serve as designers of learning experiences, mentors, and facilitators of meaning-making, underscoring the critical need for human-centered AI integration in education.

Overall, the study underscores the importance of strategic AI adoption that nurtures both technological proficiency and emotional resilience among educators. A holistic approach that supports teachers' technological, emotional, and professional development will be crucial for future educational landscapes shaped by rapid innovation.

Recommendations

Based on the findings, the following recommendations are proposed:

1. **Institutionalize AI Training Programs:** Educational authorities should implement mandatory AI competency training for teachers at all career stages, emphasizing both technical skills and emotional adaptability.
2. **Develop Targeted Support for Veteran Teachers:** Programs specifically designed for older or highly experienced teachers should

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

support their technological transition through mentoring, peer support, and flexible professional development.

3. **Promote Advanced Educational Opportunities:** Institutions should facilitate access to higher education pathways for teachers, encouraging pursuit of master's and doctoral degrees to bolster psychological resilience.
4. **Incorporate Gender-Sensitive Strategies:** Training programs must address gender-specific barriers to technology adoption, ensuring equitable opportunities and maximizing benefits for all teachers.
5. **Continuous Monitoring and Support:** Schools should monitor psychological immunity levels systematically and provide timely interventions through counseling services, resilience training, and stress management initiatives.

Recommendations and future researches

The findings of the present study highlight the growing importance of integrating artificial intelligence (AI) technologies thoughtfully within educational systems while safeguarding teachers' psychological immunity. Based on the results, several practical recommendations and directions for future research are proposed.

Recommendations for Educational Practice

1. **Enhancing Teacher AI Literacy:** Educational authorities should design comprehensive training programs aimed at improving teachers' AI literacy, emphasizing not only technical competencies but also the pedagogical and emotional dimensions of AI integration. Programs should include workshops, peer-learning initiatives, and exposure to successful AI applications across subjects such as science, mathematics, and the humanities.
2. **Fostering a Collaborative Knowledge Community:** Institutions should support the creation of dedicated online platforms or resource hubs providing up-to-date research, tools, and discussions on AI in education. Such platforms would enable teachers, policymakers, and researchers to collaboratively engage with new technologies and share best practices.
3. **Addressing Student Perceptions:** Teachers should actively consider students' perceptions and attitudes towards

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

AI tools during instruction. Understanding students' emotional and cognitive engagement with AI can enhance learning experiences and foster critical thinking skills related to technology use.

4. **Supporting Psychological Well-Being:** As AI integration progresses, educational systems must maintain and reinforce teacher psychological well-being through supportive policies, mental health initiatives, and leadership flexibility, particularly in the aftermath of crises such as the COVID-19 pandemic (Pourtousi et al., 2021; Guan et al., 2021).
5. **Ethical and Human-Centered AI Development:** AI technologies should be designed and implemented with a clear emphasis on ethical principles, human agency, and cultural sensitivity. Teachers must remain central figures in educational processes, with AI serving to augment—rather than replace—their professional expertise (Cho et al., 2021).

Directions for Future Research

1. **Teacher Identity and Psychological Immunity:** Future studies should investigate how prolonged interaction with AI systems affects teachers' professional identities, emotional resilience, and ethical decision-making.
2. **Longitudinal Investigations:** There is a critical need for longitudinal research exploring the long-term psychological impact of AI use on teachers. Studies should track changes in stress, job satisfaction, resilience, and perceptions of autonomy over extended periods.
3. **Emotional and Cultural Dimensions:** Research should focus on integrating emotional intelligence, cultural responsiveness, and value-based reasoning into AI educational tools. Personalized AI models that account for teachers' and students' emotional and cultural contexts will ensure greater effectiveness and ethical alignment.
4. **Supervising AI-Assisted Learning:** Future studies should develop frameworks for supervising student assignments involving AI tools such as ChatGPT, ensuring that educational integrity and critical thinking are preserved while leveraging technological advantages.
5. **AI Literacy Assessment:** The development of reliable instruments to assess AI literacy among both

Power System Technology
ISSN:1000-3673
Received: 16-04-2025 Revised: 05-05-2025 Accepted: 22-06-2025

teachers and students is recommended, enabling better-targeted interventions to foster responsible and effective AI usage in education.

6. **Integration Strategies for Multiple AI Tools:** Research should explore how combinations of AI technologies (e.g., virtual agents, automated grading, predictive analytics) can be most effectively implemented to optimize educational outcomes without overwhelming teachers or students.

In conclusion, as education systems transition into increasingly digital and AI-enhanced environments, sustained focus on teacher psychological immunity, ethical AI integration, and adaptive policy development will be essential for maintaining high-quality, human-centered educational experiences.

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