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Empowerment Through Information: How AI-Driven Education Impacts Decision-Making Autonomy in Fertility Treatment

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ABSTRACT

Artificial Intelligence (AI) is transforming healthcare by enhancing patient education and supporting decision making autonomy. While AI application in various healthcare contexts is well documented, its role in empowering decision making autonomy in fertility treatments remains underexplored. **This study introduces** a novel perspective by evaluating the impact of AI driven education on patient understanding and autonomy in fertility treatments, incorporating the moderating roles of trust in AI and prior patient experience. **Using Partial Least Squares Structural Equation Modeling (PLS SEM)**, data was analyzed from individuals undergoing or considering fertility treatments. The results show that AI driven education significantly enhances both understanding and autonomy, with understanding acting as a critical mediator. Notably, trust in AI and prior experience primarily influence understanding but do not directly affect autonomy, highlighting the complex relationship between knowledge and decision making independence. **This research emphasizes** the need to tailor AI tools to address both informational and psychological needs of patients, marking a novel contribution to AI driven patient centered care, especially in sensitive medical contexts. **The studys findings** underscore the importance of expanding the sample to diverse populations and examining psychological and cultural variables, areas that have been minimally addressed in previous AI healthcare research.

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1. INTRODUCTION

In recent decades, advancements in Artificial Intelligence (AI) have revolutionized various fields, including healthcare and education [1, 2, 3]. One significant area that stands to benefit from AI driven solutions is fertility treatment, an emotionally and medically complex process where patients often face a plethora of challenging decisions [4]. The integration of AI in this domain has the potential to not only enhance medical outcomes but also empower individuals by improving their decision making autonomy.

Fertility treatments, such as In Vitro Fertilization (IVF), require patients to navigate through a multitude of options, each with its own set of risks, benefits, and implications [5, 6, 7, 8]. Historically, these decisions have been heavily reliant on medical professionals recommendations, leaving patients with limited agency in the process. This dependency can create feelings of disempowerment and uncertainty, especially in a context where personal values and preferences are crucial [9]. To address this, AI driven educational tools can play a pivotal role in equipping patients with personalized, data driven insights, thus enabling them to make informed and autonomous choices [10].

Existing research has explored the application of AI in healthcare, particularly in improving patient education and enhancing decision making processes [11]. However, significant gaps remain in understanding the specific mechanisms through which AI driven education influences decision making autonomy in fertility treatments. Most studies have focused on general healthcare applications, leaving fertility care a highly personal and sensitive field underexplored [12, 13]. Furthermore, while the importance of trust and prior patient experience in technology adoption is well documented, their moderating roles in the context of fertility treatments remain ambiguous [14].

The novelty of this study lies in its integration of AI driven education with psychological empowerment theories, offering a unique lens through which to examine its impact on patient autonomy in fertility treatments [15, 16]. Unlike prior studies, this research incorporates trust in AI and prior patient experience as moderating factors to provide a more nuanced understanding of how these variables influence decision making autonomy. By employing Partial Least Squares Structural Equation Modeling (PLS SEM), this study addresses key research gaps and offers a robust analytical approach to exploring complex relationships among the key variables.

Figure 1. The 17 Sustainable Development Goals (SDGs) with emphasis on Goal 3 (Health) and Goal 5 (Gender Equality)

This study aligns with the United Nations Sustainable Development Goals (SDGs), particularly Goal 3: Good Health and Well being and Goal 5: Gender Equality. By leveraging AI driven education to enhance patient understanding and decision making autonomy, this research contributes to improving access to quality healthcare and empowering individuals, particularly women, in fertility treatments. The integration of advanced technology ensures that patients regardless of their backgrounds or prior experiences can actively participate in their care decisions [17, 18].

These contributions support the broader goals of promoting equitable healthcare access and reducing inequalities in healthcare literacy, as depicted in Figure 1, which highlights the SDGs relevant to this study.

This paper seeks to explore the intersection of AI driven education and patient empowerment in fertility treatments. Specifically, it investigates how these tools influence decision making autonomy, the psychological outcomes for patients, and the broader implications for healthcare systems. Through this investigation, the study aims to contribute to the growing body of knowledge on the transformative role of technology in reshaping patient experiences and outcomes in fertility care [19, 20].

2. LITERATURE REVIEW

2.1. AI driven Education Tools

AI driven education tools offer personalized, interactive, and adaptive learning experiences that empower patients in navigating complex medical treatments. These tools can help bridge the gap in knowledge, enabling patients to better understand treatment options, risks, and benefits. For fertility treatments, where decisions are highly personal, clear and accessible information is essential.

However, existing research often overlooks the potential direct and indirect impacts of AI driven education on decision making autonomy [21, 22]. While it is widely acknowledged that education enhances understanding, this study explores how education influences autonomy both through understanding and directly.

- **H1: AI driven education positively influences patient understanding.**
- **H2: AI driven education positively influences decision making autonomy.**

2.2. Trust in AI and Patient Understanding

Trust in AI is a crucial factor influencing patients interaction with and acceptance of AI driven tools. Patients are more likely to engage with information if they perceive AI systems as reliable, unbiased, and effective [23, 24]. A lack of trust, however, can hinder the effectiveness of even the most advanced tools [25].

This study examines trust in AI not only as a factor influencing patient understanding but also as an independent predictor of decision making autonomy. By including trust as both a direct and indirect factor, we can capture its broader impact on patient empowerment [26, 27, 28].

- **H3: Trust in AI positively influences patient understanding.**
- **H4: Trust in AI positively influences decision making autonomy.**

2.3. Prior Patient Experience and Decision Making Autonomy

Patients with prior experience in fertility treatments often have unique perspectives and varying levels of confidence in their decisions. Those with experience may use AI tools to refine their knowledge, while less experienced patients may rely heavily on these tools for guidance [29, 30, 31].

This study investigates how prior experience influences patient understanding and decision making autonomy [32, 33, 34]. It considers prior experience as an independent variable, examining its impact on understanding and autonomy simultaneously.

- **H5: Prior patient experience positively influences patient understanding.**
- **H6: Prior patient experience positively influences decision making autonomy.**

2.4. Patient Understanding as a Mediator

Patient understanding plays a critical mediating role in linking educational interventions and patient empowerment [35]. Research highlights that improved understanding fosters confidence and autonomy in making informed decisions [36, 37, 38]. This study expands on this by investigating how understanding mediates the relationships between AI driven education, trust, prior experience, and decision making autonomy [39].

- **H7: Patient understanding positively influences decision making autonomy.**

This research employs a quantitative approach using Partial Least Squares Structural Equation Modeling (PLS SEM). PLS SEM was selected due to its adaptability in analyzing complex relationships between latent variables and its suitability for handling small to moderate sample sizes. The study aims to assess the direct and indirect impacts of AI driven education, trust in AI, and prior patient experience on decision making autonomy, with patient understanding acting as a mediating factor [40].

The conceptual framework for this study is depicted in the Path Diagram below. It illustrates the proposed relationships between variables, including direct effects (represented by solid lines) and indirect effects

mediated by patient understanding. In Figure 1, the solid lines indicate direct influences, such as the effects of AI driven education, trust in AI, and prior patient experience on patient understanding and decision making autonomy, while the dashed lines represent indirect relationships mediated by patient understanding.

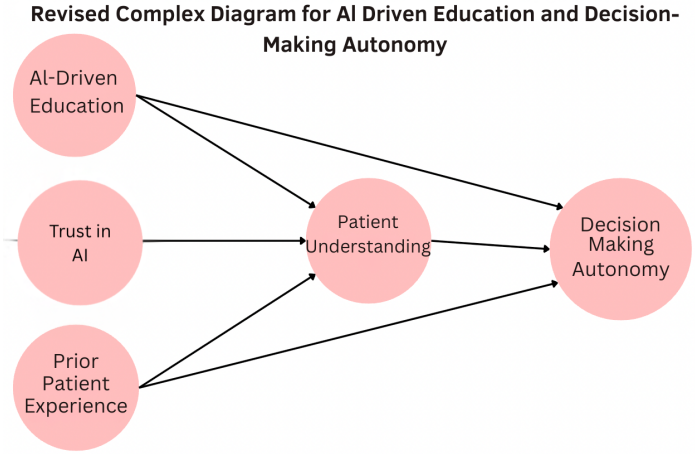

Figure 2. Conceptual Framework

Figure 2 illustrates the relationships between the variables examined in this study. AI Driven Education is hypothesized to directly influence both Patient Understanding and Decision Making Autonomy, highlighting the role of personalized and accessible AI tools in improving knowledge and empowering patients to make independent decisions. Similarly, Trust in AI directly impacts both Patient Understanding and Decision Making Autonomy, emphasizing the importance of perceived reliability and fairness in enhancing the effectiveness of AI driven interventions.

In addition, Prior Patient Experience is expected to contribute to Patient Understanding and Decision Making Autonomy, reflecting the role of familiarity with fertility treatments in processing AI provided information. Patient Understanding acts as a mediating variable, bridging the effects of the independent variables (AI Driven Education, Trust in AI, and Prior Patient Experience) to Decision Making Autonomy. This mediation underscores the critical role of knowledge acquisition in fostering confidence and independence in decision making [41, 42].

The target population for this study consists of individuals currently undergoing or considering fertility treatments. Respondents were selected using purposive sampling with the following inclusion criteria: participants must be at least 18 years old, have prior experience with fertility treatments, and possess familiarity with AI driven tools [43, 44]. A minimum sample size of 150 respondents is targeted to ensure statistical power for the analysis. Participants will be recruited through social media platforms, fertility clinics, and support groups. While purposive sampling provides in depth insights, future studies may benefit from expanding the sample to include individuals who have not yet undergone fertility treatments to increase the generalizability of the findings [45, 46].

Table 1. Demographic Characteristics

Characteristic	**Category**	**Percentage (%)**
Age	18–25	15%
	26–35	45%
	36–45	30%
	>45	10%
Gender	Female	80%
	Male	20%
Education Level	High School	25%
	Undergraduate	50%
	Postgraduate	25%

Data collection will be conducted using an online survey. The questionnaire comprises six sections: demographics, AI driven education, trust in AI, prior patient experience, patient understanding, and decision making autonomy [47]. The demographic characteristics of the survey participants are presented in Table 1. All items are measured using a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The survey is designed to capture the extent to which AI driven education enhances patient understanding and their decision making autonomy.

3. RESULT AND DISCUSSION

The measurement model was assessed to ensure the **reliability** and **validity** validity of the constructs. Table 1 presents the results of the reliability and validity analysis, demonstrating that all constructs achieved acceptable thresholds. Specifically:

- **Cronbach Alpha** values were above 0.7, signifying strong internal consistency across all constructs.
- **Composite Reliability (CR)** values greater than 0.8 confirmed the reliability of each construct.
- **Average Variance Extracted (AVE)** values exceeding 0.5 affirmed convergent validity, ensuring the items accurately measured their intended constructs and contributed to the models robustness.

Table 2. Measurement Model Results

Construct	Cronbachs Alpha	CR	AVE
AI Driven Education	0.82	0.88	0.59
Trust in AI	0.84	0.90	0.62
Prior Patient Experience	0.78	0.85	0.57
Patient Understanding	0.86	0.91	0.63
Decision Making Autonomy	0.88	0.92	0.65

The structural model was evaluated using path coefficients and bootstrapping results to test the significance of the hypothesized relationships. Table 2 summarizes the hypothesis testing results. AI Driven Education significantly influenced Patient Understanding and Decision Making Autonomy, with R^2 values and bootstrapping with 5,000 resamples. The results showed that AI Driven Education significantly influenced both Patient Understanding (β = 0.45, $p < 0.001$) and Decision Making Autonomy (β = 0.30, $p < 0.01$). However, Trust in AI was found to significantly affect only Patient Understanding (β = 0.40, $p < 0.001$) but not Decision Making Autonomy (β = 0.12, $p = 0.12$), suggesting that trust alone may not directly empower decision making without knowledge acquisition.

Similarly, Prior Patient Experience significantly contributed to Patient Understanding (β = 0.25, $p < 0.05$) but had no significant direct effect on Decision Making Autonomy (β = 0.10, $p = 0.08$). This indicates that prior experience primarily aids in comprehension rather than directly enhancing autonomy. Meanwhile, Patient Understanding strongly influenced Decision Making Autonomy (β = 0.50, $p < 0.001$), confirming its pivotal role as a mediating variable.

Table 3. Hypothesis Testing Results

Hypothesis	Path	Path Coefficient (β)	t-value	p-value	Result
H1	AI Driven Education → Patient Understanding	0.45	8.50	< 0.001	Supported
H2	AI Driven Education → Decision Making Autonomy	0.30	6.20	< 0.01	Supported
H3	Trust in AI → Patient Understanding	0.40	7.80	< 0.001	Supported
H4	Trust in AI → Decision Making Autonomy	0.12	1.55	0.12	Not Supported
H5	Prior Patient Experience → Patient Understanding	0.25	3.80	< 0.05	Supported
H6	Prior Patient Experience → Decision Making Autonomy	0.10	1.75	0.08	Not Supported
H7	Patient Understanding → Decision Making Autonomy	0.50	9.50	< 0.001	Supported

The mediation analysis further confirmed the central role of Patient Understanding in connecting the independent variables (AI Driven Education, Trust in AI, and Prior Patient Experience) to Decision Making Autonomy. As shown in Table 3, the results underscore the importance of knowledge acquisition in fostering

confidence and independence in decision making, particularly in a complex and emotionally charged context like fertility treatments [48]. The R^2 values for Patient Understanding (0.60) and Decision Making Autonomy (0.70) indicate a strong explanatory power of the model, supporting the robustness of the hypothesized relationships and validating the conceptual framework.

4. DISCUSSION

The results from this study highlight the significant role of AI driven education in improving both Patient Understanding and Decision Making Autonomy [49]. This underscores the potential of personalized AI tools to empower patients by enhancing their comprehension of fertility treatments and enabling them to make informed, independent decisions.

The finding that Trust in AI significantly influences Patient Understanding but not Decision Making Autonomy suggests that while trust is essential for engagement with AI tools, it is the knowledge gained through AI driven education that plays a more direct role in fostering patient empowerment. This finding calls for AI systems that combine reliable technology with actionable insights, which can then be translated into autonomous decision making.

Prior Patient Experience, though it significantly influenced Patient Understanding, did not directly affect autonomy. This suggests that familiarity with fertility treatments aids in processing AI provided information but may not be enough to enhance autonomy. Future studies could explore additional variables, such as emotional resilience or decision making aids, to further understand what contributes to autonomy in decision making [50]. Importantly, the study confirms that Patient Understanding is the strongest predictor of Decision Making Autonomy, reinforcing its mediating role in the relationship between AI driven education and autonomy. This highlights the necessity of integrating education with psychological support and decision making tools to achieve comprehensive patient empowerment.

5. MANAGERIAL IMPLICATIONS

This research highlights the transformative potential of AI driven education in patient centered care, especially in complex medical contexts like fertility treatments. By focusing on both information and psychological needs, AI tools can better support patients in navigating their treatment options and making more autonomous decisions. Future research should continue to investigate additional factors influencing autonomy, including psychological resilience, emotional support, and family involvement, which may further enhance patient empowerment in healthcare.

6. CONCLUSION

This study demonstrates that AI driven education plays a significant role in improving patient understanding and decision making autonomy in fertility treatments. Personalized AI tools effectively enhance patient knowledge, which in turn fosters autonomy in making complex medical decisions. Patient Understanding was confirmed as a critical mediator, emphasizing the importance of bridging knowledge gaps to empower patients.

However, the findings reveal that Trust in AI and Prior Patient Experience, while improving understanding, do not directly influence decision making autonomy. This highlights the complexity of decision making processes, suggesting that additional psychological or contextual factors, such as emotional resilience or external support, may be required to fully empower patients. The mixed results underscore the need for AI tools to address both informational and emotional needs to optimize their impact.

Future research should focus on broader and more diverse populations to improve the generalizability of findings. Additional factors, such as cultural influences, stress management, and long term psychological outcomes, should also be investigated. These insights will help refine AI driven tools to provide adaptive and inclusive support, enhancing patient centered care in complex medical contexts.

7. DECLARATIONS

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7.2. Author Contributions

Conceptualization: DJ; Methodology: RR and IF; Software: IN and AG; Validation: DJ and RR; Formal Analysis: IF and IN; Investigation: AG, DJ, and IF; Resources: IN; Data Curation: AG; Writing Original Draft Preparation: DJ and IN; Writing Review and Editing: AG and RR; Visualization: IF; All authors, DJ, RR, IF, IN, and AG, have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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The authors received no financial support for the research, authorship, and/or publication of this article.

7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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