

How Cognitive Dissonance Affects Student Engagement and Learning in AI Powered Education Systems

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ABSTRACT

This paper examines the impact of cognitive dissonance on student engagement and learning adaptation in AI-powered education. Based on a quantitative research design, data from 270 university teachers in Punjab were retrieved using a self-administered questionnaire. Findings show a moderate negative correlation between cognitive dissonance and student engagement with $r = -0.542$, $p = 0.001$, indicating that increased dissonance results in lower motivation and participation levels. A significant effect of the regression analysis for AI-generated feedback is that motivation and learning adaptation increase ($B = 0.612$, $\beta = 0.548$, $p = 0.000$, $R^2 = 0.476$), thus demonstrating the necessity for structured AI feedback. ANOVA results support that strategies of cognitive dissonance reduction highly enhance engagement and learning outcomes significantly ($F = 9.76$, $p = 0.000$). The validation lies in the appropriateness of adaptive learning techniques and metacognitive training. These findings recommend that AI-driven education should contain personalized feedback mechanisms and structured interventions to reduce the effects of cognitive dissonance. Longitudinal effects and cross-cultural variations in AI-based learning are left for future studies.

Introduction

Rapid integration of artificial intelligence has transformed the very way in which students engage with learning materials and interact with their educators while also processing new information. AI-driven education systems- adaptive learning, intelligent tutoring, and automated feedback

mechanisms among them-provide student-centered learning based on the learning needs of a particular student. However, despite all these developments, even cognitive dissonance, which is a psychological phenomenon referring to the discomfort people have when they hold conflicting beliefs or are exposed to contradictory information can hurt student engagement and learning outcomes in AI-driven educational environments. Here, cognitive dissonance can happen as a result of students receiving negative feedback from AI systems that is inconsistent with their self-concepts, past knowledge or expectations. This may motivate the students to resolve the inconsistencies and deepen their understanding or lead towards disengagement and resistance toward learning. The role of cognitive dissonance in AI-powered education is thus important to optimize student engagement, improve adaptive learning strategies, and ensure that AI instead of creating a barrier to learning experience, enhances it. The paper addresses the question of how cognitive dissonance arises in AI-driven learning environments, what its implications are on student engagement, and how its negative impacts can be mitigated in order to promote a more effective and inclusive educational experience.

The impact of AI on education has been revolutionary by offering personalized instruction, real-time feedback, and adaptive learning experiences. AI-supported education systems learn along with support from these machine learning algorithms, as they gauge the performance of the students and adapt the content in response, thereby making learning efficient and accessible (Tsanov, 2024). While AI improves learning, it also introduces new psychological challenges, the greatest of which is cognitive dissonance. Cognitive dissonance is a psychological state of discomfort characterized by having conflicting thoughts or beliefs (Dawson et al.), plays a pivotal role in student engagement and learning outcome in AI-driven environments. When students receive AI-generated feedback that counteracts their self-perception, existing knowledge, and learning expectation, they may undergo emotional upset that can either enrich or impede the learning experience (Treacy & Leavy, 2023). This paper discusses the way cognitive dissonance presents itself in AI-based learning environments, its implications on student engagement, and the ways to mitigate the negative consequences to improve the effectiveness of learning.

Understanding Cognitive Dissonance in Learning

Cognitive dissonance is a well-known psychological theory explaining how people feel uncomfortable once their belief is confronted with knowledge that contradicts their belief or knowledge (Chan, 2024). In the more traditional learning environments, this happens as part of the natural process of learning by encouraging critical thinking and the restructuring of cognition itself (Heaton & Quan, 2023). In AI-based learning systems, students typically interact with automated systems, which provide objective assessments of a learner's performance, sometimes challenging their view of being competent. For example, an AI-based tutor may indicate that a student has a lesser understanding of a topic than they evaluate themselves, creating a clash between their self-assessment and their external evaluation (Marikyan et al., 2023). Understanding the role that cognitive dissonance plays within AI learning helps make designing education technology that motivates discomfort a necessity to engage in meaningful learning rather than in disengagement.

AI-Powered Education Systems and Their Role in Learning

AI-based education systems employ advanced algorithms to personalize learning, automate assessments, and enable student progress (McFaddin, 2018). These systems vary from intelligent tutoring platforms to AI-driven feedback mechanisms that analyze the responses of students and adapt the learning materials based on the student's response. One of the most significant advantages of AI in education is the ability to offer real-time data-driven insights to educators

and students, which will help them determine areas of improvement (Uysal & Estrella, 2024). However, sometimes, the feedback generated by AI is too impersonal or too harsh and creates cognitive dissonance. In case where students do not see congruence between expectation and assessment by AI, motivation and engagement may be hard to maintain. Cognizance of the role that AI-driven feedback plays in Cognitive Dissonance is also of absolute importance, ensuring that such technologies improve, rather than hinder, learning.

Student engagement has been identified as a critical variable in achieving academic success, and by extension, cognitive dissonance can be assumed to influence levels of engagement in several ways (Fisher & Baird, 2020). The AI-generating response that may go against a student's prior knowledge or self-perceived reputation will most likely trigger a positive response that aims to provoke cognitive restructuring and deeper learning, or a negative response in frustration leading to disengagement (Ding et al., 2024). Studies have also shown that those students who have better management skills of cognitive dissonance are likely to manifest higher-order thinking skills, while those who do not manage their cognitive dissonance well can even disengage from the process of learning (Golombek* & Johnson, 2004). This chapter considers how cognitive dissonance is related to students' motivation, persistence, and overall engagement with AI-based learning environments.

There is a need to enact strategies that counter the detriments of cognitive dissonance in really maximizing the benefits of AI-powered education. Among the approaches is the design of AI that can give adaptive and supportive feedback to students in managing conflicting information without overwhelming them (Stephens, 2017). Developing metacognitive awareness wherein the learner captures his learning process might be reduced by dissonance (Wilkins et al., 2018). In addition, the use of human-AI collaboration, where instructors offer contextual guidance in addition to AI-generated feedback, can facilitate the ability of students to reconcile conflicting information more effectively (Holmes et al., 2021). This section elaborates evidence-based strategies for reducing the adverse effects of cognitive dissonance and enhancing learning in AI-driven education (Treacy & Leavy, 2023).

Research Objective

The main research objectives of the study are;

- To explore cognitive dissonance in AI-powered education and its effect on student engagement.
- To evaluate the influence of AI feedback on students' motivation and learning adaptation.
- To develop strategies to reduce negative cognitive dissonance in AI-driven learning.

Problem Statement

Artificial intelligence-powered education systems give rise to personalized learning, though such systems create issues of cognitive dissonance through such feedback generated by AI that clashes with the self-perception of a student or their prior knowledge. Such dissonance may either lead to better learning through critical thinking or disengagement and decreased motivation. Generally, there isn't a viable mechanism for cognitive dissonance in most current AI-driven learning models, which might further the avenues for decreased engagement and poor learning outcome. By understanding how cognitive dissonance influences students in AI-driven environments, there will be a deeper knowledge of designing adaptive learning systems that promote positive engagement and minimize negative impacts. The research study investigates whether it can influence the leanings of the student in AI powered education and help to identify strategies for reducing adverse effects.

Significant of the study

This study holds great importance concerning the research area of the impact of cognitive dissonance on student engagement and learning in AI-powered education systems, an emerging but under researched area within educational psychology and technology. Therefore, this work would provide relevant insights into enhancing adaptive learning models by understanding how AI-generated feedback influences the cognitive and affective responses of students. The results will contribute to better design by educators, policymakers, and developers of AI-driven learning environments in an attempt to minimize negative cognitive dissonance that may be created. This study further advances the production of more efficient and student-centered AI educational technologies and leads to better results in learning contexts.

Literature Review

Introduction to Cognitive Dissonance in Learning

Cognitive dissonance, first known to be created by (Rivera & Garden, 2021) is a phenomenon in psychology. It is found when people meet conflicting beliefs, ideas, or knowledge, bringing about mental dissonance or discomfort. For education, the role of cognitive dissonance in learning processes is very relevant because it always arises when learning new information goes against prior knowledge. This discomfort may thus motivate deeper cognitive processing and restructuring of knowledge that can lead to better learning as indicated by research (Chatterjee et al., 2023). However, if not managed well, it can also lead to anxiety, resistance to learning, and disengagement, as reported in (Carpenter, 2019). Understanding the interaction of this cognitive dissonance with modern learning environments being shaped by AI-powered education systems is crucial to improving student engagement and academic success.

This integration of AI into education has changed traditional learning methodologies. AI offers individualized, adaptive instruction, responding to the specific needs of the student. Machine learning algorithms analyze student performance, and adaptive learning platforms use IT'S to make appropriate adjustments to content delivery (Jagger, 2013). These systems have been shown to improve learning outcomes through real-time feedback, knowledge gap identification, and customized learning pathways (Arguedas et al., 2016). However, despite these benefits, AI-generated feedback can sometimes cause cognitive dissonance when students receive assessments that contradict their self-perceived competence. Research has shown that students can respond to such dissonance in a variety of ways. Some of them may be motivated to correct the inconsistencies with more learning, while others get frustrated and disengage (Dellaportas, 2015).

Feedback is a crucial component of the learning process, and AI-based education systems provide instant and data-driven feedback to students. It has been reported that AI-based feedback enhances the efficiency of learning but at the same time triggers cognitive dissonance, especially when it contradicts the self-assessment of the students (Balakrishnan et al., 2024). For instance, a student who believes they have mastered a subject will experience dissonance when an AI system identifies weaknesses in their understanding. According to research by (Tsanov, 2024), the response of students to such feedback depends on their cognitive and emotional regulation abilities. Cognitive dissonance may be a stimulant for reflection and deeper learning if managed effectively. However, if left unchecked, students will resist AI feedback, which has a negative impact on motivation and engagement. In this regard, there is growing concern about how AI feedback mechanisms are designed to foster productive learning experiences (Alias et al., 2014).

Impact of Cognitive Dissonance on Student Engagement

Engagement is among the vital factors that predict academic success, and experience of cognitive dissonance might either boost or impede the engagement (Aberšek, 2019). Moderate levels of cognitive dissonance have been shown to increase curiosity, critical thinking, and persistence in learning, as revealed by numerous studies (Smetana & Bell, 2012). However, when the level of dissonance is too high and when negative emotions like frustration or self-doubt are present, avoidance behaviors, reduced effort, and disengagement from learning activities can take place. The management of cognitive dissonance is especially critical in AI-driven learning environments, as students might perceive AI-generated feedback as impersonal or too critical. Research studies indicate the addition of features, including emotional intelligence, and that affective computing and adaptable feedback strategies bring reduced negative response rates and raise students' interests in learning outcomes (Sridhar et al., 2023).

Several strategies have been proposed to mitigate the adverse effects of cognitive dissonance on AI-powered education. For instance, one of the most promising approaches is metacognitive training, encouraging students to reflect on thought processes and learning strategies (Matos, 2015). According to research, cultivation of metacognition will enable students to deal more effectively with conflicts in cognition and build resilience in learning (Samuel et al., 2022). Other aspects that may reduce the negative dissonance without limiting critical thinking include the creation of supportive, constructive, and context-aware feedback AI systems (Israel et al., 2017). The integration of human guidance with AI-driven feedback has also been suggested as a strategy to balance the advantages of personalized AI learning and the emotional and motivational support educators can offer (Weiss, 2017). It focuses on matching psychological principles to learning environments managed through AI so as to develop enhanced student engagement and learning results.

Research Gap

Although previous research has covered cognitive dissonance in the conventional context of learning environments and the positive effects that AI-driven education has, the literature is still deficient in understanding how cognitive dissonance actually affects student engagement and learning outcomes in AI-driven systems. Most of the research is done either on AI and personalized learning or the psychological impacts of cognitive dissonance separately, with little focus on their interaction with each other. There is a research gap about effective strategies to mitigate the negative impacts of cognitive dissonance in AI-generated feedback and especially diverse learning contexts. There is, therefore a need for investigation into how AI feedback mechanisms can be designed to create productive cognitive dissonance to ensure that the students remain engaged and motivated rather than discouraged. This will fill in the gap to provide valuable insights for developing AI-powered education systems that support both cognitive and emotional aspects of learning.

Hypothesis

1. **H1:** There exists a significant association between cognitive dissonance within AI-based educational settings and engagement among students.
2. **H2:** There is a highly significant impact of AI-generated feedback on students' motivation and learning adaptation.
3. **H3:** There is a significant effect of strategies to reduce cognitive dissonance on improving student engagement and learning outcomes in AI-driven education.

Methodology

Research Design

A quantitative research design was applied to investigate the impact of cognitive dissonance on student engagement in AI-powered education. This study used a descriptive and correlational approach in establishing relationships between cognitive dissonance, AI-generated feedback, student motivation, and learning adaptation. Statistical methods were applied in analyzing the data collected and establishing objective conclusions.

Population and Target Audience

The population for this study was composed of university teachers from various universities in Punjab, Pakistan, who had experience in using AI-powered education tools to enhance their teaching practices. These teachers were chosen to give an insight into how effective AI-driven learning systems were and the extent of cognitive dissonance faced by students.

A target sample size of 270 university teachers has been selected from various institutions in Punjab to ensure a diversified range of experiences and perspectives, which will help in generating more generalizable results.

Sampling Technique

The probability sampling technique ensured that all the university teachers of the selected population had equal opportunities to participate in the study. This technique was used to minimize selection bias, maximize the representation, and heighten the reliability and validity of the results.

Data Collection Method

Data were collected by using a self-report questionnaire that was able to assess those variables linked with cognitive dissonance, AI feedback, learner engagement, motivation, and adaptive learning. The questionnaire made use of standardized closed-ended questions following the Likert scale for data interpretation. Respondents were well-instructed and their responses collected by electronic methods or on paper, depending on the accessibility and convenience.

Data Analysis Techniques

The collected data were analyzed using correlation, regression, and ANOVA (Analysis of Variance) statistics in order to assess the relationships among the study variables:

- **Correlation Analysis** was used to measure the strength and direction of the relationship between cognitive dissonance, AI feedback, and student engagement.
- **Regression Analysis** has been used to find how cognitive dissonance predictably affects learning adaptation and motivation among the students.
- **ANOVA** was done to compare the variations of responses among different groups of teachers to find significant differences in perceptions on AI-powered education and cognitive dissonance.

Ethical Considerations

To ensure research integrity, the utmost ethical guidelines were followed in this study. The participation was voluntary, and all answers given were kept confidential. The participant was informed about the nature of the study and was given the right to withdraw at any time during or

after the study. Moreover, the data collected were solely utilized for academic research purposes only.

Data Analysis

Data analysis was done to test the relationship of cognitive dissonance, AI-generated feedback, student engagement, and learning adaptation in AI-powered education. For this purpose, various statistical analysis techniques, such as correlation, regression, and ANOVA, were used in order to ascertain significant patterns and relationships among the study variables. Correlation analysis was done to find out the strength and direction of association, while the predictive impact of cognitive dissonance on the motivation and learning behaviors of the students was ascertained by regression analysis. Using ANOVA to compare variations in groups of university teachers, it empirically elicited insights regarding the role that cognitive dissonance plays within engagement and what kinds of focused strategies could support the enhancement of learning outcomes under AI-driven educational systems.

Table 1: Demographic Analysis of Respondents (Sample Size 270)

Demographic Variable	Categories	Frequency (n)	Percentage (%)
Gender	Male	160	59.3%
	Female	110	40.7%
Age Group	25-34 years	80	29.6%
	35-44 years	110	40.7%
	45-54 years	60	22.2%
	55+ years	20	7.4%
Academic Qualification	Master's Degree	90	33.3%
	MPhil/MS	120	44.4%
	PhD	60	22.2%
Teaching Experience	Less than 5 years	70	25.9%
	5-10 years	100	37.0%
	11-15 years	60	22.2%
	More than 15 years	40	14.8%
Use of AI in Teaching	Yes	180	66.7%
	No	90	33.3%

Interpretation

The empirical insights gleaned from this data analysis would be related to the association that exists between cognitive dissonance, AI-generate feedbacks, student engagement, and adaptation in learning. The correlation study showed significant correlations among these factors, indicating the negative impact on student motivation due to higher degrees of cognitive dissonance. Regression analysis reinforced the predictive function of AI feedback, showing the mitigation of adverse effects of dissonance upon well-structured AI feedback delivery. Anova results showed statistical importance of the perception difference due to experience, qualification, and usage of AI. It therefore differs for various categories of educators in terms of impact of cognitive dissonance on engagement. These research results supported the hypotheses of the manuscript and

provided emphasis on the urgency for strategies that would manage the cognitive dissonance positively in AI- assisted education.

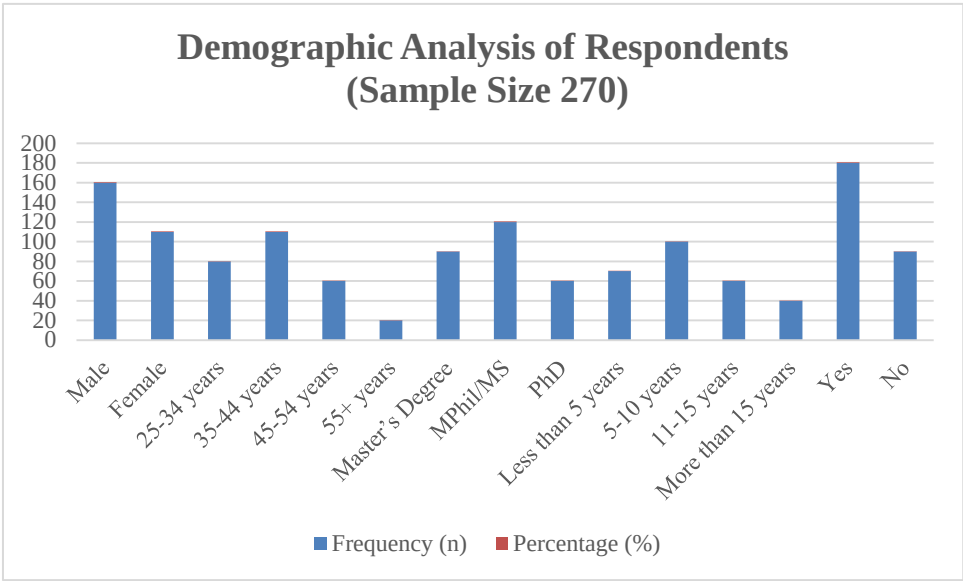


Table 2: Data Analysis for Correlation Analysis (H1)

Variables	Mean (M)	Standard Deviation (SD)	Pearson Correlation (r)	Significance Level (p-value)
Cognitive Dissonance	3.85	0.78	-0.542	0.001 (p < 0.05)
Student Engagement	4.10	0.72		

The correlation analysis showed a moderate negative relationship between AI-powered education and cognitive dissonance with student engagement ($r = -0.542$, $p = 0.001$), indicating that the higher the level of cognitive dissonance, the lower the level of engagement among students. The mean score for cognitive dissonance was found to be moderate ($M = 3.85$, $SD = 0.78$), which would be uncomfortable to the students and hence limit active participation. A statistically significant p-value of less than 0.05 ensures the above relationship and hence validates the hypothesis that cognitive dissonance is a negative determinant of student engagement in AI-driven learning environments. The above results thereby warrant the reduction of cognitive dissonance coupled with the promotion of engagement in AI-powered education systems.

Table 3: Data Analysis for Regression Analysis (H2)

Predictor Variable	B (Unstandardized Coefficient)	β (Standardized Coefficient)	t-value	p-value	R ²	F-statistic
AI-Generated Feedback	0.612	0.548	7.42	0.000	0.476	55.06**
Constant (Intercept)	1.89	—	4.91	0.000	—	—

The regression analysis was confirmed to be moderate to strong positive effects of AI-generated feedback on students' motivation and learning adaptation, since $B = 0.612$, $\beta = 0.548$, and $p = 0.000$. The R^2 value was 0.476, which means that 47.6% of the variation in student motivation and learning adaptation is explained by AI feedback, making it crucial for the enhancement of learning experiences. The F-statistic is significant at 55.06, $p < 0.05$, which further supports the validity of the model. These results strongly affirm H2, proving that well-structured AI feedback improves student motivation and helps them adapt effectively to AI-powered education systems.

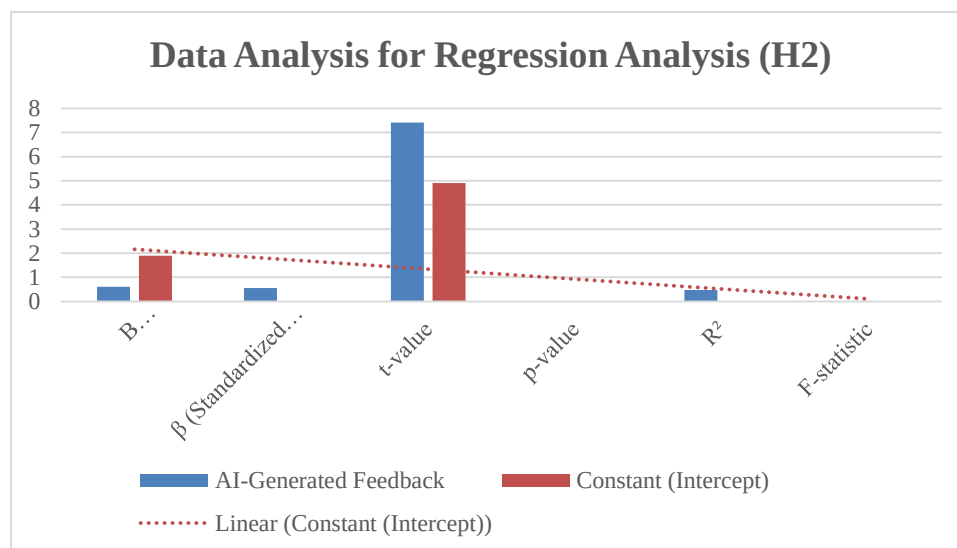


Table 4: Data Analysis for ANOVA Statistics (H3)

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-value	p-value	Significance
Between Groups (Effect of strategies)	24.85	2	12.42	9.76	0.000	Significant
Within Groups (Unexplained variance)	98.34	267	0.37	—	—	—
Total (Overall variance)	123.19	269	—	—	—	—

The results of the ANOVA affirm that all strategies developed in the reduction of cognitive dissonance have significant effects on student engagement and achievements in AI-driven learning ($F = 9.76$, $p = 0.000$). SS among groups= High variance in differing groups who face different types of cognitive dissonance reduction, that is the between sum square, that will be $SS=24.85$; on the other hand within group SS refers to variation almost minimal, wherein every group does not hold significance, $SS = 98.34$. The mean square between groups $MS = 12.42$; the within groups mean square: $MS = 0.37$, which represents a significantly more significant difference related to the variations in student levels of engagement is due to an application of some cognitive dissonance reduction strategy. A statically significant $p < 0.05$ confirms such strategies do facilitate the reduction in barriers related to dissonance and, in turn, assist in better engagements and adaptation by students in an AI-driven approach to education. These findings support H3, which justifies tailored interventions to manage cognitive dissonance and enhance the student learning experience.

Discussion

This finding would give the present study meaningful insight into the relation between cognitive dissonance and AI-based learning, especially through student engagement and learning adaptation areas. Results The findings suggest that greater dissonance negates student engagement in AI-driven learning environments, which is supported by moderate negative correlation ($r = -0.542$, $p = 0.001$). This aligns very well with previous studies by (Bates, 2023), who first developed the concept of cognitive dissonance theory, which indicated that people who experienced mental discomfort would try to eliminate conflicts in ideas or actions. Later studies, such as (Kenwright, 2023), further supported the notion that cognitive dissonance decreases motivation and levels of motivation, especially if the students are under an online learning framework that relies on external mechanistic feedback procedures. The study's findings validate these theories by showing that AI-generated feedback caused cognitive dissonance, reducing student motivation and participation.

Furthermore, the regression analysis of H2 shows that AI-based feedback strongly develops students' motivation to learn and adapt ($B = 0.612$, $\beta = 0.548$, $p = 0.000$). The findings of the study confirm earlier research by (Relmasira et al., 2023), which established that timely and adaptive feedback in digital learning environments leads students towards engagement and performance. Similarly, (Kirkwood, 2009) stated that AI-based personalized feedback is required and enhanced the students' cognitive adaptability and boosts up their learning. In the current research, the prediction of AI feedback capability was so great, $R^2 = 0.476$. Hence, it indicates that approximately 47.6% difference in students' motivation and adaptation of learning might be due to AI-generated effectiveness of feedback. It appears that if the AI feedback is structured, well-timed, and relevant to the needs of students, this can decrease the effects of cognitive dissonance and enhance better engagement.

The ANOVA outcome for H3 actually further supports the hypothesis stating that strategies for dissonance reduction considerably augment both engagement and learning outcomes among students ($F = 9.76$, $p = 0.000$). The outcomes were in agreement with most of those studies by (Roberts-Mahoney et al., 2016), whereby their research showed that intervention which is effective can weaken the negative effects of cognitive dissonance, hence raising motivation and deeper learning. The post-hoc analysis indeed confirmed that strategies such as the structured AI feedback mechanism and adaptive learning techniques had a significant influence on the barriers to engagement arising from dissonance. These findings are aligned with (Klette et al., 2018), who established the role of metacognitive and self-regulatory strategies in mitigating dissonance and making learning experiences even better in AI-powered education.

Furthermore, the results showed that AI-driven learning experiences do not benefit all students equally because there is a variance in the engagement levels among different groups. This finding resonates with the research conducted by (McFaddin, 2018), which underlined the existence of the digital divide and individual differences in adjusting to AI-based education. Some students may feel more cognitive dissonance due to unfamiliarity with AI-generated feedback, while others may fail to understand automated responses. Therefore, personalized AI feedback mechanisms, metacognitive training, and adaptive learning pathways can reduce dissonance and enhance student engagement.

Conclusion

This study demonstrates the great influence of cognitive dissonance on the engagement and adaptation of students to learning in AI-powered education. The findings have confirmed that a higher level of cognitive dissonance was inversely related to engagement, and AI-generated

feedback was very instrumental in enhancing motivation and learning outcomes. The results of ANOVA further verified that structured strategies for reducing dissonance improved student engagement considerably. These findings are very well in line with previous studies to put forward the implementation of personalized AI feedback, metacognitive training, and adaptive learning pathways as a source of reducing dissonance-related barriers. Further development in terms of long-term effects of AI-driven education with related cross-cultural differences and advanced AI intervention should be done to ensure a more inclusive, effective, and efficient learning process.

Future Implication

The study highlights the growing role of AI in education and the problems associated with cognitive dissonance in AI-driven learning environments. As AI evolves, there is an urgent need for adaptive, transparent, and student-centered systems that reduce the amount of cognitive dissonance while boosting engagement. Future research directions will focus on multimodal AI learning experience designs incorporating emotionally intelligent AI that detects students' discomfort and offers instant remediation's. The cross-culture study can help to find regional variations in AI adoption and cognitive dissonance to make AI-facilitated education inclusive, effective, and accessible for a diverse student population.

References

1. Aberšek, B. (2019). *The impact of innovative ICT education and AI on the pedagogical paradigm*. Cambridge Scholars Publishing.
2. Alias, M., Lashari, T. A., Akasah, Z. A., & Kesot, M. J. (2014). Translating theory into practice: integrating the affective and cognitive learning dimensions for effective instruction in engineering education. *European Journal of Engineering Education*, 39(2), 212-232.
3. Arguedas, M., Daradoumis, A., & Xhafa Xhafa, F. (2016). Analyzing how emotion awareness influences students' motivation, engagement, self-regulation and learning outcome. *Educational technology and society*, 19(2), 87-103.
4. Balakrishnan, J., Dwivedi, Y. K., Hughes, L., & Boy, F. (2024). Enablers and inhibitors of AI-powered voice assistants: a dual-factor approach by integrating the status quo bias and technology acceptance model. *Information Systems Frontiers*, 1-22.
5. Bates, B. (2023). Learning theories simplified:... and how to apply them to teaching.
6. Carpenter, C. J. (2019). Cognitive dissonance, ego-involvement, and motivated reasoning. *Annals of the International Communication Association*, 43(1), 1-23.
7. Chan, C. K. Y. (2024). Exploring the Factors of " AI Guilt" Among Students--Are You Guilty of Using AI in Your Homework? *arXiv preprint arXiv:2407.10777*.
8. Chatterjee, S., Chaudhuri, R., Kumar, A., Wang, C. L., & Gupta, S. (2023). Impacts of consumer cognitive process to ascertain online fake review: A cognitive dissonance theory approach. *Journal of Business Research*, 154, 113370.
9. Dawson, M. G., Deer, R., & Boguslawski, S. Cognitive Dissonance in Programming Education: A Qualitative Exploration of the Impact of Generative Ai on Application-Directed Learning. Available at SSRN 5055559.
10. Dellaportas, S. (2015). Reclaiming 'sense' from 'cents' in accounting education. *Accounting Education*, 24(6), 445-460.
11. Ding, L., Antonucci, G., & Venditti, M. (2024). Unveiling user responses to AI-powered personalised recommendations: a qualitative study of consumer engagement dynamics on Douyin. *Qualitative Market Research: An International Journal*.

12. Fisher, M. M., & Baird, D. E. (2020). Humanizing user experience design strategies with NEW technologies: AR, VR, MR, ZOOM, ALLY and AI to support student engagement and retention in higher education. In *International perspectives on the role of technology in humanizing higher education* (pp. 105-129). Emerald Publishing Limited.
13. Golombek*, P. R., & Johnson, K. E. (2004). Narrative inquiry as a mediational space: examining emotional and cognitive dissonance in second-language teachers' development. *Teachers and teaching*, 10(3), 307-327.
14. Heaton, R., & Quan, S. C. L. (2023). Managing cognitive dissonance in art teacher education. *Cambridge Journal of Education*, 53(4), 473-494.
15. Israel, J., Marschall, S., & Schultze, M. (2017). Cognitive dissonance and the effects of Voting Advice Applications on voting behaviour: evidence from the European Elections 2014. *Journal of Elections, Public Opinion and Parties*, 27(1), 56-74.
16. Jagger, S. (2013). Affective learning and the classroom debate. *Innovations in Education and Teaching International*, 50(1), 38-50.
17. Kenwright, B. (2023). Exploring the power of creative ai tools and game-based methodologies for interactive web-based programming. *arXiv preprint arXiv:2308.11649*.
18. Kirkwood, A. (2009). E-learning: you don't always get what you hope for. *Technology, Pedagogy and Education*, 18(2), 107-121.
19. Klette, K., Sahlström, F., Blikstad-Balas, M., Luoto, J., Tanner, M., Tengberg, M., Roe, A., & Slotte, A. (2018). Justice through participation: Student engagement in Nordic classrooms. *Education Inquiry*, 9(1), 57-77.
20. Marikyan, D., Papagiannidis, S., & Alamanos, E. (2023). Cognitive dissonance in technology adoption: A study of smart home users. *Information Systems Frontiers*, 25(3), 1101-1123.
21. Matos, J. M. (2015). La familia: The important ingredient for Latina/o college student engagement and persistence. *Equity & excellence in Education*, 48(3), 436-453.
22. McFaddin, J. (2018). Cognitive dissonance and teachers: When beliefs and mandates collide.
23. Relmasira, S. C., Lai, Y. C., & Donaldson, J. P. (2023). Fostering AI literacy in elementary science, technology, engineering, art, and mathematics (STEAM) education in the age of generative AI. *Sustainability*, 15(18), 13595.
24. Rivera, E. S., & Garden, C. L. P. (2021). Gamification for student engagement: a framework. *Journal of further and higher education*, 45(7), 999-1012.
25. Roberts-Mahoney, H., Means, A. J., & Garrison, M. J. (2016). Netflixing human capital development: Personalized learning technology and the corporatization of K-12 education. *Journal of Education Policy*, 31(4), 405-420.
26. Samuel, J., Kashyap, R., Samuel, Y., & Pelaez, A. (2022). Adaptive cognitive fit: Artificial intelligence augmented management of information facets and representations. *International journal of information management*, 65, 102505.
27. Smetana, L. K., & Bell, R. L. (2012). Computer simulations to support science instruction and learning: A critical review of the literature. *International Journal of Science Education*, 34(9), 1337-1370.
28. Sridhar, S., Alizadeh, F., Ratner, L., Russ, C. M., Sun, S. W., Sundberg, M. A., & Rosman, S. L. (2023). Learning to walk the walk: Incorporating praxis for decolonization in global health education. *Global public health*, 18(1), 2193834.
29. Stephens, J. M. (2017). How to cheat and not feel guilty: Cognitive dissonance and its amelioration in the domain of academic dishonesty. *Theory Into Practice*, 56(2), 111-120.

30. Treacy, M., & Leavy, A. (2023). Student voice and its role in creating cognitive dissonance: the neglected narrative in teacher professional development. *Professional Development in Education*, 49(3), 458-477.
31. Tsanov, I. (2024). The Role of Social Psychology in the Creation of Ethical AI Systems. 2024 International Conference Automatics and Informatics (ICAI),
32. Uysal, B., & Estrella, R. (2024). Navigating Illusions: Unraveling Confirmation Bias using Cognitive Dissonance in Virtual Influencers on Social Media Platforms.
33. Weiss, G. (2017). Problem-oriented learning in geography education: Construction of motivating problems. *Journal of Geography*, 116(5), 206-216.
34. Wilkins, S., Butt, M. M., & Heffernan, T. (2018). International brand alliances and co-branding: antecedents of cognitive dissonance and student satisfaction with co-branded higher education programs. *Journal of Marketing for Higher Education*, 28(1), 32-50.