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AI LITERACY, GROWTH MINDSET, AND ADAPTIVE LEARNING BELIEFS AMONG TEACHERS AND STUDENTS' IN LOW RESOURCE SCHOOLS IN LAHORE, PAKISTAN

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Abstract
Artificial intelligence (AI) offers new opportunities for teaching and learning, but AI literacy may vary with digital access and learning related beliefs. This study examined AI literacy, growth mindset, and adaptive learning beliefs among 100 teachers and 100 students in selected low resource schools in Lahore, Pakistan, using a cross sectional quantitative survey. Teachers scored higher than students in AI literacy (M = 3.84 vs. 1.96), growth mindset (M = 4.60 vs. 2.38), and adaptive learning beliefs (M = 4.53 vs. 2.29). Strong positive correlations were found among the three constructs in both groups. However, the unusually high correlations warrant further examination of item coding, scale construction, and construct validity. Digital access was limited, with 99% of students lacking home internet access and 36% owning a smartphone. These findings highlight the importance of considering educational beliefs alongside digital access when examining AI related learning in resource constrained settings.

INTRODUCTION
Artificial intelligence (AI) is increasingly influencing education through lesson planning, content development, feedback, and personalised learning. AI literacy is a comprehensive skill set that extends beyond technical operation to include critical evaluation, risk recognition (such as bias and privacy), and ethical responsibility, with frameworks like UNESCO's (2024) emphasizing a human-centered approach for students and teachers. AI literacy goes far beyond the basic technical ability to operate digital tools. According to Long & Magerko, 2020; Ng et al., 2021) it encompasses a broader set of critical skills such as Understanding AI capabilities, Evaluating generated information and Recognizing inherent risks such as bias, inaccuracy, and privacy concerns.

Developing AI literacy cannot be treated purely as an individual cognitive skill; it is deeply interdependent with structural equity and the material conditions of the learning environment. This breakdown help clarify how contextual factors shape the implementation of AI competency frameworks and how systemic barriers influence the development of AI literacy in resource-constrained low resource educational schools. Low-resource schools face specific barriers, including a lack of devices, unstable internet connectivity, limited

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technical support, and insufficient teacher training. These constraints directly hinder students' and teachers' opportunities to cultivate AI competencies. In Pakistani context, Device ownership (e.g., smartphones) does not equate to effective digital learning. (Dweck, 2006). Previous research has examined the relevance of mindset to students' responses to learning challenges and educational interventions (Blackwell et al., 2007; Yeager et al., 2019).

Pintrich & De Groot, 1990 explain that motivation and self-regulated learning also illustrates the significance of learner's beliefs about their competence and approach to learning. In this study, adaptive learning beliefs indicate confidence and a mastery approach to learning. This may be applicable in situations where teacher and students are using new AI tools, judging the information provided and dealing with errors. However, whilst there is a theoretical link between these concepts, this does not infer causation. While Artificial Intelligence (AI) literacy and learning beliefs are gaining more attention, it is important to explore the relationship between these concepts in low resource settings. Separating the beliefs of teachers and students can provide clarity on how they differ and relate to each other. It will also provide valuable background information on student smartphone and home internet availability. This study explores these concepts in a sample of teachers and students at low resource schools in Lahore, Pakistan. The research questions include:

3. Research Questions

1. What are the levels of AI literacy, growth mindset, and adaptive learning beliefs among teachers and students in public schools in Lahore, Pakistan?
2. What differences exist between teachers and students in their scores on AI literacy, growth mindset, and adaptive learning beliefs?
3. What associations exist among AI literacy, growth mindset, and adaptive learning beliefs among teachers and students?
4. What are the patterns of smartphone ownership and home internet connectivity among students in public schools in Lahore, Pakistan?

4. Methodology

4.1 Research design

in order to examine AI literacy, growth mindset and adaptive learning views among teachers and students this study uses a cross-sectional survey design. This enables researchers to gain an understanding of the participant responses and explore any relationships between the variables. However, this design does not allow researchers to understand reasons for changes in beliefs over time or establish cause and effect relationships.

4.2 Research setting and definition of low resource schools

This study focused around some schools deemed to be under-resourced in Lahore, Pakistan. Low-resourced was defined using six criteria including: A lack of computers in relation to the number of students, No/Unreliable internet access for students, High teacher-pupil ratio, Low household income, Poor lab equipment for Science and Mathematics and No/Unstructured CPD for teachers in the last 2 years.

If a school met at least 3 of these criteria they would be considered an under-resourced school. Schools were chosen from Data Ganj Bakhsh, Ravi and Shalimar.

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4.3 Participants and sampling

Non-probability purposive sampling was employed to identify schools located in low income areas of Lahore. A total sample size of 200 individuals were collected (100 teachers and 100 students). Schools were identified using indicators such as lack of resources including IT facilities, internet, and high student: teacher ratio, low socio-economic status of families, lack of lab facilities and professional development opportunities for teachers. The total number of schools involved in the study and how the indicators were measured are clearly stated. All schools will have met the same criteria to be included.Due to the limitation of non-probability sampling in the study the findings are limited and not generalizable to all teachers and students in Lahore or Pakistan.

4.4. Research Instruments and Data Preparation

The questionnaire based on below questions that measured: AI literacy; growth mindset; adaptive learning beliefs; demographics; and access to technology. The nine AI literacy questions were modelled on those provided by Long and Magerko (2020) and Ng et al (2021). These questions were asked to comprehend the awareness of participating sample about AI, knowledge and their confidence in using AI technologies, and their knowledge of ethical issues such as privacy and bias. There were six growth mindset questions based on Dweck (2006). Eight questions were used to measure adaptive learning beliefs, they were modelled on existing literature relating to self-efficacy, mastery goals and self-regulated learning (Pintrich & De Groot, 1990). Finally, questions were asked about demographics and access to technology.

Before computing composite scores, the items on the questionnaire were checked to make sure they were worded correctly and were scored appropriately. Items that were reverse coded only measured the construct of interest in the opposite direction. Composite scores were then computed using consistent scoring rules. Missing data were dealt with by applying the scoring rules. Internal consistency reliability estimates (Cronbach's alpha) were computed from the study data for the multi item measures.

4.5 Data analysis

Descriptive and inferential statistics were used to analyze data. Other descriptive data analysis techniques such as Frequency and percentage analysis was done to give a summary of participants' demographics and digital access. Mean and standard deviation analysis provided an overview of participants' levels of AI literacy, growth mindsets and adaptive learning beliefs. Pearson correlations were calculated to explore relationships between the three constructs for both teachers and students. Independent sample comparisons were conducted to compare scores between teachers and students.

Statistical assumptions, influential cases, linear relationships, construct overlap and clustering at a school level were taken into account when interpreting the results. Group differences were tested using statistical significance, confidence intervals and effect sizes. Permissions were gained from the institutions and schools. The survey was voluntary to participate in. Informed consent and assent were gained from students. All participants were kept confidential by keeping their data safe.

5. Results

5.1 Student demographic characteristics

There were 100 students and 100 teachers participating in the study. There was an equal amount of males and females in both groups. The students were aged between 12 and 16 years old (M = 13.99). Most students

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were in grades 6-8. The teachers had an average teaching experience of 12.20 years (SD = 7.13). The range of teaching experience was between 5 and 35 years.

5.2 Students' access to digital technology

With reference to digital resources, 36% of students had a smartphone and only 1% had internet access in the home. This indicates that students have limited access to the internet at home and therefore may struggle to complete online learning outside of school. However, there was no direct correlation found between digital resources and the constructs.

5.3 Teacher demographic characteristics

The teacher sample comprised 100 participants, including 50 male and 50 female teachers. The original analysis reported a mean teaching experience of 12.20 years (SD = 7.13), with experience ranging from 5 to 35 years.

These findings vary according to the experience of the teaching staff. However, the mean and standard deviation against raw data are further ensured by T statistical test used in the study.

5.4 Descriptive statistics for the main constructs

Teachers reported higher mean scores than students on all three constructs. For AI literacy, the mean was 3.84 for teachers and 1.96 for students. For growth mindset, the respective means were 4.60 and 2.38, while adaptive learning beliefs had means of 4.53 and 2.29.

Table 3
Reported Descriptive Statistics for the Main Constructs

Group	Construct	*M*	*SD*
Students	AI literacy	1.96	0.61
Students	Growth mindset	2.38	0.53
Students	Adaptive learning beliefs	2.29	0.63
Teachers	AI literacy	3.84	0.59
Teachers	Growth mindset	4.60	0.51
Teachers	Adaptive learning beliefs	4.53	0.57

The differences in the descriptive data may suggest differing response patterns between the two groups. However, it is significant to consider how each scale was scored and whether higher scores truly reflect a greater degree of competence in applying AI in practice and positive growth oriented beliefs.

5.5 Correlations among the constructs

All relationships between varibles were positive and strong. The strongest correlation was with growth mindset and adaptive learning beliefs in students (\(r = .965\)). This mirrored relationships in teachers (\(r = .972\)). AI Literacy was also strongly correlated with growth mindset and adaptive learning beliefs in both.

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Table 4
Reported Correlations among the Constructs

Group	Association	*r*	Reported significance
Students	AI literacy and growth mindset	.933	$p < .001$
Students	AI literacy and adaptive learning beliefs	.897	$p < .001$
Students	Growth mindset and adaptive learning beliefs	.965	$p < .001$
Teachers	AI literacy and growth mindset	.845	$p < .001$
Teachers	AI literacy and adaptive learning beliefs	.881	$p < .001$
Teachers	Growth mindset and adaptive learning beliefs	.972	$p < .001$

Although these results suggest that higher scores on the constructs tended to occur together, the exceptionally high correlations warrant careful examination. Potential explanations include overlapping item content, common method effects, or scoring errors. The correlations should therefore be recalculated after verifying reverse coding and composite scores. These associations do not establish causation.

5.6 Comparison of Teacher and Student Scores

The results show that teachers have higher mean scores than students on all three measures – AI Literacy, Growth Mindset and Adaptive Learning Beliefs. The means are not enough to determine if these differences are statistically significant.

Independent samples t-tests would be appropriate if the measures were comparable between groups and the assumptions were met.

5.7 Summary of Findings

Findings show that there is a lack of home internet access for students in the study. Teachers' mean scores are overall higher than students' scores across all three constructs. There are strong positive correlations between AI literacy, growth mindset and adaptive learning beliefs in both groups. The differences between groups and these correlations are validated at item level. Findings are interpreted within the context of the schools. Findings cannot be generalized to all teachers and students in Lahore or Pakistan.

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6. Discussion

6.1 Differences between Teachers and Students

Higher scores were identified by teachers when compared to students for AI Literacy, Growth Mindset, and Adaptive Learning. This may be due to the different roles they have within education, their learning experiences and their knowledge of educational concepts. However, this has not been directly tested.

There could be differences in interpretation of the items in the questionnaire. Teachers' confidence with AI might be based on their perceptions of AI's use within education whilst students' responses may be affected by low engagement with digital tools. Future work should investigate how the measures perform similarly across both groups. In addition, objective measures should be used to compliment self-reports in order to measure participants' knowledge and skills regarding AI.

6.2 Digital Access and Learning Opportunities

The results show that 99% of students in the study had no internet at home. As well as this, whilst 36% had smartphones, it does not mean they would have access to online resources.

There may be opportunities to explore AI tools, develop digital skills and engage in autonomous learning that are limited by constraints on digital access. However, no statistically significant relationship was found between digital access and the three constructs. This finding suggests that digital access is an important factor to consider when discussing education; however there was no evidence to suggest that low levels of digital access led to lower scores.

It is imperative to promote AI education platform in same setups to infer concepts of shared devices, offline learning resources, supervised access, and classroom activities that have limited dependence on continuous internet connectivity.

6.3 Relationships among AI Literacy, Growth Mindset, and Adaptive Learning Beliefs

The reported positive associations suggest that there may be an association between AI-literacy, growth mindsets and adaptive learning beliefs within the sample. On a conceptual level, those confident in developing new skills may report a higher willingness to engage with new technology and adapt their learning approaches.

However, given the extremely high correlations between the three measures, there are concerns that they are sufficient to capture the intended constructs. The similarities in wording of items, common method variance and potential scoring errors may have contributed to this. It is therefore important to consider reverse coding, item inter-correlations, reliability and evidence for construct validity prior to interpreting the relationships.

This the limitation of cross sectional design that do not show causal direction in findings and conclusion so it is suggested to further research using validated measures and complementary assessment methods should follow the nature of these relationships.

7. Implications

The findings highlight the importance of considering both educational beliefs and access to digital resources when planning AI education in low resource schools. Teacher professional development could address AI capabilities and limitations, critical evaluation of generated information, privacy, bias, and responsible classroom use. Students could benefit from age appropriate activities that develop their ability to evaluate AI generated content, verify information, and use digital tools while maintaining independent reasoning.

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Given the limited home internet access reported in this sample, schools should consider shared devices, offline resources, and supervised learning opportunities. Future initiatives should also assess school infrastructure and teachers' professional development needs before introducing technology dependent activities.

Further research should employ validated instruments, verified scoring procedures, and diverse school samples. Combining questionnaires with interviews, classroom observations, and direct assessments of AI literacy would provide a clearer understanding of how educational beliefs, digital access, and actual AI related practices interact.

8. Limitations and Conclusion

This study used a non-probability sampling technique which may limit the validity of the results since only a sample of 100 teachers and 100 students from selected schools in Lahore were included. This study also used a cross-sectional design. As such causal relationships cannot be established and self report measures were used meaning that it cannot be stated that teachers are actually competent with AI. The high correlation values, statistics surrounding teacher experience and comparison between the groups should be further verified using the original data. Reliability of the instruments and validity of the constructs should also be established.

Overall, teachers also had higher mean scores on AI literacy, growth mindset and adaptive learning beliefs. Students also reported significant barriers to accessing internet at home. This provides a snapshot of the schools that took part in the research. It does however highlight that when developing AI education, consideration must be made of the digital resources available to students. The conclusions drawn from the correlations and differences between groups need to be treated with caution until the methods of measurement are confirmed. Future research using validated measures, larger sample sizes and direct measurement will be required to determine the relationship between the constructs and educational opportunities within low resource settings.

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