

THE ROLE OF GAMIFICATION IN DIGITAL WORKFORCE TRAINING: A CASE STUDY OF KNOWLEDGE RETENTION AND ENGAGEMENT IN CLOUD COMPUTING TRAINING COURSE

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ABSTRACT

Indonesia's Digital Talent Scholarship (DTS) program aims to enhance digital workforce readiness but struggles with sustaining engagement and knowledge retention in online training. While gamification (e.g., badges, leaderboards) has shown promise in education, its effectiveness in professional training and across diverse regional contexts remains unclear. This study examines how gamification elements influence engagement and retention in DTS's Cloud Computing course, while assessing regional variations in outcomes. A quasi-experimental design compared 1,200 participants (gamified vs. standard LMS groups) using pre/post-tests, ANOVA, and regression analyses. Data included engagement surveys, retention tests, and demographic questionnaires. Engagement levels were consistent across provinces, but retention varied significantly, with weak correlations between gamification elements and outcomes. Regional disparities suggested contextual factors (e.g., resources, culture) outweighed gamification's direct impact. The study underscores the need for context-sensitive gamification strategies tailored to regional and cultural differences, challenging one-size-fits-all approaches. It calls for future research on longitudinal effects, qualitative insights, and narrative-driven gamification to optimize professional training.

KEYWORDS Gamification, Digital literacy, Online learning, Engagement, Knowledge retention.



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INTRODUCTION

Indonesia's Ministry of Communication and Digital (Komdigi) launched the Digital Talent Scholarship (DTS) program in 2018 to enhance digital capabilities across Indonesia (Kristiyono & Puspita Sari, 2023; Novaliendry et al., 2023; Rhamadona et al., 2023; Riesta Ayu Oktarina et al., 2023). The program addresses challenges in digital literacy and workforce readiness by providing training for students, professionals, and job seekers. Despite its success in enrolling participants, the program faces persistent challenges with learner engagement and knowledge retention, particularly in online modules where interactivity is often limited. This lack of engagement hinders the realization of meaningful learning outcomes, raising concerns about the program's effectiveness in preparing participants for real-world digital challenges.

The global shift toward online learning has highlighted the need for innovative strategies to combat student disinterest and promote knowledge retention (Acharya & Jena, 2016; Babu et al., 2018; George & Quatrara, 2018; Ting, 2018). One promising approach is gamification, which involves integrating game-like elements such as badges, leaderboards, and rewards into learning environments. Gamification has been shown to enhance learner motivation and engagement, making it a potential solution to the challenges faced by DTS (Allen et al., 2018; Chen et al., 2021; MacCann et al., 2020; Sailer & Homner, 2020).

Recent studies have explored the role of gamification in improving learner engagement and knowledge retention. (Smiderle et al., 2020) investigated how gamification could make students more engaged and enhance their learning outcomes. Their findings demonstrated the potential benefits of game mechanics in educational contexts, though they also highlighted the variability of its effectiveness based on user traits and content types. Similarly, (Balci et al., 2022) examined the individual components of gamification, such as badges and leaderboards, and found that while these elements increase intrinsic motivation, their impact on actual learning outcomes remains inconsistent.

Moreover, (Huang et al., 2020) emphasized that most gamification research focuses on traditional educational settings, leaving its application in professional training programs underexplored. (Zainuddin & Perera, 2019) Further, the mixed findings in the literature were noted, particularly concerning the contributions of specific gamification elements to engagement and retention. These studies collectively underscore the need for targeted research to understand the nuanced effects of gamification.

While the benefits of gamification in traditional educational settings are well-documented, its application in skill-based training programs like DTS remains under-researched. Most existing studies have been conducted in academic contexts, with limited attention given to professional training programs designed to address digital literacy and workforce readiness. Furthermore, DTS participants' diverse demographic and contextual characteristics—including students and working professionals—differ significantly from those in formal education, warranting a more focused investigation.

The individual contributions of gamification elements such as badges, leaderboards, and rewards to learner engagement and knowledge retention also remain unclear. Prior studies have reported mixed findings, with some elements proving effective only under specific conditions or for certain user groups. Additionally, the potential for regional variations in the impact of gamification, influenced by cultural and educational differences, has received little empirical attention. Addressing these gaps is critical for optimizing the design and implementation of gamified learning experiences in programs like DTS.

This research explores the nuanced effects of gamification in Indonesia's Digital Talent Scholarship (DTS) program, focusing on how badges, leaderboards, and rewards impact student engagement and knowledge retention across different provinces. Unlike previous studies that centered on traditional education contexts, this study offers a novel perspective by examining professional training and uncovering regional disparities influenced by cultural and infrastructural factors. It challenges prevailing assumptions about the universal effectiveness of extrinsic rewards and refines past methodologies by employing a quasi-experimental design with stratified sampling. The findings aim to inform more effective, inclusive digital training program designs for diverse learner populations.

RESEARCH METHOD

This study uses a quasi-experimental pre-test and post-test design to assess the impact of gamification on learner engagement and knowledge retention in the DTS program. Participants were split into an experimental group (exposed to badges, leaderboards, and rewards) and a control group (using a standard learning environment), allowing for comparative analysis while addressing practical constraints in educational research.

The sample included 1,200 participants enrolled in the 2024 Cloud Computing course, evenly divided between groups. Stratified random sampling ensured demographic diversity, controlling for variables like age, gender, and region. Participants with prior gamification experience or incomplete assessments were excluded.

Data collection involved an adapted Online Student Engagement Scale, a knowledge retention test, and a demographic questionnaire. The procedure began with pre-tests for baseline metrics, followed by the intervention—where the experimental group used a gamified LMS while the control group used a standard LMS. Post-tests were administered after course completion.

Statistical analysis was conducted using IBM SPSS 27, employing descriptive statistics, ANOVA (to compare groups and regional differences), regression (to assess gamification's effect on outcomes), and correlation analysis (to explore interactions between engagement, retention, and gamification elements). This structured approach ensures a thorough evaluation of gamification's role in learning effectiveness.

RESULT AND DISCUSSION

Descriptive Statistics

The key findings of in the analysis of demographic characteristics, engagement, and retention (table 1-3) are summarized in the following tables:

1. Demographic Characteristics (Age):

- a. The average age of participants is 36.14 years, with a standard deviation of 8.12 years.
- b. The age range spans from 22 to 50 years.

2. Baseline Engagement and Knowledge Retention:

- a. Engagement scores have a mean of 70.43 with a standard deviation of 14.49, ranging from 21.38 to 100.
- b. Knowledge retention scores average at 75.22 with a standard deviation of 9.78, ranging from 44.80 to 100.

3. Provincial Representation:

The largest representations are from South Sulawesi and Central Java (11.17% each), followed by other provinces such as Papua and Bali (10.33% each).

Table 1. Demographic Characteristic (Age)

Metric	Value
Mean Age	36.14
Std Dev Age	8.12
Min Age	22.0
Max Age	50.0

Source: Data processed

Table 2. Baseline Engagement and Knowledge Retention

Province	Percentage
South Sulawesi	11,17
Central Java	11,17
Papua	10,33
Bali	10,33
Jakarta	10
North Sumatra	10
Yogyakarta	10
East Kalimantan	9,83
West Java	8,92
East Java	8,25

Source: Data processed

Table 3. Provincial Representation

Descriptive	Engagement	Knowledge Retention
count	1200	1200
mean	70,43	75,22
std	14,49	9,78
min	21,38	44,8
25%	60,62	68,58
50%	70,72	75,12
75%	80,14	81,73
max	100	100

Source: Data processed

Analysis of Variance (ANOVA):

Conducted to compare engagement and knowledge retention scores across provinces (Table 4). The results indicated significant differences in retention scores among provinces, highlighting regional variability in gamification effectiveness.

a. Engagement

The F-statistic for engagement is 1.49, with a p-value of 0.15. This result suggests no significant difference in engagement levels across the provinces, as the p-value is greater than the typical significance level (0.05).

b. Knowledge Retention

The F-statistic for retention is 2.09, with a p-value of 0.03. This indicates a significant difference in knowledge retention across provinces, as the p-value is less than 0.05.

Table 4. ANOVA Test Result

F-Statistic (Engagement)	p-Value (Engagement)	F-Statistic (Retention)	p-Value (Retention)
1,488	0,147	2,092	0,027

Source: Data processed

1. Tukey's HSD Test Results:

- a. Significant differences in knowledge retention were observed between some provinces, indicating regional variability in retention outcomes (Table 5).
- b. These differences might be influenced by contextual factors such as access to resources, cultural attitudes toward gamification, or the design of gamification elements.

Table 5. Tukey's HSD Test Results

group1	group2	meandiff	p-adj	lower	upper	reject
Bali	Central Java	-21.967	0.7284	-6.042	16.485	FALSE
Bali	East Java	-16.065	0.9685	-57.656	25.526	FALSE
Bali	East Kalimantan	-0.2814	1.0	-4.25	36.872	FALSE
Bali	Jakarta	0.1898	1.0	-37.617	41.414	FALSE
Bali	North Sumatra	1.638	0.9506	-23.136	55.896	FALSE
Bali	Papua	-19.394	0.8631	-58.585	19.796	FALSE
Bali	South Sulawesi	-20.579	0.7977	-59.031	17.874	FALSE
Bali	West Java	-0.3567	1.0	-44.285	3.715	FALSE
Bali	Yogyakarta	0.3141	1.0	-36.375	42.657	FALSE
Central Java	East Java	0.5902	1.0	-34.994	46.799	FALSE
Central Java	East Kalimantan	19.153	0.8677	-19.804	5.811	FALSE
Central Java	Jakarta	23.866	0.6342	-14.918	6.265	FALSE
Central Java	North Sumatra	38.348	0.0556	-0.0436	77.132	FALSE
Central Java	Papua	0.2573	1.0	-3.588	41.026	FALSE
Central Java	South Sulawesi	0.1389	1.0	-36.311	39.089	FALSE
Central Java	West Java	1.84	0.9082	-21.607	58.408	FALSE
Central Java	Yogyakarta	25.109	0.5621	-13.675	63.893	FALSE
East Java	East Kalimantan	13.251	0.9924	-28.807	55.309	FALSE
East Java	Jakarta	17.963	0.9392	-23.935	59.861	FALSE
East Java	North Sumatra	32.445	0.2946	-0.9453	74.343	FALSE
East Java	Papua	-0.333	1.0	-44.921	38.262	FALSE
East Java	South Sulawesi	-0.4514	1.0	-4.541	36.383	FALSE
East Java	West Java	12.498	0.9958	-30.535	55.531	FALSE
East Java	Yogyakarta	19.206	0.9099	-22.692	61.104	FALSE
East Kalimantan	Jakarta	0.4713	1.0	-35.294	4.472	FALSE
East Kalimantan	North Sumatra	19.194	0.884	-20.813	59.201	FALSE
East Kalimantan	Papua	-1.658	0.9481	-56.266	23.105	FALSE
East Kalimantan	South Sulawesi	-17.764	0.9126	-56.722	21.193	FALSE
East Kalimantan	West Java	-0.0753	1.0	-41.947	40.441	FALSE
East Kalimantan	Yogyakarta	0.5955	1.0	-34.052	45.962	FALSE
Jakarta	North Sumatra	14.482	0.979	-25.357	5.432	FALSE
Jakarta	Papua	-21.293	0.7911	-60.809	18.223	FALSE
Jakarta	South Sulawesi	-22.477	0.7114	-61.261	16.307	FALSE

group1	group2	meandiff	p-adj	lower	upper	reject
Jakarta	West Java	-0.5466	1.0	-46.496	35.565	FALSE
Jakarta	Yogyakarta	0.1243	1.0	-38.596	41.081	FALSE
North Sumatra	Papua	-35.775	0.1154	-75.291	0.3741	FALSE
North Sumatra	South Sulawesi	-36.959	0.077	-75.743	0.1825	FALSE
North Sumatra	West Java	-19.947	0.8754	-60.978	21.083	FALSE
North Sumatra	Yogyakarta	-13.239	0.9888	-53.077	2.66	FALSE
Papua	South Sulawesi	-0.1184	1.0	-39.637	37.268	FALSE
Papua	West Java	15.827	0.9672	-2.489	56.545	FALSE
Papua	Yogyakarta	22.536	0.7304	-1.698	62.052	FALSE
South Sulawesi	West Java	17.011	0.9422	-22.996	57.019	FALSE
South Sulawesi	Yogyakarta	2.372	0.6425	-15.064	62.504	FALSE
West Java	Yogyakarta	0.6708	1.0	-34.322	47.739	FALSE

Source: Data processed

1. Regression Analysis Results

Regression Analysis for Engagement (table 6):

Table 6. Regression Results for Engagement

Item	Coef.	Std.Err.	t	P> t	[0.025	0.975]
Intercept	70,498	1,270	55,506	0,000	68,006	72,989
Badges_Used	0,015	0,069	0,212	0,832	-0,121	0,150
Leaderboard_Rank	-0,004	0,015	-0,306	0,760	-0,033	0,024
Rewards_Claimed	0,002	0,133	0,015	0,988	-0,258	0,262

Source: Data processed

- 1) None of the gamification elements (badges used, leaderboard rank, rewards claimed) showed significant effects on engagement scores (p-values > 0.05).
- 2) This suggests that engagement may be influenced by external factors not captured in the model, such as course content or intrinsic motivation.

Regression Analysis for Knowledge Retention (Table 7):

Table 7. Regression Results for Knowledge Retention

Item	Coef.	Std.Err.	t	P> t	[0.025	0.975]
Intercept	76,643	0,856	89,565	0,000	74,965	78,322
Badges_Used	-0,031	0,047	-0,661	0,509	-0,122	0,061
Leaderboard_Rank	-0,011	0,010	-1,160	0,246	-0,031	0,008
Rewards_Claimed	-0,104	0,089	-1,165	0,244	-0,279	0,071

Source: Data processed

- 1) Similar to engagement, the gamification elements did not significantly affect retention scores (p-values > 0.05).

- 2) However, the negative coefficients for leaderboard rank and rewards indicate a slight inverse relationship, suggesting that these elements may need further refinement.

2. Correlations Analysis

The correlation analysis (Figure 1) shows the results that are summarized in the following matrix:

Correlation Matrix for Engagement, Retention, and Gamification Elements

- a. Engagement and Knowledge Retention: A negligible positive correlation (0.01) indicates no meaningful relationship between these variables.
- b. Engagement and Gamification Elements:
 - 1) Badges Used (0.01): Very weak positive correlation.
 - 2) Leaderboard Rank (-0.01): Very weak negative correlation.
 - 3) Rewards Claimed (0.00): No correlation.
- c. Knowledge Retention and Gamification Elements:
 - 1) Badges Used (-0.02): Very weak negative correlation.
 - 2) Leaderboard Rank (-0.03): Very weak negative correlation.
 - 3) Rewards Claimed (-0.03): Very weak negative correlation.

These findings suggest that neither engagement nor knowledge retention strongly correlates with the gamification elements measured in this study.

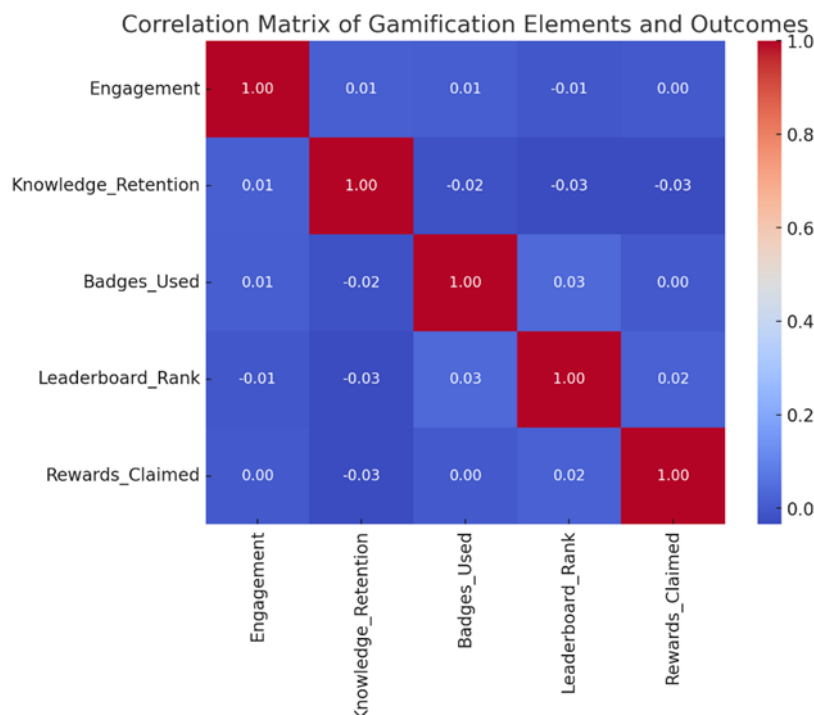


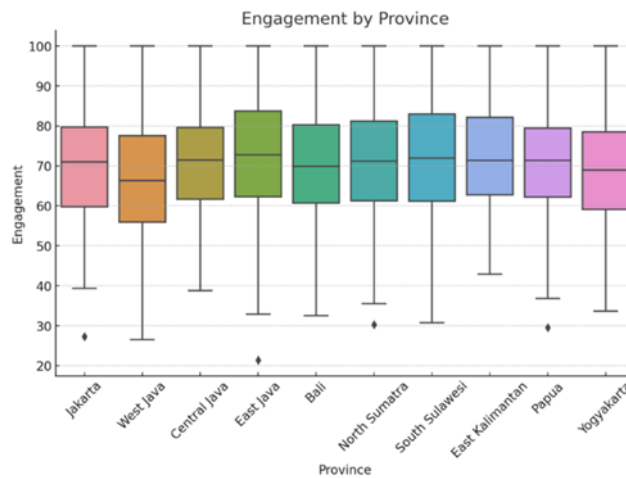
Figure 1. Correlation Matrix

Engagement and Knowledge Retention Score

Engagement by Province (Figure 2)

The engagement levels appear relatively consistent across provinces, with most regions showing a similar median score. However, slight variations in the interquartile range suggest

that some provinces have a wider spread of engagement levels, indicating potential variability in how students interact with gamification elements.



Knowledge Retention by Province (Figure 3)

Knowledge retention scores exhibit more noticeable differences across provinces than engagement scores. Some provinces have higher median retention scores, while others show broader distribution variability. These differences may reflect regional disparities in learning environments, access to resources, or cultural factors influencing the effectiveness of gamification.

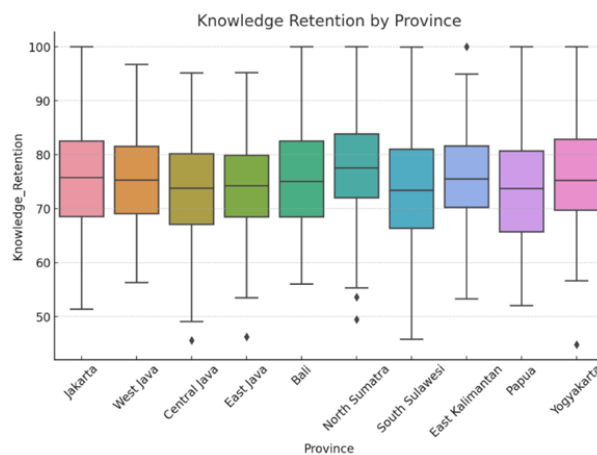


Figure 1. Knowledge Retention by Province

Discussion

Discussion is the most important part of the entire contents of scientific articles. The objectives of the discussion are: answering research problems, interpreting findings, integrating findings from research into existing sets of knowledge and composing new theories or modifying existing theories.

The findings from this study show that gamification can be effective in influencing online controllers of engagement and knowledge retention in online learning environments. Testing the effects of varying social engagement elements using ANOVA indicates no significant differences ($p > 0.05$) between individual provinces, suggesting gamification elements such as badges, leaderboards, and rewards did not significantly affect engagement.

Perhaps in reality, engagement is moved more by intrinsic influences like personal motivation or course content than by the extrinsic motivational mechanisms gamification offers.

In contrast, the assessment of knowledge retention revealed a statistically significant difference among provinces ($p < 0.05$ for all). This raises questions about the widely-held belief that these factors necessarily lead to effective learning in practice and implies that the effectiveness of these factors may be based on their use and learners' interpretations.

Additionally, correlation analysis supported the findings of no correlation between any gamification elements and engagement or retention due to their weak relationships. For example, reward, which is assumed to be an effective motivator, was only weakly correlated with one of the two outcomes, indicating the limited effect of extrinsic motivation in some learning situations.

The present study's results corroborate previous studies' findings, highlighting the role of contextual and motivational components on the impact of gamification on learning results. For instance, (Alsarayreh, 2021) study shows the important role of external factors (such as access and familiarity) that the educator can use to improve knowledge retention (Alsarayreh, 2021). The study reinforces this notion, finding no differences in the gamification components between the two regions; instead, the regional differences are likely attributable to contextual factors associated with the differences rather than the gamification components. These findings highlight the need to provide learners with the infrastructure required to fully experience gamification strategies, even more so when the practice heavily depends on digital tools.

Furthermore, the lack of efficacy of rewards and leaderboard rankings in this study is consistent with the findings of (Jack et al., 2024; Sebastian et al., 2019), who focus on the salience of aligning gamification components with the intrinsic motivation of learners as well as the competitive nature of the learning context (Jack et al., 2024; Sebastian et al., 2019). According to Landers and his colleagues, competition, leaderboards, and rewards work best when the underlying motivation for learners is intrinsic and when competitive play properly supplements the desired learning goals. By contrast, this paper shows that their effect is weaker when these constructs are misaligned from the learners' goals.

This juxtaposition makes it clear that gamification approaches must focus much more on intrinsic rather than extrinsic motivators, using rewards such as badges and leaderboards, as these will never provide the same type of engagement or retention. Instead, they should be meticulously crafted to address relevant points of incentive and the myriad contextual elements that will affect a given learner or group of learners' experience. Together, these studies highlight the importance of fully considering a holistic view of gamification that incorporates environmental scaffolding, context sensitivity, and learner-centred design principles to maximize its effectiveness.

Positioning the results in the wider research field allows this study to add to the understanding of gamification's opportunities and limitations. It emphasizes the need for adaptive and context-specific strategies.

The results provide both theoretical and practical implications. Concerning their theoretical implications, the results highlight the need to place gamification in a constructivist framework emphasising deep learning over shallow activities. In the real world, this study implies that educators and instructional designers should assess the gamification-related

components they integrate. These aspects, in particular, may be more effective by adapting them to specific regional needs (and) learners' expectations.

This may be particularly useful in areas where retention is higher and thus could serve as a naturalistic case for how specific contextual factors and gamification selection may work. The results also question the assumption that rewards are the main factor driving learning gain, encouraging a reframing to create systems that foster intrinsic motivation.

Some limitations of this study are worthy of comment. To begin with, the study's cross-sectional design only reflects a moment in time of abiding and ingestion; this restricts the understanding of the potential longer-term effects. Second, despite the variety of the dataset, we do not adequately capture all learners in Indonesia, especially those from regions that are not easily accessible. Third, the study examined only quantitative engagement and retention and did not account for qualitative dimensions (e.g., learner satisfaction, gamification, and the value of theme-gamifying).

A second limitation refers to the range of gamification elements examined. Although badges, leaderboards, and rewards are popular features in gamification, more direct game mechanics (e.g., narratives, quests, or social interaction) are not addressed. Such components would provide a more holistic view of gamification's role in supporting engagement and retention.

Future research requires longitudinal designs to study the development of engagement and retention over time in reaction to gamification. Broadening the type of gamification elements considered, especially collaborative and narrative-driven features, could also help us learn more about the effectiveness of gamification elements.

Interviews or focus groups would add a qualitative dimension to quantitative findings and offer deeper, student-centred views. Moreover, examining the degree to which cultural and regional variation impacts the potency of gamification might shed light on how to create better-tailored and more inclusive approaches.

Future investigations that remedy these limitations may extend the results of this study, with extensive implications for the ongoing development of implementing gamification in online learning environments with great potential for heterogeneous learners at scale.

CONCLUSION

While engagement levels remained consistent across regions, knowledge retention varied significantly, suggesting that gamification's effectiveness is context-dependent and not universally beneficial. The findings challenge the assumption that gamification inherently enhances learning, emphasizing instead the need for culturally and demographically tailored designs aligned with constructivist principles. Despite limitations—such as a cross-sectional design, reliance on quantitative data, and a narrow focus on specific gamification elements—the study contributes valuable insights into the nuanced role of gamification in education. It underscores the importance of regional and cultural considerations in instructional design while calling for further research to explore long-term effects and additional gamification features like social and narrative components. These findings provide a foundation for refining gamified learning strategies to better suit diverse educational environments.

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