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Strengthening Cognitive Domain Learning in TVET Institutions through Information Integration using Real-Time Online Assessment

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ABSTRACT

This paper investigates the potential of real-time online assessments in enhancing the cognitive domain of learners within Technical and Vocational Education and Training (TVET) institutions. Through simulated data analysis, correlations between student performance and three critical feedback dimensions alignment, quality, and timeliness were examined. Results from both pilot ($n = 80$) and full simulation ($n = 200$) datasets highlight significant relationships, indicating that assessment alignment and timely feedback are strong predictors of student achievement. Multiple regression further validates the integrated framework, suggesting that ornamental information integration within online assessments can serve as a cognitive catalyst for improved learning outcomes in TVET.

1. Introduction

The rise of real-time digital platforms has reshaped assessment practices in higher education, particularly within TVET institutions, where applied knowledge and performance-based learning are emphasized. Cognitive development in this context depends not only on the learner's knowledge acquisition but also on how instructional feedback is delivered, aligned, and integrated into the learning process.

This paper presents an analysis of simulated real-time assessment data to understand how alignment of content, feedback quality, and timeliness interact with student performance. Building upon Bloom's taxonomy in the cognitive domain, the study explores how information integration can enhance ornamental cognitive development in TVET learning environments.

1.1 Related Work

Prior studies have examined online assessment effectiveness, often highlighting the importance of constructive alignment, personalized feedback, and rapid response mechanisms. However,

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empirical evidence focusing on correlated effects of these dimensions within TVET contexts remains limited. Recent advancements in AI-supported analytics also provide opportunities to quantify these relationships, offering a data-driven basis for instructional design improvements.

2. Methodology

A two-phase simulation study was carried out to examine the relationships between student performance and key assessment-related variables. The first phase involved a pilot dataset of 80 participants, tested using Classkick.com as the platform for online assessment, which allowed the initial model to be evaluated and potential patterns of correlation to be identified. The second phase expanded the sample to 200 participants, providing stronger validation of the findings and reducing sampling variance.

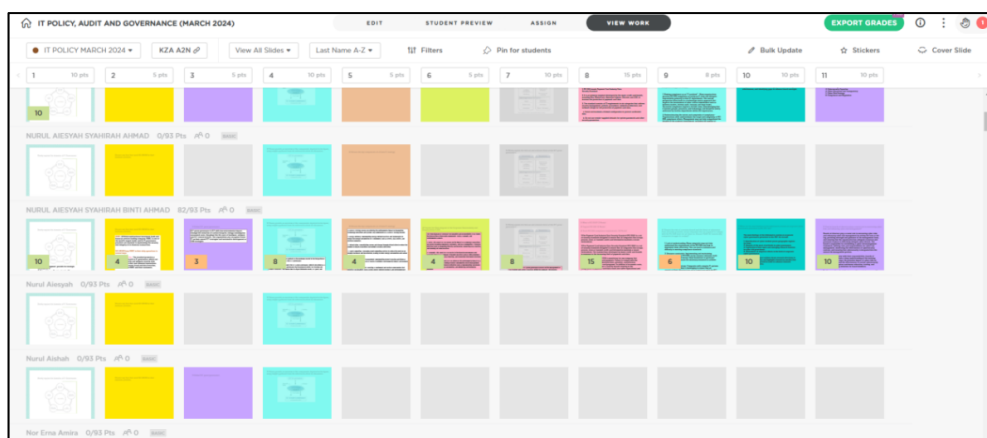


Fig. 1. Classkick.com platform for online assessment

The analysis focused on several core variables. The dependent variable, *StudentScore*, represented the learners' overall performance. Independent variables included *AlignmentScore*, which measured the extent to which assessment tasks aligned with learning outcomes; *FeedbackQuality*, which captured the clarity and usefulness of instructor feedback; and *FeedbackTimeliness*, which reflected the turnaround time in hours between submission and receiving feedback, where lower values indicated faster response.

To evaluate these relationships, the study employed Pearson correlation to measure associations between variables, followed by multiple regression analysis using the Ordinary Least Squares (OLS) method. This statistical approach enabled the identification of significant predictors of student performance as well as the estimation of their relative contribution to learning outcomes.

3. Results

Table 1 summarizes correlation and regression results for both pilot and full simulation datasets. The findings indicate that *AlignmentScore* maintains a consistently strong positive correlation with *StudentScore* across both the pilot and full datasets. *FeedbackQuality* demonstrates a moderate yet statistically significant positive effect in the larger dataset, while *FeedbackTimeliness* shows a negative correlation, emphasizing the critical role of faster feedback in supporting better student performance.

Table 1
 Correlation and regression results for both pilot and full simulation datasets

Analysis	Variable	Pilot (n = 80)	Full Sim (n = 200)
Correlation (r)	StudentScore	↔ r = 0.434, p = 0.0001	r = 0.355, p < 0.0001
	AlignmentScore		
	StudentScore	↔ r = 0.245, p = 0.0286	r = 0.254, p = 0.0003
	FeedbackQuality		
	StudentScore	↔ r = -0.215, p = 0.0550	r = -0.256, p = 0.0003
	FeedbackTimeliness		
Regression (OLS)	R ²	0.202	0.202
	AlignmentScore (β)	0.2355, p = 0.0001	0.1568, p < 0.0001
	FeedbackQuality (β)	0.0903, p = 0.0883	0.0911, p = 0.0209
	FeedbackTimeliness (β)	-0.1571, p ≈ 0.05	-0.1598, p = 0.0006

Regression analysis further reinforces these patterns, highlighting alignment as the strongest predictor of learning outcomes. Timeliness emerges as the next most influential factor, whereas feedback quality, though meaningful, plays a comparatively secondary role in predicting student achievement.

4. Discussion

The results reinforce the role of constructive alignment in cognitive development, consistent with existing literature on outcome-based education. The significance of timeliness indicates that cognitive processing benefits from immediate reinforcement, aligning with real-time learning theories. Interestingly, while feedback quality was less significant in the pilot, its effect became more evident in the full dataset, suggesting that sustained exposure to structured feedback improves learning impact.

These findings support the hypothesis that ornamental cognitive development in TVET contexts can be enhanced through information integration mechanisms embedded in online assessments. Real-time analytics and AI-powered feedback systems offer promising avenues to automate these enhancements.

5. Conclusion

This study demonstrates the value of systematically integrating alignment, quality, and timeliness within real-time online assessment systems to optimize cognitive learning outcomes in Technical and Vocational Education and Training (TVET) institutions. The findings provide empirical support—derived from simulated data—for the predictive significance of these assessment dimensions in enhancing learners’ cognitive performance and engagement. The results suggest that well-aligned assessment content, high-quality feedback mechanisms, and timely assessment delivery collectively contribute to more effective learning processes in digitally mediated TVET environments. Building on these findings, future research will extend the proposed framework through implementation in live classroom settings to validate its practical applicability. In addition, the integration of artificial intelligence–assisted adaptive assessment systems will be explored to enable personalized feedback,

dynamic assessment pathways, and continuous performance monitoring, thereby further strengthening the effectiveness and sustainability of real-time online assessment in TVET.

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