



The Impact of Adaptive Training Approaches on Trainee Engagement in CBET: The Mediating Role of Trainee Motivation

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Abstract

The need to determine specific pathways through which trainee motivation mediates the relationship between adaptive training strategies and trainee engagement necessitated this study. The study was based on a correlational design to explore the relationship between adaptive training strategies (Problem Based Learning, Localized Curriculum, Gamification and Metacognition) and trainee engagement through the mediating role of trainee motivation. Data was collected from a total of 50 students pursuing their course at Kenya School of TVET. Participants were exposed to a total of four adaptive training strategies for a period of eight weeks. Trainees were exposed to each adaptive training strategy for a period of two weeks, after which they were asked to complete a questionnaire consisting of self-reporting items that assessed their level of motivation, engagement levels, and how the adaptive training strategy influenced their motivation and engagement. Mediation analysis was used to determine how the relationship between adaptive training strategies and trainee engagement is mediated by trainee motivation. Findings suggest that trainee motivation partially mediates the relationship between problem-based learning and trainee engagement, as well as the relationship between gamification and trainee engagement. Moreover, it was found out that, trainee motivation fully mediates the relationship between metacognition training strategy and trainee engagement, as well as the relationship between localized curriculum and trainee engagement. The study reveals novel findings that the only way through which localized curriculum and metacognition can positively affect trainee engagement is through by first enhancing the level of trainee motivation. Recommendations on how localized curriculum and metacognition can enhance motivation of trainees to actively engage in learning activities are proposed based on the self-determination theory.

Keywords: Adaptive Teaching Strategy, Metacognition, Localized Curriculum

Introduction

Competence Based Education and Training (CBET) has emerged as a powerful training approach that emphasizes on acquisition of competencies (Kufaine & Chitera, 2013). While illustrating the paradigm shift in education and training, Kotsunthon (2025) observes that, comparative to the conventional rote learning approach, competency based education and training demands the use of adaptive training strategies that are modeled to meet the individual needs of the trainee. Beyond meeting the needs of the learner, the use of adaptive training strategies such as gamification, Problem Based Learning (PBL), localized curriculum, and metacognition fosters trainee engagement, which as opined by Baah et al. (2024), facilitates the acquisition of competency. For instance, Baah et al. (2024) note that the use of board games in science based classes is associated with increased trainee involvement. They further posit that gamification not only leads to increased trainee engagement but also enhances intrinsic motivation among trainees as a result of reduced cognitive load. Similarly, Boom-Cárcamo et al. (2024) contend that integrating the use of problem based learning with gamification increases the level of trainee engagement and creativity as well as improving the academic performance of trainees. Although ElSayad (2024) evaluated the mediating role of metacognition in blended learning environments, their findings affirm that metacognition self-regulation improves student's engagement.

Despite studies suggesting a positive impact of adaptive training strategies on trainee engagement, such as studies by du Plooy, Casteleijn & Franzsen (2024) and Rincon-Flores et al. (2024), specific pathways through which such adaptive training approaches affect trainee engagement remain underexplored. In particular, the mediating role of trainee motivation, a phenomenon which has been identified as a core learning construct in the self-determination theory (Deci & Ryan, 2012), remains rarely tested. Even though Baah et al. (2024) assert that gamification enhances motivation, the findings by the authors indicate that reduction in cognitive load has a stronger influence on trainee engagement, suggesting that motivation is not a strong mediator between gamification and trainee engagement. This indicates inconsistencies in the effects of PBL and Gamification on trainee engagement. Moreover, no studies have been undertaken to explore the mediating role of trainee motivation on the relationship between the use of localized curriculum and metacognition strategies on trainee engagement. Thus, this study seeks to address this gap by exploring the specific pathways, through which motivation mediates the relationship between adaptive training strategies (Problem Based Learning (PBL), Metacognition, Localized Curriculum and Gamification) and trainee engagement.

This study aims at determining the specific pathway through which trainee motivation mediates the relationship between adaptive training strategies and trainee engagement. The study is therefore guided by the following research question: How is the effect of adaptive training strategies on trainee engagement mediated by trainee motivation? The specific objectives of the study were the following: i). To examine whether trainee motivation mediates the relationship between metacognition and trainee engagement. ii). To determine whether trainee motivation mediates the relationship between problem based learning and trainee engagement. iii). To determine whether trainee motivation mediates the relationship between localized curriculum and trainee engagement and iv). To examine whether trainee motivation mediates the relationship between gamification and trainee engagement

Literature Review

Researchers such as Baah et al. (2024) and Gil-Doménech and Berbegal-Mirabent (2019), found that the use of gamification as a pedagogical strategy motivates trainees to actively interact with learning materials. Moreover, agreeing to the sentiments by Gil-Doménech and Berbegal-Mirabent (2019), Bouchrika et al. (2021) observe that the use of gamification in learning not only elicits interest in learning among trainees but also boosts their interaction and engagement with classroom materials. While studies such as Baah et al. (2024), Gil-Doménech and Berbegal-Mirabent (2019), and Bouchrika et al. (2021) found a positive association between gamification and trainee engagement, Manzano-León et al. (2021) argue that that gamification does not lead to increased trainee engagement and there is a need to further investigate the compounded effect of gamification on trainee attributes such as cognition. Consequently, Montenegro-Rueda et al. (2023) further stressed the need for an investigation into understanding the effects of gamification on trainee engagements in different academic fields. Notably, studies by Manzano-León et al. (2021) and Montenegro-Rueda et al. (2023) do not evaluate the mediating effect of motivation on trainee engagement in the use of gamification. This presents a research gap due to the inconsistencies in the effects of PBL and Gamification on trainee engagement. In contexts where metacognition has been investigated, studies such as the study done by ElSayad (2024) treats metacognition as a mediating variable rather than a predictor variable. As such, in their investigation, ElSayad (2024) does not explore how the effect of metacognition learning strategy on trainee engagement is mediated by trainee motivation. Thus, this study seeks to address the above research gap by offering a novel approach to investigating the effect of metacognition on trainee engagement through the mediating role of trainee motivation.

In their study Orji and Ogbuanya (2022), found out that motivation mediates the relationship between problem based learning and trainee engagement. Specifically, they noted that PBL experiences intrinsically motivate trainees to actively engage in the acquisition of practical skills. In contrast, a meta-analysis on the mediating effect of motivation on trainee engagement in PBL contexts by Wijnia et al. (2024) found out that motivation may not mediate the relationship between PBL and trainee engagement. According to Wijnia et al. (2024), despite the high task value of PBL in

enhancing enjoyment and interest among trainees, the use of PBL did not significantly impact on deeper intrinsic and extrinsic motivational drivers. The contrasting empirical findings in the studies by Orji and Ogbuanya (2022) and Wijnia et al. (2024) necessitated this study as they point out to existence of inconsistencies in the effects of PBL strategy on trainee motivation. Hence, the present study seeks to add to existing body of knowledge by determining whether trainee motivation mediates the relationship between PBL and trainee engagement.

Although the use of a localized curriculum has been recognized as a critical aspect of adapting learning to trainee needs, empirical investigations on the impacts of localized curriculum use on trainee engagement remains moderately limited (Laeen et al. 2019). Even in cases where such studies exist, such as the study by Rahaman (2024), the focus is predominantly on the direct effect of localized curriculum on trainee engagement. The study by Rahaman (2024) highlights the significance of aligning curriculum experiences in enhancing trainee engagement while neglecting the underlying motivational constructs that define this engagement. Thus, this study offers a novel approach by exploring how the impact of localized curriculum on trainee engagement is mediated by trainee motivation.

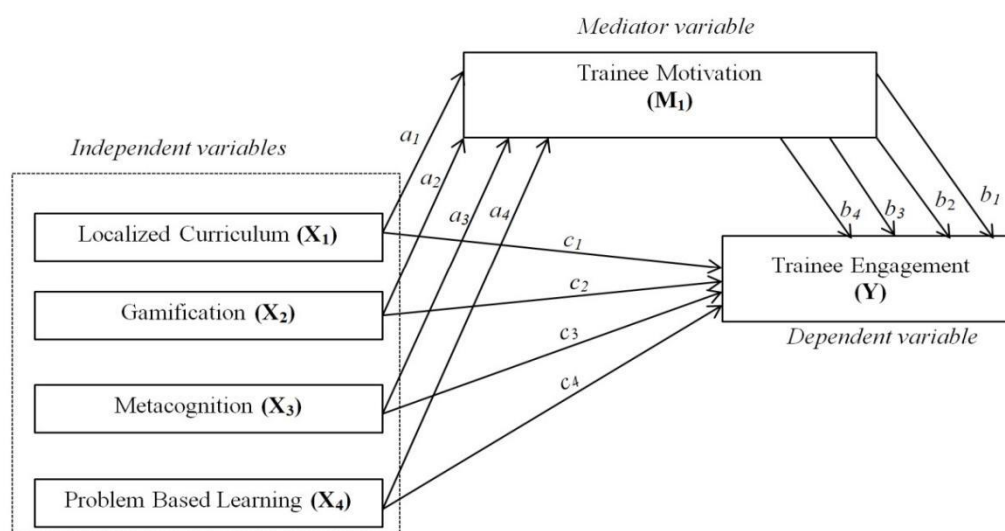
Methodology

The correlational research design was adopted as the underpinning approach in evaluating the relationship between trainee engagement and adaptive training strategies through the mediating effect of trainee motivation. According to Curtis et al. (2016), in a correlation design, a researcher aims at establishing the relationship between variables without manipulating or controlling the variables. The present study sought to evaluate how the relationship between adaptive training strategies and trainee engagement is mediated by trainee motivation, thus making a correlational design as the most appropriate research design for the research of this genre.

The dependent variable for the study was trainee engagement while the independent variables were adaptive training strategies (Localized Curriculum, Gamification, Metacognition, and Problem Based Learning). Both the dependent and the independent variables were measured as categorical variables on a five point Likert scale self-reporting items. The mediating variable for the study was trainee motivation which was coded as a categorical variable measured on a five point Likert scale self-reporting items.

Figure 1

Conceptual Framework



The above conceptual framework is based on the mediation model described by the following formulas;

Full mediation exists where; $a_n \times b_n$ is significant while c_n is not

Partial mediation exists where $a_n \times b_n$ and c_n are significant

Total effect = $c_n + (a_n \times b_n)$

The target population for the study was a total of 55 students enrolled in a pedagogy course at Kenya School of TVET. The target population was guided by UNESCO Institute observation that the average teacher to student ratios in most African countries is 55:1 (UNESCO, 2024). In order to determine the final sample size from the target population, the statistical formula for sample size determination in a finite population by Taro Yamane was applied (Umar & Wachiko, 2021) with a desired 5% margin of error.

$$n = N/(1+N \cdot e^2)$$

Where;

- N = Total Population size (55)
- n = Sample size
- e = error (0.05)

$$n = \frac{55}{1 + (55 \cdot 0.05 \cdot 0.05)}$$

Thus $n = 48.35$.

This means a minimum response rate from 48 participants for the study. However, the study successfully obtained responses from 50 participants, which is above the minimum threshold of 48 participants as illustrated from the sample size determination formula by Yamane (1967).

Primary data was collected using self-reporting Likert Scale type responses. Participants were required to indicate their level of agreement on the Likert Scale responses. The study adopted the use of a single-item self-reporting measure of trainee engagement, trainee motivation, localized curriculum, PBL, and gamification. Data was collected over a period of eight weeks. Participants were exposed to a different adaptive training strategy for an average period of two weeks, after which they were required to fill a questionnaire on their level of trainee engagement, motivation as well as their perception towards effectiveness of each of the adaptive training strategy. Mediation analysis was conducted on the data collected to establish whether trainee motivation fully or partially mediated the relationship between adaptive training strategies and learner engagement.

A pilot study was conducted on 10 students in order to determine the internal consistency of the data collection instrument. Cronbach's alpha coefficient was calculated to establish the level of internal consistency of the data collection instrument for each adaptive training strategy as illustrated in the table below.

Table 1

Cronbach's Alpha Coefficients

Adaptive Training Strategy	Cronbach's Alpha	N of Items
Gamification	0.925	3
Localized Curriculum	0.908	3
Metacognition	0.929	3
Problem Based Learning	0.905	3

The Cronbach's Alpha coefficient for Gamification is 0.925, Localized Curriculum (0.908), Metacognition (0.929), and Problem Based Learning (0.905) which indicates an excellent level of internal consistency of the questionnaire self-reporting items used in each adaptive training strategy (Cortina, 1993).

Results and Discussion

Effect of Gamification on Trainee Engagement

A mediation analysis was conducted to determine whether the effect of gamification on trainee engagement is mediated by the level of trainee motivation. The results of the mediation analysis are illustrated below.

Table 2

Total effect of Gamification on Trainee Engagement

Effect	se	t	p	LLCI	ULCI
.7449	.0877	8.4967	.0000	.5686	.9211

The total effect of use of gamification in training on trainee engagement was significant $b = 0.7449$, $t(48) = 8.4967$, $p = 0.000$. It indicates that use of gamification positively affects trainee engagement.

Table 3

Direct Effect of Gamification on Trainee Engagement

Effect	se	t	p	LLCI	ULCI
.6292	.2132	2.9514	.0049	.2003	1.0581

The direct effect of use of gamification in training and learning on trainee engagement was also statistically significant $b = 0.6292$, $t(48) = 2.9514$, $p = 0.0049$, after accounting for the effect of trainee motivation, implying that the use of gamification in isolation positively affects trainee engagement.

Table 4

Indirect Effects of Gamification on Trainee Engagement

Effect	BootSE	BootLLCI	BootULCI
0.1156	0.2522	0.1012	0.5821

The indirect effects of gamification on trainee engagement through trainee motivation was significant, with an effect of $b = 0.1156$, at 95% CI [.2112, 0.5821]. Since the confidence interval does not include a zero value, this indicates a statistically significant mediation effect. This means that trainee motivation partially mediates the relationship between use of gamification and trainee engagement. The findings suggests that one pathway through which use of gamification increases trainee engagement is through increasing the level of trainee motivation. The other pathway is that gamification directly affects trainee engagement. Hence, both pathways c_2 , and $a_2 \times b_2$ that define the effect of gamification on trainee engagement are significant. The findings of the present study resonate with arguments by Baah, Govender & Subramaniam (2024) and Gil-Doménech and Berbegal-Mirabent (2019) that gamification promotes trainee engagement through motivating trainees to actively interact with training materials. Furthermore, the study found a direct effect of gamification use on trainee engagement echoing the sentiments made by (Khaleel, Ashaari & Wook, 2020). Thus, the findings of the present study adds to the existing body of knowledge by hypothesizing that the use of gamification directly increases trainee engagement, as well as enhances trainee motivation which subsequently leads to increased trainee engagement.

Effect of Localized Curriculum on Trainee Engagement

A mediation analysis was conducted to determine whether the effect of localized curriculum use on trainee engagement is mediated by the level of trainee motivation. The results of the mediation analysis are illustrated in Tables 5, 6 and 7 below.

Table 5

Total Effect of Localized on Trainee Engagement

Effect	se	<i>t</i>	<i>p</i>	LLCI	ULCI
0.6121	0.0943	6.4936	0.0000	0.4226	0.8017

The total effect of use of a localized curriculum on trainee engagement was significant $b = 0.6121$, $t(48) = 6.4936$, $p = 0.000$. It indicates that use of a localized curriculum positively affects trainee engagement

Table 6

Direct effect of Localized Curriculum on Trainee Engagement

Effect	se	<i>t</i>	<i>p</i>	LLCI	ULCI
0.0847	0.1840	0.4605	0.6473	-0.2855	0.4549

The direct effect of use of a localized curriculum on trainee engagement was statistically insignificant $p = 0.6473$ which is greater than the p value of 0.005 as suggested by Chuang et al. (2023). The findings suggest that use of localized curriculum in isolation does not directly affect trainee engagement.

Table 7

Indirect effects of Localized Curriculum on Trainee Engagement

Effect	BootSE	BootLLCI	BootULCI
0.5274	0.1897	0.1464	0.8985

The indirect effects of use of localized curriculum on trainee engagement through trainee motivation was significant, with an effect of $b = 0.5274$, at 95% CI [0.1464, 0.8985]. Since the confidence interval does not include a zero value, this indicates a statistically significant mediation effect.

The findings indicate that trainee motivation fully mediates the relationship between use of a localized curriculum and trainee engagement, indicating that pathway $a_1 \times b_1$ is significant while pathway c_1 is insignificant. This means that, the only way through which the use of a localized curriculum can increase trainee engagement is through increasing trainee motivation. Thus, this study contributes novel insights by positing that the use of a localized curriculum in isolation does not lead to trainee engagement; rather, significant trainee engagement only emerges when the localized curriculum elements are explicitly linked to enhancement of trainee motivation.

Effect of Metacognition on Trainee Engagement

Table 8

Total effect of Metacognition on Trainee Engagement

Effect	se	<i>t</i>	<i>p</i>	LLCI	ULCI
0.7963	0.0951	8.3721	0.0000	0.6051	0.9875

The total effect of use of metacognition on trainee engagement was significant $b = 0.7963$, $t(48) = 8.3721$, $p = 0.000$. It indicates that use of metacognition positively affects trainee engagement.

Table 9

Direct effect of Metacognition on Trainee Engagement

Effect	se	t	p	LLCI	ULCI
0.4138	0.2126	1.9467	0.0576	-0.0138	0.8415

The direct effect of metacognition on trainee engagement was statistically insignificant $p = 0.0576$ which is greater than the p value of 0.005. These findings suggest that the use of metacognition strategies in isolation does not lead to increased trainee engagement.

Table 10

Indirect effects of Metacognition on Trainee Engagement

Effect	BootSE	BootLLCI	BootULCI
0.3825	0.1961	0.0225	0.7951

The indirect effects of use of metacognition strategies on trainee engagement through trainee motivation was significant, with an effect of $b = 0.3825$, at 95% CI [0.0225, 0.7951]. Since the confidence interval does not include a zero value, this indicates a statistically significant mediation effect.

The findings show that trainee motivation fully mediates the relationship between metacognition strategies and trainee engagement, indicating that pathway $a_3 \times b_3$ is significant while pathway c_3 is insignificant. This means that, the only way through which the use of metacognition strategies can increase trainee engagement is through increasing the trainee motivation. The findings of the present study contributes to existing body of knowledge by providing findings that the use of metacognition in isolation does not lead to trainee engagement. However, meaningful trainee engagement only emerges when metacognition strategies are linked to enhancement of trainee motivation.

Effect of PBL on Trainee Engagement

Table 11

Total effect of Problem Based Learning on Trainee Engagement

Effect	se	t	p	LLCI	ULCI
0.6446	0.0762	8.4582	0.0000	0.4914	0.7978

The total effect of problem based learning on trainee engagement was significant $b = 0.6446$, $t(48) = 8.4582$, $p = 0.000$. It indicates that use of problem based learning positively affects trainee engagement.

Table 12

Direct effect of Problem Based Learning on Trainee Engagement

Effect	se	t	p	LLCI	ULCI
0.4819	0.1269	3.7965	0.0004	0.2265	0.7372

The direct effect of use of problem based learning on trainee engagement was statistically significant, with an effect of $b = 0.4819$, $t(48) = 3.7965$, $p = 0.0004$ after accounting for the

effect of trainee motivation. It indicates that use of problem based learning positively affects trainee engagement.

Table 13

Indirect effects of Problem Based Learning on Trainee Engagement

Effect	BootSE	BootLLCI	BootULCI
0.1627	0.1120	0.0632	0.3759

The indirect effects of the use of problem based learning on trainee engagement through trainee motivation was significant, with an effect of $b = 0.1627$, at 95% CI [0.0632, 0.3759]. Since the confidence interval does not include a zero value, this indicates a statistically significant mediation effect. This means that trainee motivation partially mediates the relationship between use of problem based learning and trainee engagement.

The findings suggests that one pathway through which the use of problem based learning increases trainee engagement is through increasing the level of trainee motivation. The other pathway is that problem based learning directly affects trainee engagement. Hence, both pathways c_4 , and $a_4 \times b_4$ that define the effect of problem based learning on trainee engagement are significant. While this study found out that, motivation mediates the relationship between PBL and trainee engagement, Wijnia et al. (2024) expressed contrasting view points by asserting that motivation does not mediate the relationship between PBL and level of trainee engagement. Nonetheless, the findings from this study adds to the existing body of knowledge by affirming the sentiments made by Orji and Ogbuanya (2022) that trainee motivation mediates the relationship between PBL and trainee engagement.

Conclusion and Recommendations

This study aimed at evaluating the specific pathways through which trainee motivation mediates the relationship between adaptive training strategies (PBL, Gamification, Metacognition, and Localized Curriculum) and trainee engagement. Findings show that, trainee motivation partially mediates the relationship between problem based learning and trainee engagement as well as partially mediating the relationship between and gamification and trainee engagement. This indicates that both problem based learning and gamification have two pathways to increasing trainee engagement. In the first pathway, which is mediated by trainee motivation, it was found out that PBL and gamification increases trainee engagement through increasing the level of trainee motivation. The second pathway, involves a direct effect where PBL and gamification had a positive direct effect on trainee engagement. Furthermore, findings show that the effect of localized curriculum and metacognition on trainee engagement is fully mediated by trainee motivation suggesting that the use of localized curriculum and metacognition in isolation does not improve trainee engagement. While all the adaptive training strategies considered in this study had a significant total effect on trainee engagement, the total effect observed in the use of localized curriculum and metacognition adaptive strategies is attributed to the full mediation effect of trainee motivation.

Consequently, the study proposes the following recommendations for strengthening trainee engagement in competency based education and training based on the self-determination theory of motivation; i). Localized curriculum strategy - The use of a localized curriculum should be meticulously designed in a manner that integrates community based and culturally relevant training and learning activities and resources. The localized curriculum must purposely infuse the divergent cultural orientations of trainees while at the same time incorporating experiences that create tangible value and a profound sense of belonging among trainees. Consequently, the localized curriculum experiences should empower trainees to co-design local learning experiences and develop pragmatic solutions that systematically address the pressing

community needs, thus reinforcing the relevance of their learning experiences and ultimately intrinsically motivating trainees to fully engage in learning activities. ii). Metacognition – In order to promote autonomy as illustrated in the self-determination theory, trainees need to set their own learning goals and reflect on why the learning goals matter to them personally. Moreover, trainers need to promote the use of self-evaluation, reflection prompts and scaffolding strategies at every stage of the learning process among trainees, which will subsequently promote the competency, construct in the self-determination theory. Furthermore, in order to create a sense of relatedness, trainers need to encourage peer metacognition strategies such as peer evaluation and reflection on shared challenges. Moreover, TVET institutions and policy makers need to develop a system of metacognition credit accumulation and transfer in order to promote relatedness. Such accumulated credits can be used for employment or enhancing academic mobility through credit transfers. Further, the study recommends that metacognition learning logs be introduced in TVET curriculum as an examinable unit of competence.

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