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Tactical Cognitive Readiness of Military Personnel: The Effect of Transfer of Training

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Abstract

Cognitive Readiness (CR) is a critical competency for military personnel, enabling them to respond effectively to complex and unpredictable operational environments. This quantitative study investigates the effect of training transfer on CR development, specifically examining how the Knowledge, Skills, and Abilities (KSA) acquired during military training are applied in real-world contexts among Malaysian Army (MA) personnel. CR encompasses the cognitive preparedness of military personnel, ensuring they possess the necessary KSA to perform effectively during military deployments. With the Malaysian Army in the early stages of its transformation plan for future forces, particularly in the development of Tactical Cognitive Readiness (TCR), this study offers crucial insights into how effective training transfer affects CR development. Through a structured survey and rigorous statistical analysis, the study evaluates the relationship between training transfer and CR. The results reveal a significant effect of training transfer on CR, as evidenced by a path coefficient (β=0.669) and a robust effect size (f^2=0.808). These findings provide actionable insights for optimizing military training programs, emphasizing the importance of effective training transfer in enhancing personnel readiness for the increasingly complex demands of modern military operations.

Keywords: Cognitive Readiness, Military Personnel, Military Operations, Military Training, Transfer of Training, Soldier Readiness

Introduction

Cognitive readiness (CR) is an essential attribute for military personnel, enabling them to adapt and perform effectively in complex and rapidly evolving environments. In the context of the Malaysian Army (MA), the development of CR is critical for military personnel to make quick and informed decisions during military operations. The ability to think critically and respond efficiently under pressure is vital to mission success (Martin et al., 2024; Crameri et al., 2021; Vine et al., 2021; Martin et al., 2020; Vrijkotte et al., 2016; Endsley, 2015). However, the extent to which training effectively enhances CR depends on how well military personnel can transfer the knowledge, skills, and abilities (KSA) acquired during training to real-world military operations.

The transfer of training refers to the application of learned competencies in actual operational settings (Baldwin & Ford, 1988; Boldovici, 1987), which directly affects on CR of military personnel. In the MA, military personnel undergo rigorous training programs designed to equip them with the necessary KSA to excel in various operational contexts. However, despite these efforts, challenges remain in ensuring that the KSA acquired during training is fully transferred and effectively utilized in operational environments. Understanding the effect of transfer of training is crucial to developing the CR of MA personnel.

This article aims to examine the effect of training transfer on the CR of MA personnel proposed by Alim et al., (2024). Specifically, it seeks to measure the effect of the transfer of training on CR of military personnel in MA. By examining this effect, this article aims to provide insights into how military training programs can be optimized to ensure military personnel are cognitively ready for the demands of military operations. Addressing these issues is vital for improving military personnel readiness in the MA.

The Concept of Cognitive Readiness

CR refers to an individual's preparedness to think critically, make decisions, and adapt effectively in dynamic, high-pressure situations (Fletcher & Wind, 2013). In the context of military operations, CR encompasses the ability of military personnel to apply their cognitive abilities to assess situations quickly, solve complex problems, and take decisive actions under uncertainty (Crameri et al., 2021; Jensen et al., 2020; Fautua & Schatz, 2012; Bolstad et al., 2008). It is particularly important for modern military personnel, as they face rapidly evolving battlefields where the ability to adapt and respond to unforeseen challenges can determine mission success or failure. CR is thus considered a core component of military competence, especially for those operating at the level of military organization (Strategic, Operational, and Tactical levels).

The development of CR is a multifaceted process that encompasses cognitive skills, psychological resilience, and situational awareness. Cognitive skills involve critical thinking, problem-solving, and decision-making abilities, enabling military personnel to assess and respond to complex situations effectively. Psychological resilience refers to the ability to maintain composure and focus under stress (Thompson & McCreary, 2006; Schraagen, 1993), ensuring that individuals can perform effectively in high-pressure environments. Situational awareness, as described by Cosenzo et al. (2007), involves a soldier's capacity to perceive, comprehend, and anticipate changes in the battlefield environment. These interrelated dimensions collectively equip soldiers to navigate uncertainty, ambiguity, and threats, ensuring effective performance in challenging operational contexts.

A key factor in developing CR is the effective transfer of training, which involves applying the KSA acquired during training programs to real-world military operations (Alim et al., 2024; Taylor et al., 2023; Flood & Keegan, 2022). CR extends beyond formal training; it necessitates that military personnel continually adapt and learn from their experiences within operational environments. Well-designed training programs are essential for fostering CR, as they ensure that the KSA gained during training is effectively translated into practical application in complex operational settings.

The literature on CR underscores the critical role of cognitive flexibility and metacognition in military training (Crameri et al., 2021; Keegan et al., 2021; Prykhodko et al., 2021; Endsley, 1995). Cognitive flexibility refers to the ability to adjust thinking strategies and adapt to new information, while metacognition involves the awareness and regulation of one's cognitive processes. These components of CR empower military personnel to engage in reflective thinking, adapt their strategies in response to unforeseen challenges, and maintain a heightened state of mental preparedness throughout their missions. Consequently, military training programs are increasingly emphasizing the development of these cognitive skills to better prepare personnel for complex and unpredictable operational environments. CR is a comprehensive construct that integrates critical cognitive skills, psychological resilience, and the ability to transfer training effectively into real-world operations. It requires soldiers to be cognitively ready in the face of uncertainty in a complex operating environment (COE). By developing CR, military organizations can enhance their personnel's ability to perform effectively in demanding COE in military operations. Table 1 below provides a summary of key definitions of CR from various scholars and perspectives.

Table 1
Cognitive Readiness Definitions

Authors	**Definition of Cognitive Readiness (CR)**
Etter (2000)	Cognitively ready to perform effectively under complex, uncertain, and high-stress environments.
Morrison & Fletcher (2002)	Cognitive readiness refers to individuals' mental preparation to engage in complex military operations.
Salas & Fiore (2004)	A multifaceted capability that includes cognitive flexibility, metacognition, and adaptability for complex decision-making.
Grier (2012)	A soldier's ability to apply cognitive skills, situational awareness, and psychological resilience in operational settings is based on the level of military organizations (strategic, operational, and tactical). a. Strategic Cognitive Readiness (SCR) is defined as an individual's potential to carry out assigned planning and organizational duties in the complex and unpredictable environment of modern military operations. It reflects the capacity of military personnel to achieve an optimal level of CR for a mission. b. Operational Cognitive Readiness (OCR) refers to the mental preparation including skills, knowledge, abilities, motivations, and personal dispositions required for an individual to achieve and maintain competent performance in the complex and unpredictable environment of modern military operations. It specifically pertains to the CR of military personnel prior to deployment on a mission. c. Tactical Cognitive Readiness (TCR) is defined as a state of mental sharpness required to ensure an acceptable level of performance during assigned missions.
O'Neil et al. (2014)	The integration of military knowledge, skills, and abilities (KSA) is essential for military personnel to effectively determine how to act and react during military operations.

This table reflects the evolving definitions of CR, emphasizing the importance of KSA for military personnel confronting complex operational challenges. While the concept of CR varies slightly across different authors, it consistently centers around a common theme: being cognitively prepared for effective performance in demanding and unpredictable military environments. Therefore, in this study, CR refers to military personnel who are cognitively ready with the necessary military KSA at the tactical level to perform in military deployments.

Military Training for Cognitive Readiness

Military training emphasizes the integration of physical, cognitive, and spiritual development to prepare personnel for the multifaceted demands of combat. Physical training builds endurance and strength, while cognitive training enhances decision-making, problem-solving, and emotional regulation, ensuring readiness in high-stress environments. Spiritual training focuses on resilience and moral grounding, helping military personnel maintain inner strength during challenging missions. By addressing these three areas, military training aims to develop well-rounded military personnel who can respond effectively to both the physical and mental challenges of modern warfare (Vaara et al., 2022; Herrera, 2020; Raffensperger & Schrage, 1997). This approach ensures that personnel are equipped to respond effectively, both cognitively and emotionally, in high-pressure situations.

Success in modern military situations depends on military personnel who are cognitively ready for military deployment (Scott & Deuster, 2024; Etter, 2000). Researchers (Crameri et al., 2021; Brunyé et al., 2020; Preddy et al., 2020; Simpson & Oser, 2003) mentioned that military organizations and law enforcement organizations attempt to increase the CR of personnel utilizing cognitive training. Cognitive training offers advantages such as increased cognitive performance using training technologies. However, the training outcomes of training are debated and further study is needed to assess their effect on training outcomes especially CR in preparing personnel for complex and ambiguous scenarios.

Military training programs are designed to enhance military personnel readiness through both the structure of the training itself and the use of environment-intense scenarios (Blacker et al., 2019; Bruzzone & Massei, 2017; Tyler et al., 2010; Chipman et al.,2000; Gagne, 1962). These scenarios aim to replicate the unpredictability and stress of real-world operations, helping soldiers develop critical skills such as decision-making, problem-solving, and emotional regulation. By simulating high-pressure conditions, military personnel are better prepared to transfer the KSA in training to actual combat situations, making military training a key component in developing CR.

However, while theoretical assumptions suggest that the transfer of training significantly **affects** CR, empirical studies are necessary to substantiate these claims. The exact mechanisms by which military training enhances CR for personnel remain unclear. Investigating how training transfer **affects** CR can provide critical insights into optimizing military training programs to ensure personnel are fully prepared for the complexities of modern warfare. As the science of military training evolves, understanding how the transfer of training **affects** CR is essential for enhancing operational effectiveness.

Transfer of Training

The evolving science of training highlights the critical relationship between training transfer and its outcomes, particularly in the development of CR military personnel (Crameri et al., 2021; Garavan et al., 2021; Kaplan et al., 2021; Gegenfurtner et al., 2020; Hughes et al., 2020; Etter, 2002). As military personnel are increasingly required to operate in complex and unpredictable environments, their ability to effectively transfer training to real-world scenarios becomes crucial for enhancing CR (Fiore et al., 2012; Grier, 2012; Grier, 2011). The transfer of training ensures that the KSA acquired during military training is not only retained but applied in operational settings where they are most needed. Concurrently, CR ensures that military personnel remain cognitively prepared, mentally agile, and capable of executing their missions in diverse and challenging environments. Together, training transfer (Baldwin & Ford, 1988) and the development of CR (Alim et al., 2024; Etter, 2002) are essential for ensuring that military personnel can effectively apply the KSA acquired during training, thereby enhancing their operational effectiveness and readiness in MA combat situations.

Training transfer refers to the ability of military personnel to effectively apply the KSA gained during training to real-world operational contexts. Successful training transfer leads to heightened levels of CR, enabling personnel to perform competently in unpredictable, high-pressure environments. Mastering the transfer of training not only improves individual performance but also plays a critical role in ensuring mission success. As military training evolves, understanding the effect of training transfer on the development of CR has become essential for enhancing the operational readiness of military personnel (Crameri et al., 2021).

By expanding our study to examine the outcomes of CR through the effect of training transfer, this research aims to establish empirically based guidelines for developing CR among military personnel in the MA, particularly at the tactical level. This insight helps to unravel the complex processes involved in training transfer within military contexts. While certain challenges remain unresolved, significant progress has been made in formulating hypotheses that identify the effect of transfer of training on CR, thereby enhancing the broader understanding of the conceptual framework and its practical applications.

One key component of CR mentioned by Grier (2011) is Tactical Cognitive Readiness (TCR), which focuses specifically on ensuring that military personnel maintain a high level of mental sharpness during assigned missions at the tactical level of military operations. TCR involves the ability to make quick decisions, adapt to changing circumstances, and apply tactical knowledge effectively in the field. Given the unpredictable nature of military operations, soldiers must rely on their training to maintain this mental acuity under pressure. Without TCR, personnel may struggle to meet the demands of their missions, putting both themselves and their unit at risk.

TCR is particularly important in environments that require immediate decision-making and rapid adjustments to unforeseen challenges (Crameri et al., 2021). For example, during combat missions or tactical operations, soldiers must process information quickly and make split-second decisions that can have significant consequences. A well-developed state of TCR enables them to stay mentally alert, prioritize tasks, and execute plans with precision, even in the face of stress or fatigue. This level of readiness is essential for maintaining operational effectiveness and ensuring mission success.

The transfer of training plays a significant role in developing and sustaining TCR. Military personnel must be able to take the lessons learned from simulated environments or classroom instruction and apply them in real-world scenarios (McConnell & Benveniste, 2024; McInerney et al., 2024; Milshtein et al., 2024; Saul et al., 2024; Jha et al., 2015; Halff et al., 1986). This transition from theoretical knowledge to practical application requires not only technical expertise but also the cognitive flexibility to adapt training principles to unique operational contexts. Effective transfer of training ensures that soldiers are not just proficient in isolated skills but can integrate those skills into their broader tactical operations.

Moreover, the development of TCR depends on how well military personnel are prepared for the unpredictable nature of modern combat. The complexities of military operations today demand that soldiers are equipped with the cognitive readiness to anticipate and respond to a wide range of challenges. This readiness goes beyond basic knowledge and skills; it involves developing the mental resilience to manage high-pressure situations and sustain performance throughout a mission. The transfer of training is instrumental in ensuring that this mental readiness is deeply embedded in military personnel, enabling them to respond effectively to the demands of the battlefield.

The development of TCR plays a critical role in ensuring that military personnel maintain the mental sharpness required to perform effectively during missions. TCR, as a subset of overall CR, focuses on the ability to make rapid decisions, adapt to evolving situations, and execute tactical plans in high-pressure environments at the tactical level of military operations. Given the unpredictable nature of modern military operations, the transfer of training becomes a key element in developing and sustaining TCR, ensuring that personnel can effectively KSA gained during training to real-world scenarios.

To explore this relationship further, the conceptual framework for TCR should focus on the mechanisms that the successful effect of transfer of training on CR. This framework would map out how training programs are designed, how effectively they are transferred into practice, and the role they play in keeping personnel cognitively prepared for tactical operations. Key components of the framework would include the quality of training, individual characteristics, and the training environment, all of which contribute to TCR development. This framework could also help identify gaps in the current training process that may hinder the full realization of TCR in military personnel.

Conceptual Framework

The conceptual framework serves as a guide for understanding the effect of transfer of training on CR, particularly at the tactical level, where military personnel must operate with precision and adaptability. By clarifying how the transfer of training contributes to the development of Tactical Cognitive Readiness (TCR), this framework ensures that military personnel are equipped with the necessary mental acuity to meet the demands of their assigned missions. Integrating this link into military training practices is essential for preparing personnel to respond effectively in high-pressure, unpredictable environments.

Additionally, this framework contributes to the long-term development of military personnel by continuously refining training practices based on feedback from field performance. As personnel advance through their careers, the transfer of training becomes even more critical, ensuring that they can apply accumulated knowledge and experience to increasingly complex tactical roles. Ultimately, the conceptual framework ensures that TCR is not only developed but sustained, enhancing both individual and unit performance in modern military operations. Figure 1 illustrates the conceptual framework for this study.

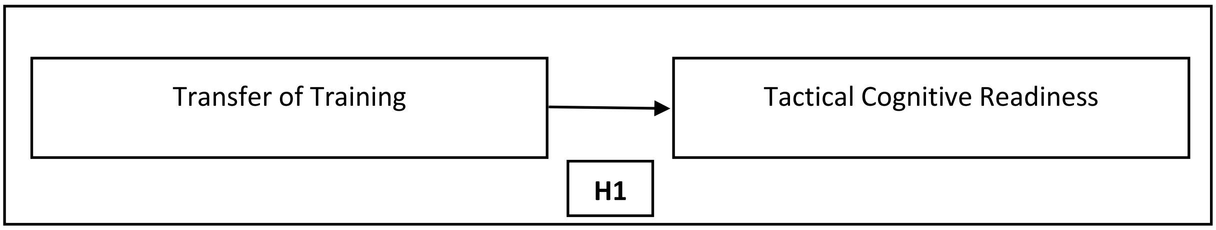

Figure 1 Conceptual Framework for Tactical Cognitive Readiness (TCR)
Hence, we propose the following hypothesis:

Hypothesis 1 (H1): The transfer of training significantly affects Tactical Cognitive Readiness (TCR).

The transfer of training significantly affects Tactical Cognitive Readiness (TCR). A critical aspect of military training is the degree to which training transfers into real-world tactical environments. In this study, we explore two key dimensions of training transfer: First, how effectively immediate cognitive improvements, such as enhanced decision-making and situational awareness, persist in actual tactical missions. Second, how behavioral transfer reflects the way training shapes subsequent actions in high-stress military scenarios. For instance, military personnel undergoing tactical drills decide on operational strategies, and according to cognitive readiness theories, these decisions are influenced by the scenarios and instructions provided during training.

Based on these principles, we hypothesize that the strategies presented during tactical training exercises will transfer into the decisions and behaviors exhibited by personnel in future missions. For example, if a training module emphasizes maintaining cover and minimizing unnecessary engagement, we expect military personnel to apply this tactical restraint when facing live situations in the field. Specifically, a training design focused on caution in hostile environments may lead military personnel to adopt more conservative tactical behaviors, such as delaying engagement until a clear and immediate threat is identified.

This highlights the potential of training transfer to directly develop CR at the tactical level, equipping military personnel with the necessary KSA by enhancing critical thinking, problem-solving, and decision-making in real-world military operations. By ensuring that military personnel can effectively transfer their training into practice, they are better equipped to handle complex tactical situations, make informed decisions, and execute tasks with greater precision, all of which contribute to enhanced readiness in high-stress environments.

Method

Overview

In social science research, measurement is a core concept that underpins the study of variables, serving as the foundation for accurately assessing, quantifying, and analyzing variables within a study. The Statistical Package for the Social Sciences (SPSS) and Structural Equation Modeling-Partial Least Squares (SEM-PLS) were employed to analyze the effect of transfer of training on the development of CR among military personnel. The participants, all of whom had completed a 24-month training cycle within the Malaysian Army, completed a self-administered survey designed to gather relevant data for the analysis.

A measurement scale is a tool used in studies to categorize, quantify, or rank variables systematically, determining how the properties of variables are measured and providing structure for data collection and analysis. This study utilizes both nominal and ordinal scales. The nominal scale is applied to categorize demographic variables such as ranks and units, where each category is distinct and does not have an inherent order. The ordinal scale is used for measuring respondents' perceptions through a 7-point Likert scale, ranging from 1 (Strongly Disagree) to 7 (Strongly Agree), allowing for the ranking of responses in terms of agreement levels, with a clear order of intensity between the points.

Participants

A total of 2,261 military personnel participated in this study, representing key combat units of the MA, namely the Royal Malay Regiment (RMR), Royal Ranger Regiment (RRR), and Border Regiment. The selection of participants was based on their completion of 24 months of military training, ensuring that they had acquired the necessary KSA to perform in operational contexts. The sample included a diverse representation of ranks, roles, and experience levels within these regiments, reflecting the broader structure of the MA combat forces. These personnel were chosen due to their direct involvement in tactical operations, making them suitable for evaluating the effect of training transfer on CR. Table 2 presents a detailed list of participants involved in this study.

Table 2
Participants' Involvement in the Study

Rank	**Unit**			**Total**
	Royal Malay Regiment	**Royal Ranger Regiment**	**Border Regiment**	
Lance Corporal	307	83	130	520
Corporal	584	173	172	929
Sergeant	198	54	81	333
Staff Sergeant	87	30	26	143
Warrant Officer II	36	10	6	52
Warrant Officer I	10	6	2	18
Lieutenant	62	24	38	124
Captain	40	10	6	56
Major	44	12	16	72
Lieutenant Colonel	7	3	4	14
Total	1375	405	481	**2261**

Procedure

The data collection was conducted through a structured questionnaire distributed among personnel from the combat branches of the MA. Participants were selected based on their completion of the Malaysian Army Training System (MATS), a comprehensive 24-month training program, ensuring their relevant experience and military training exposure. The questionnaire was designed to assess the effect of transfer of training on CR, with a specific focus on how military KSA are acquired and reinforced through military training. The detailed breakdown of the questionnaire is presented in Table 3.

Table 3
The detail of breakdown of the questionnaire

Section	Variable	Questions
A	Demographic of respondents	2
B	Unit military training	2
C	The effect of training transfer	
	Transfer of Training	6
	Cognitive Readiness of military personnel	6
Total		17

Result

Unit Training Analysis

Unit training in the military follows a structured, systematic approach designed to enhance both individual and unit proficiency, with the ultimate goal of achieving mission readiness through a combination of individual and collective training. Individual training focuses on developing the foundational KSA necessary for each service member to effectively perform their specific duties. This is achieved through a mix of classroom instruction, hands-on practice, and application in controlled environments. Conversely, collective training emphasizes unit-level performance by engaging personnel in complex scenarios that simulate real-world missions, necessitating teamwork, coordination, and the integration of diverse military capabilities.

This dual approach ensures that personnel not only excel in their roles but are also adept at functioning cohesively within joint and combined arms operations, where success relies on precise execution and seamless collaboration under high-stress conditions. By integrating individual and collective training components, military units refine their capacity to respond dynamically to operational challenges, ultimately achieving a heightened state of readiness and operational effectiveness. Tables 4 and 5 detail the participation of military personnel in individual and collective training activities.

Table 4
Individual Training

Involment in Invidual Training	Frequency	Percent
1 Involvement	94	4.2%
2 Involvement	420	18.6%
3 Involvement	461	20.4%
4 Involvement	726	32.1%
More than 5 Involvement	560	24.8%
Total	2261	100%

Table 5
Collective Training

Involment in Invidual Training	Frequency	Percent
1 Involvement	176	7.8%
2 Involvement	446	19.7%
3 Involvement	525	23.2%
4 Involvement	620	27.4%
More than 5 Involvement	494	21.8%
Total	2261	100%

Tables 4 and 5 present an overview of the frequency of military personnel's participation in individual and collective training activities. For individual training, 32.1% of personnel reported attending four training sessions, while 24.8% participated in more than five sessions, indicating significant engagement in these training efforts. In collective training, the highest level of involvement was also observed at four sessions (27.4%), followed by more than five sessions (21.8%), showing a similar trend of consistent participation. These findings suggest that military personnel are actively involved in both individual and collective training, reflecting a strong commitment to continuous development and maintaining operational readiness through regular engagement in these training activities.

Structural Equation Modeling (SEM)
Structural Equation Modeling (SEM) utilizing Partial Least Squares (PLS) was conducted to assess the relationships among the study variables. The PLS-SEM analysis addressed both the measurement and structural models. The measurement model demonstrated high reliability and validity, confirming the accurate representation of the constructs. The structural model revealed significant pathways between Transfer of Training variables and Cognitive Readiness (CR), thereby supporting the hypothesis that transfer of training exert a substantial effect on CR through military training. These results highlight the pivotal the effect of transfer of training in fostering CR within a military setting. Figure 2 presents a reflective measurement model in PLS-SEM.

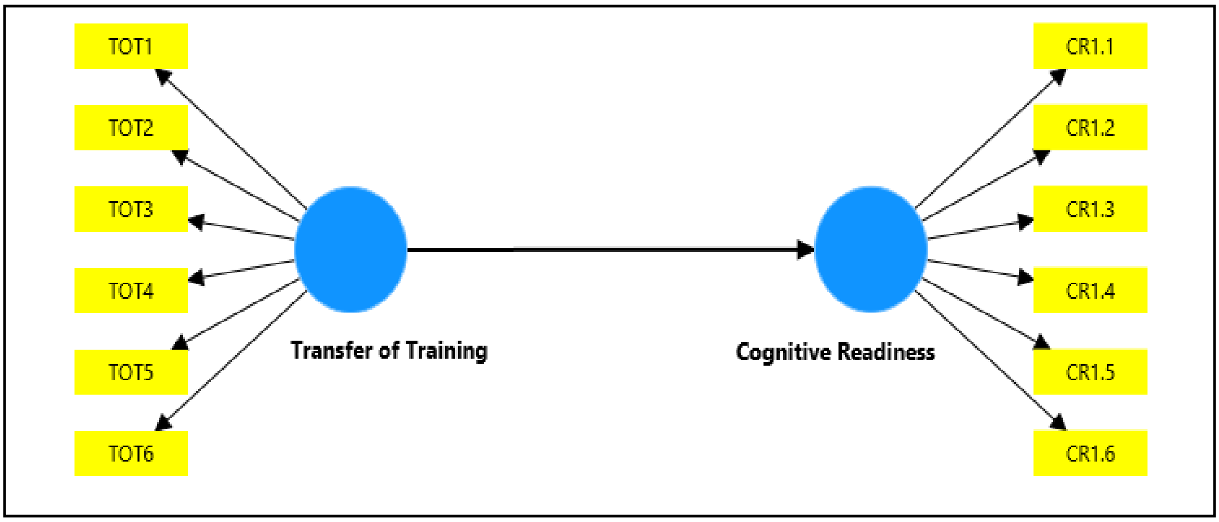

Figure 2. Conceptual Framework for Measurement

Evaluation of Reflective Measurement Model

In PLS-SEM, a reflective measurement model is employed to evaluate latent constructs through multiple indicators that reflect an underlying concept. A systematic evaluation process is conducted to ensure the model's reliability and validity. The first step is assessing internal consistency reliability, which determines whether the indicators consistently measure the same latent construct. Following this, convergent validity is examined to confirm that the indicators accurately capture the intended construct, ensuring both reliability and that the indicators effectively represent the latent concept. This study adheres to the guidelines for reflective measurement model evaluation, as outlined by Hair et al. (2019).

In this context, the reflective measurement model was utilized to examine the effect of transfer of training on the CR of military personnel. This approach provides a detailed understanding of how the transfer of training construct contributes to CR. The evaluation process was comprehensive, ensuring that the model accurately captures the relationships between the constructs. Specifically, the study assessed the relationships between observed indicators and their respective latent variables transfer of training and CR. The evaluation involved testing for internal consistency reliability, indicator reliability, convergent validity, and discriminant validity. Through this rigorous validation process, the measurement model confirms that each indicator reliably and correctly represents its underlying theoretical concept.

Figure 2 illustrates the reflective measurement model employed in PLS-SEM, while Figure 3 presents the results of assessing internal consistency reliability, convergent validity, and discriminant validity based on data collected from 2,261 military personnel within the MA.

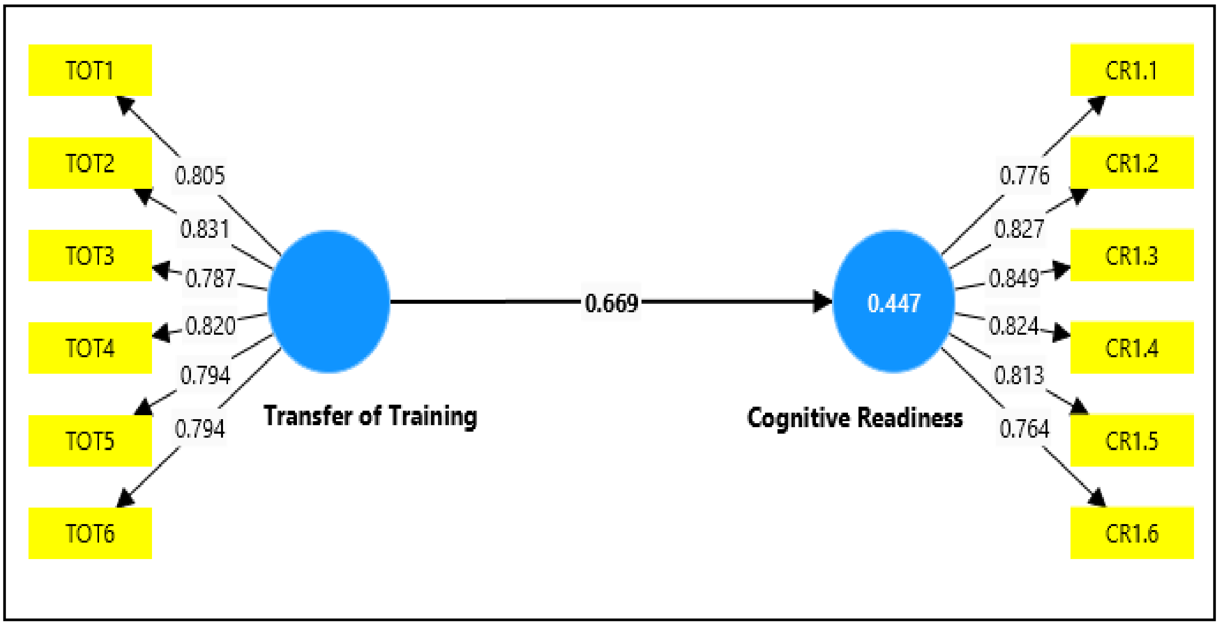

Figure 3: Reflective measurement model

Internal Consistency Reliability

The initial criterion for evaluation is internal consistency reliability. Table 6 displays the values for both Cronbach's alpha and composite reliability. Traditionally, Cronbach's alpha has been used to estimate internal consistency by assessing the intercorrelations among observed indicators. In PLS-SEM, composite reliability is typically reported alongside Cronbach's alpha to assess internal consistency reliability.

Table 6
Cronbach's Alpha and Composite Reliability Value

	Cronbach's alpha	Composite reliability (rho_a)
Cognitive Readiness	0.894	0.896
Transfer of Training	0.892	0.892

This table presents the reliability metrics for the key constructs in the model. Both Cronbach's alpha and composite reliability values exceed the recommended threshold of 0.7, indicating robust internal consistency and reliability across all constructs. These results confirm that the internal consistency of the model is satisfactory, thereby reinforcing the validity of the measurement model in testing the study's hypotheses.

Convergent Validity

Convergent validity assesses how well different indicators measure the same construct, demonstrating a strong correlation among them and confirming that they accurately reflect the underlying concept. This is typically evaluated using the Average Variance Extracted (AVE), which measures the proportion of variance in the construct explained by the indicators relative to variance attributed to measurement error. A high AVE indicates that the construct captures most of the variance across its indicators, ensuring both accuracy and consistency.

Establishing convergent validity is essential for reinforcing the distinctiveness of each construct, thereby enhancing the reliability and credibility of the overall measurement model.

Table 7 presents the outer loadings and AVE values for the reflective measurement model. Following PLS-SEM guidelines, all criteria for convergent validity were fully met.

Table 7
Outer Loading and Average Variance Extracted Value

Indicators	Outer Loadings	Average Variance Extracted (AVE)
CR1	0.776	
CR2	0.827	
CR3	0.849	0.655
CR4	0.824	
CR5	0.813	
CR6	0.764	
TOT1	0.805	
TOT2	0.831	
TOT3	0.787	0.649
TOT4	0.820	
TOT5	0.794	
TOT6	0.794	

The table above presents the outer loadings and Average Variance Extracted (AVE) values for each indicator, key metrics in assessing the convergent validity of the measurement model. All indicator loadings surpass the recommended threshold of 0.7, indicating a strong relationship between each indicator and its respective construct. Additionally, the AVE values for both the Cognitive Readiness (CR) and Transfer of Training (TOT) constructs exceed 0.5, confirming that each construct explains a sufficient proportion of variance in its indicators. These results provide robust support for the measurement model's convergent validity.

Discriminant Validity

Discriminant validity ensures that a construct accurately measures its intended concept without overlapping with other constructs. One method to assess this is through cross-loadings, where each item should load more strongly on its designated construct than on any other, thereby confirming the construct's uniqueness. Additionally, the Heterotrait-Monotrait Ratio (HTMT) provides a more stringent criterion, measuring the ratio of between-construct correlations to within-construct correlations. A low HTMT value suggests that the constructs are empirically distinct, further supporting the model's discriminant validity.

Assessing discriminant validity is crucial for verifying that the constructs within the measurement model are differentiated. As shown in Table 8, Table 9, and Figure 4, both the cross-loading values and the HTMT meet the established criteria, confirming that the model satisfies the requirements for discriminant validity. These results indicate that all discriminant validity conditions have been fully met, reinforcing the distinctiveness and separation of the constructs in the reflective measurement model. This rigorous validation enhances the credibility and robustness of the model’s overall structure and measurement.

Table 8
Cross-loading Value

Items	Cognitive Readiness (CR)	Transfer of Training (TOT)
CR1	0.776	0.547
CR2	0.827	0.547
CR3	0.849	0.572
CR4	0.824	0.547
CR5	0.813	0.534
CR6	0.764	0.496
TOT1	0.542	0.805
TOT2	0.550	0.831
TOT3	0.517	0.787
TOT4	0.557	0.820
TOT5	0.520	0.794
TOT6	0.543	0.794

Table 9
Heterotrait-Monotraut Ratio (HTMT)

	Heterotrait-monotrait ratio (HTMT)
Transfer of Training <-> Cognitive Readiness	0.748

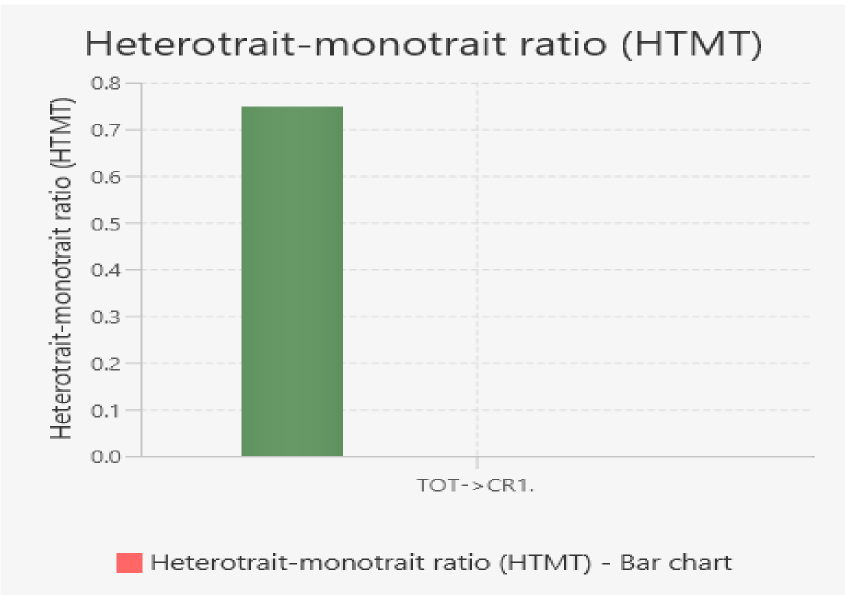

Figure 4. Heterotrait-Monotraut Ratio (HTMT)

The successful assessment of discriminant validity confirms the distinctiveness of the constructs within the reflective measurement model, ensuring that each construct is uniquely represented without overlap. This validation strengthens the model's overall reliability and validity, enhancing confidence in the accuracy of the construct measurements and the integrity of the model's structure.

Table 10
The Summary Result of the Reflective Measurement Model

Indicators	Outer Loadings	Composite Reliability	Average Variance Extracted (AVE)	Discriminant Validity
CR 1	0.776	**0.896**	**0.655**	**Yes**
CR 2	0.827			
CR 3	0.849			
CR 4	0.824			
CR 5	0.813			
CR 6	0.764			
TOT1	0.805	**0.892**	**0.649**	**Yes**
TOT2	0.831			
TOT3	0.787			
TOT4	0.820			
TOT5	0.794			
TOT6	0.794			

Table 10 demonstrates that the reflective measurement model for both the Cognitive Readiness (CR) and Transfer of Training (TOT) constructs shows strong reliability and validity. All indicator loadings exceed 0.70, with composite reliability values of 0.897 for CR and 0.899 for ML, indicating high internal consistency. The Average Variance Extracted (AVE) values of 0.655 for CR and 0.649 for TOT confirm adequate convergent validity, while discriminant validity has been successfully established for both constructs. These findings indicate that the measurement model is robust and well-suited for subsequent analyses.

Measurement Structural Model

Following the validation of the measurement model, the next step involves evaluating the structural model to assess its predictive power and the relationships between the latent constructs. The goal is to confirm that the empirical data aligns with the theoretical framework developed from the literature and supports the study's hypotheses. In PLS-SEM, this evaluation process involves fitting the model to the sample data to derive optimal parameter estimates, focusing on maximizing the explained variance of the endogenous latent variables. This study adheres to the guidelines for assessing PLS-SEM structural models as outlined by Hair et al. (2019).

A comprehensive structural model assessment involves a systematic procedure, covering several key criteria: (a) **Collinearity Assessment,** which checks for multicollinearity issues that may distort the path coefficient estimates; (b) **Structural Model Path Coefficients,** which examines the significance and strength of the hypothesized relationships; (c) **Coefficient of Determination (R^2 Value),** which quantifies the model's explanatory power for the endogenous constructs; (d) **Effect Size (f^2),** which assesses the impact of each predictor on the target variables; (e) **Predictive Relevance (Q^2),** which measures the model's predictive accuracy; and (f) **PLSpredict Analysis,** which evaluates the model's out-of-sample predictive power. Applying these criteria ensures a robust evaluation of the structural model, reinforcing the theoretical assumptions with empirical data.

Figure 5 depicts a Structural Equation Modeling (SEM) framework using Partial Least Squares (PLS) analysis, illustrating the relationship between the constructs of Military Leader and Cognitive Readiness (CR). The model is based on data from 2,261 military personnel within the Malaysian Army. The arrows represent the connections between latent variables and their respective indicators (TOT1 to TOT6 for Transfer of Training, and CR1 to CR6 for CR).

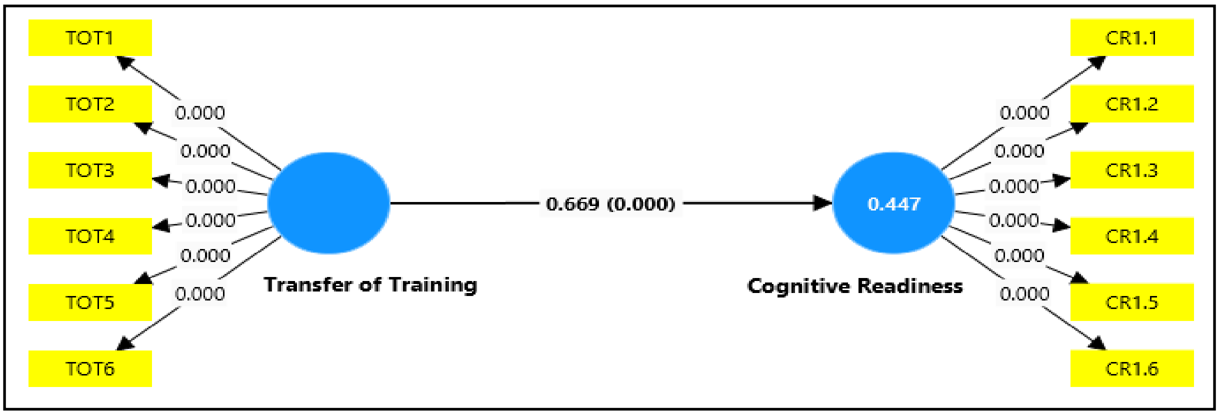

Figure 5. Measurement Model

Collinearity Assessment (Variance Inflation Factor- VIF)

To ensure the accuracy of path coefficient estimation, it is crucial to evaluate the structural model for collinearity before proceeding with the analysis. This step is particularly important as Ordinary Least Squares (OLS) regression is used for each endogenous latent variable and its associated antecedent constructs. Collinearity statistics, such as the Variance Inflation Factor (VIF) and Tolerance, are employed to assess the degree of correlation among predictors, helping to identify potential multicollinearity issues. This evaluation is essential for maintaining the reliability of coefficient estimates and preventing distortions in the model. Table 11 presents the collinearity statistics, highlighting the correlation levels among the predictor variables.

Table 11
Collinearity Values (Variance Inflation Factor - VIF)

Items	VIF
CR1	2.058
CR2	2.518
CR3	2.552
CR4	2.368
CR5	2.224
CR6	1.876
TOT1	2.176
TOT2	2.404
TOT3	1.931
TOT4	2.143
TOT5	2.016
TOT6	1.962

Collinearity was evaluated using the criteria applicable to both reflective and formative models, ensuring that VIF values fall between 0.20 and 5. According to Hair et al. (2014), VIF values below 0.20 are acceptable, while values equal to or greater than 5 indicate potential collinearity issues. As shown in Table 11, the collinearity criteria are satisfied, enabling the estimation of structural path coefficients through bootstrapping.

Structural Model Path Coefficients
In PLS-SEM, bootstrapping is employed to assess the significance of path coefficients, which reflect the estimated relationships between latent variables within the structural model. While the minimum number of bootstrapping samples should equal the number of valid observations, increasing the sample size to 10,000 is recommended for achieving more robust and reliable results. A bootstrapping analysis was performed to test the direct effect of the transfer of training on CR, as specified in hypothesis H1. The findings are detailed in Table 12.
H1: Transfer of Training has a significant effect on the CR of military personnel.

Table 12
Result Hypothesis H1

Hypothesis	Path Coefficients β	t value	*p*-value
Transfer of Training -> Cognitive Readiness	0.669	39.745	0.000

Note: * Significant at t > 1.96; **t >2.58; ***3.29 (Two Tailed Test)

The results in Table 12 demonstrate that the transfer of training has a significant effect on CR among military personnel, with a path coefficient (β) of 0.669, a t-value of 39.745, and a p-value of 0.000. The high t-value and p-value below 0.001 confirm a strong and statistically significant relationship, validating the hypothesized effect. These findings underscore the crucial role of effective transfer of training in fostering CR within military contexts. They highlight the importance of a well-structured transfer of training process in enhancing personnel readiness, emphasizing the need for a military training system that prioritizes the development of cognitive skills essential for successful deployment in military operations.

Examine the Coefficient Of Determination (R^2 Value)

The Coefficient of Determination (R^2) is a statistical measure used to assess the goodness-of-fit of a regression model, reflecting the proportion of variance in the dependent variable that is explained by the independent variables. R^2 values range from 0 to 1, with values closer to 1 indicating a stronger model fit, as a greater proportion of the variance is accounted for by the predictors. In contrast, lower R^2 values suggest a weaker fit, indicating that a smaller proportion of the variance is explained by the model. Table 13 presents the R^2 values obtained from the PLS-SEM analysis in this study.

Table 13
R^2 Value

	Original sample (O) R^2	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Cognitive Readiness	0.447	0.448	0.022	19.895	0.000

The results in Table 13 show that the R^2 value for CR is 0.447, indicating that the model explains 44.7% of the variance in CR. The close alignment between the sample mean (0.448) and the original sample (0.447) suggests consistency in the model estimation. The standard deviation of 0.022, along with a high t-statistic of 19.895 and a p-value of 0.000, signifies that the R^2 value is statistically significant at the 0.001 level. These results indicate that the model has a moderate explanatory power, capturing a substantial proportion of the variance in CR.

Examine Effect Size F^2

The effect size f^2 is a statistical metric that evaluates the contribution of an independent variable to the dependent variable within a multiple regression model. It offers deeper insights beyond the R^2 value by quantifying the unique impact of each predictor on the variance explained in the outcome variable. Specifically, f^2 measures the change in R^2 when a particular independent variable is added to or removed from the model, thereby highlighting the variable's effect. Table 14 presents the f^2 values for the effect of Transfer of Training on CR.

Table 14
f^2 value

	Original sample (O) f^2	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Transfer of Training -> Cognitive Readiness	0.808	0.814	0.074	10.932	0.000

The f^2 value of 0.808 indicates a substantial effect of Transfer of Training on CR. The close alignment between the original sample (f^2 = 0.808) and the sample mean (0.814) demonstrates the reliability of the effect size estimation. With a standard deviation of 0.074 and a t-statistic of 10.932, the effect is statistically significant at the 0.001 level, as evidenced by the p-value of 0.000. These results highlight the significant contribution of Transfer of Training to the variance in CR, underscoring its pivotal role in the model.

Assessment of Predict Relevance (Q^2)

The assessment of predictive relevance Q^2 is a critical criterion for evaluating the predictive accuracy of a structural model. Unlike R^2, which measures the proportion of variance explained, Q^2 assesses the model's capability to predict the data points of the dependent variable. A Q^2 value greater than zero indicates that the model has predictive relevance for a given endogenous construct, implying that the independent variables possess predictive power in estimating the outcomes of the dependent variable. Table 15 presents the Q^2 value for CR, confirming the model's predictive relevance.

Table 15
Q^2 Value

Assessment of predictive relevance	Q^2predict
Cognitive Readiness	0.445

The Q^2 value of 0.445 for CR indicates that the model has substantial predictive relevance for this construct. A Q^2 value greater than zero suggests that the model has sufficient predictive power, indicating that the independent variables effectively contribute to the accurate prediction of CR outcomes. These findings underscore the robustness of the model's predictive capability.

PLSpredict

PLSpredict is a vital tool in PLS-SEM for assessing a model's predictive performance on unseen data, thereby providing an out-of-sample evaluation of predictive accuracy. It utilizes metrics such as root mean squared error (RMSE) and mean absolute error (MAE) to quantify prediction errors, enabling a clear classification of predictive power as low, medium, or high. This approach enhances the model's assessment by examining its ability to predict outcomes accurately for new data, ensuring robustness and generalizability. Consequently, PLSpredict offers valuable insights into the practical utility and decision-making applicability of the PLS-SEM model. Table 16 provides the RMSE values for the CR indicators using the PLSpredict method.

Table 16
PLSpredict

Items	Q^2predict	PLS-SEM_RMSE	LM_RMSE	PLS-SEM RMSE – LM RMSE
CR1	0.296	0.718	0.713	0.005
CR2	0.297	0.748	0.749	-0.001
CR3	0.325	0.726	0.727	-0.001
CR4	0.297	0.722	0.724	-0.002
CR5	0.284	0.766	0.766	0.000
CR6	0.245	0.760	0.760	0.000

The results in Table 16 provide a detailed assessment of the predictive accuracy of the PLS-SEM model for CR through the Q^2 predicted values and a comparison of Root Mean Square Error (RMSE) values between PLS-SEM and a linear model (LM). The Q^2 prediction values for each indicator (CR1 to CR6) are all positive, with values ranging from 0.245 to 0.325. This finding indicates that the model exhibits predictive relevance for all measured items, suggesting that the independent variables in the model contribute meaningfully to the accurate prediction of CR outcomes. A positive Q^2 predict value is a critical indicator of a model's ability to forecast data points accurately, thereby affirming its applicability in real-world scenarios.

The comparison between the RMSE values of the PLS-SEM and LM models further reveals nuanced insights into the predictive power of the model. The differences between the RMSE values for PLS-SEM and LM across the indicators are minimal, ranging from -0.002 to 0.005. These slight variations indicate that the PLS-SEM model's predictive performance is comparable to that of the LM, with marginal differences that do not undermine the reliability of the PLS-SEM model. For indicators CR2, CR3, and CR4, the negative differences suggest that the PLS-SEM model offers predictive accuracy that is slightly better than or equal to that of the LM model. For other indicators like CR1, the PLS-SEM model exhibits a slightly higher RMSE, suggesting a minor reduction in predictive precision.

Overall, the results suggest that the PLS-SEM model is robust in predicting CR outcomes, offering an effective balance between predictive relevance and accuracy. The positive Q^2predict values, alongside the comparable RMSE differences, demonstrate the suitability of using PLS-SEM in this study to assess the relationship between Transfer of Training and Cognitive Readiness. These findings support the use of PLS-SEM as a powerful analytical tool in structural equation modeling, highlighting its ability to deliver reliable insights into the dynamics of training effectiveness and cognitive readiness in military contexts.

Discussion

This study provides critical insights into the effect of the transfer of training on the development of CR among military personnel in the Malaysian Army (MA). The findings indicate that the Transfer of Training has a significant positive effect on CR, as evidenced by a strong path coefficient (β=0.669) and a substantial effect size (f^2=0.808). These findings emphasize the crucial role of effective training transfer in improving readiness and operational performance within complex and challenging environments. The findings highlight the importance of applying the KSA acquired during training to real-world scenarios, which is vital for maintaining high levels of CR in dynamic military settings.

The results suggest that military training programs should place a greater emphasis on strategies that facilitate the effective transfer of learning. This includes the use of realistic training scenarios that closely mirror operational conditions, fostering metacognitive practices to encourage self-reflection and adaptability, and incorporating continuous feedback loops to reinforce learning outcomes. Such approaches can help bridge the gap between training environments and operational performance, ensuring that personnel are equipped to adapt swiftly to the complexities and uncertainties characteristic of modern military operations.

Moreover, the predictive relevance of the model, as indicated by a Q^2 value of 0.445, demonstrates that the transfer of training is a strong predictor of CR. This finding further emphasizes the necessity of tailored training programs that prioritize the practical application of learned competencies, thereby enhancing military personnel's preparedness for high-stress and high-stakes environments.

The comparison between the predictive performance of the PLS-SEM model and the linear model (LM) revealed minimal differences in RMSE values, ranging from -0.002 to 0.005. These findings indicate that while the two models offer similar levels of predictive accuracy, the PLS-SEM model provides a more nuanced understanding of the relationship between training transfer and CR. The robustness of the PLS-SEM approach in this context reinforces its suitability for analyzing complex, multifaceted relationships within military training effectiveness research.

Limitation

The development of CR among Malaysian Army (MA) personnel, has several limitations that should be acknowledged. First, the focus on a specific sample military personnel from the MA who have completed a 24-month training cycle limits the generalizability of the findings. The results may not extend to other branches of the military, such as the Navy or Air Force, or personnel in different geographical or cultural contexts. Expanding the scope of future research to include a wider range of military and law enforcement units would enhance the study's external validity by allowing for more generalizable findings across different organizational contexts.

Moreover, the cross-sectional design of the current study captures the effect of training transfer on CR at a single point in time, limiting the ability to observe the dynamic progression of CR within military culture. To address this limitation, future studies could adopt a longitudinal design, which would offer deeper insights into how training transfer influences CR development over time, particularly across various stages of military operations and deployment. This approach would provide a more nuanced understanding of the long-term effects of training on CR in evolving operational environments. Furthermore, the reliance on self-reported survey data introduces potential biases, such as social desirability bias, despite efforts to ensure anonymity and encourage honest responses. Future studies could benefit from integrating objective performance measures, such as mission evaluations or simulation scores, to validate the self-reported data and enhance the reliability of findings.

Another limitation is the study’s emphasis on Tactical Cognitive Readiness (TCR), which, while crucial, does not encompass other important aspects of CR, such as Strategic Cognitive Readiness (SCR) or Operational Cognitive Readiness (OCR). A broader exploration of these dimensions could provide a more complete understanding of how training impacts readiness at different command levels. Additionally, the study did not differentiate between various training methods, such as classroom instruction, simulation-based training, or field exercises, in its analysis of training transfer. This approach may overlook the potential variability in the effectiveness of different training methods in facilitating the transfer of KSA to real-world operational contexts. Future research should consider comparing the impact of different training approaches on CR to identify the most effective methods for enhancing readiness in complex and high-pressure military environments. These limitations suggest avenues for further study, aimed at deepening our understanding of the complex dynamics between training transfer and CR in military settings.

Conclusion

The findings of this study offer critical insights for the MA, particularly in advancing the development of Tactical Cognitive Readiness (TCR) at the tactical level. By pinpointing both the barriers and enablers of effective training transfer, this research contributes to the design of more targeted and efficient training programs, aimed at enhancing the CR of military personnel and optimizing operational effectiveness. The development of CR through optimized training transfer is essential for equipping military personnel to navigate the complexities of modern warfare, thereby bolstering the operational capabilities of the MA. CR is a key attribute that enables military personnel to engage in critical thinking, make rapid, informed decisions, and adapt to fluid and unpredictable operational environments. The seamless transfer of training to real-world scenarios is directly connected to the readiness of military personnel, ensuring they are well-prepared for deployment and able to perform effectively in complex missions.

This study employed a rigorous quantitative analysis using PLS-SEM to assess the relationship between training transfer and CR, with a particular focus on Tactical Cognitive Readiness (TCR). It examined the extent to which the knowledge and skills gained through training are applied in tactical-level operations. The thorough validation of the measurement model ensured the accurate representation of the constructs, while the structural model provided a clear understanding of the direct effects of training transfer on CR. The results demonstrated that effective training transfer significantly enhances CR, highlighting the critical role of practical, scenario-based training that replicates the complexities of real-world military operations.

These findings offer valuable guidance for the design of training programs that align with the cognitive demands of contemporary military operations. Emphasizing realistic simulations, reflective learning practices, and continuous feedback can bridge the gap between training and operational application, thus enhancing the preparedness and adaptability of military personnel. Future research should explore longitudinal studies and integrate objective performance metrics, such as mission outcomes or simulation evaluations, to gain a more comprehensive understanding of the long-term effects of training transfer on CR.

This study provides robust evidence of the importance of effective training transfer in fostering CR among military personnel. Ensuring that the KSA acquired during training is effectively applied in operational settings can significantly improve the readiness of military forces. Addressing the identified limitations and pursuing the proposed future research directions will further refine our understanding of the role of training transfer in preparing military personnel for the cognitive challenges of modern warfare. Such efforts are essential to ensuring that military organizations maintain high levels of operational effectiveness in increasingly complex global security environments.

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the official policy or position of the Malaysian Armed Forces (MAF), the Malaysian Army (MA), or the Malaysian Government.

Ethical Approval and Permissions

Permission for the participation of Malaysian Army personnel in this study was obtained from the relevant authorities within the Malaysian Army. The study was conducted following all guidelines and protocols set by the Malaysian Army to ensure compliance with ethical standards. All participants were informed about the study's purpose, procedures, and their rights before participating, and their informed consent was obtained voluntarily.

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Conflict of Interest: The author declares no conflict of interest.

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