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Educating Soldiers' Competencies Through Battlefield Simulation Systems

Svajone BEKESIENE[1*], **Linas VARŽINSKAS**[1]

[1] *General Jonas Žemaitis Miltitary Academy of Lithuania, Silo g. 5A, LT-10322 Vilnius*

*Correspondence: *svajone.bekesienel@lka.lt*

Abstract

The study analyses the development of soldiers' competencies using the Joint Conflict and Tactical Simulation (JCATS). The results of the linear regression analysis identified several key findings regarding the factors influencing competency development with JCATS. Technological knowledge (TEC) emerged as the most crucial component, followed by strategic thinking (STR), both showing significant positive influences. These competencies should be prioritized in training programs and skill development initiatives involving the JCATS simulator. Additionally, the number of training sessions completed (TST) highlighted the importance of practical experience and continuous learning. Although leadership skills (LED) did not reach statistical significance, they may still impact competency development in complex leadership scenarios or over the long term.
This analysis helps to identify where the Armed Forces should focus its resources to maximize the effectiveness of competency development with JCATS, emphasizing technological knowledge and strategic thinking as key areas for effective soldier development.

KEY WORDS: *training of military personnel; soldiers' competencies; JCATS systems; simulated combat scenarios; realistic and immersive training environment*

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1. Introduction

In the modern era, military operations have become increasingly complex and dynamic, necessitating continuous adaptation and improvement in training methodologies [1-7]. To ensure operational success and minimize casualties, it is more important than ever to provide advanced and specialized courses for military personnel. In this context, battlefield simulation systems have emerged as a crucial tool, offering soldiers a virtual platform where they can engage in realistic and intense exercises. Competent and well-prepared command personnel are essential, as they play a decisive role in decision-making, strategy formulation, and battlefield management [8, 9].

The importance of technology in military operations and training has grown with the ever-changing nature of modern conflicts [10-11]. Battlefield simulation systems have become a powerful tool among the technical innovations that have transformed military operations. These technologies offer soldiers a realistic virtual environment to train in a variety of operational scenarios and improve their tactical skills. In recent years, the use of battlefield simulation systems in military training has become very popular [12-16]. These devices reduce the risks associated with live ammunition and real combat scenarios, making them a safe and low-cost alternative to live training exercises. They allow soldiers to rehearse combat scenarios, enhance their skills and improve their decision-making abilities by providing a realistic and immersive training environment [17].

Battlefield simulation tools also make it easier for allied forces and the various branches of the military to conduct joint training and exercises [xx]. Military units can train together in virtual space, thus breaking down distance barriers and improving coordination, interoperability and promoting a better understanding of each other's capabilities and tactics. Battlefield simulation tools are also very helpful for the study and analysis of common strategies and tactics.

Commanders can assess the success of their strategies by simulating a wide range of scenarios and then make necessary adjustments. This process improves military doctrine, identifies problem areas and improves overall operational readiness.

However, it must be recognized that war simulation programs have limitations. The models of the simulation systems and the quality of the data used have a major impact on the accuracy and realism of the simulation programs. It can be difficult to accurately replicate complex real-world environments, and simulation technologies need to be continuously improved to ensure the highest level of fidelity.

Moreover, the effective training programs are essential to ensure that military personnel are equipped with the skills and knowledge needed to navigate this challenging environment. One of the most significant advancements in military training has been the development and implementation of battlefield simulation systems such as the Joint Conflict and Tactical Simulation (JCATS), provide a highly realistic and immersive training environment for military personnel. These systems arrange for soldiers with a virtual platform for realistic and intense exercises, enhancing their readiness for real-world combat scenarios. Also, the competence and preparedness of command personnel are paramount, as they play a decisive role in decision-making, strategy formulation, and battlefield management.

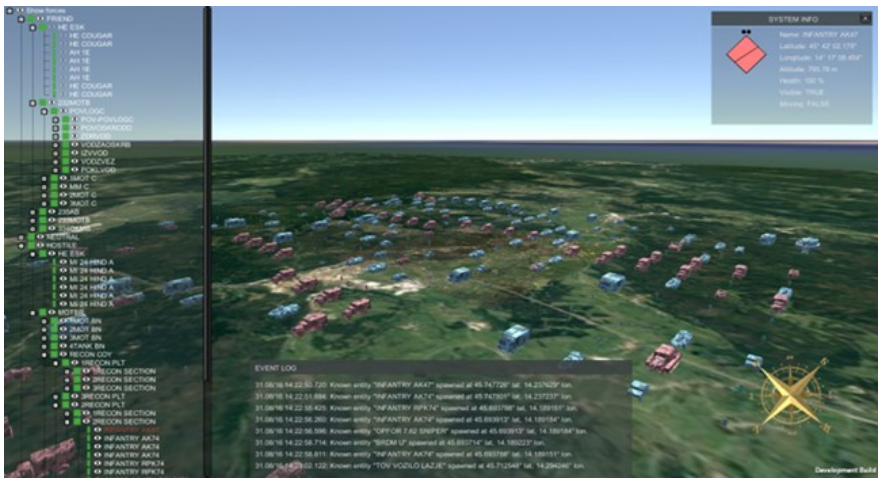

Fig.1. The Joint Conflict and Tactical Simulation (JCATS) system [18].

These advanced systems are designed to replicate real-world conditions as accurately as possible, offering soldiers a comprehensive platform to practice and refine their tactics and strategies. JCATS offer a highly realistic and immersive training environment [19-23]. These systems simulate real-world conditions, allowing soldiers to practice and refine their tactics and strategies in a controlled setting. JCATS, for example, can model diverse combat scenarios, including urban warfare, counter-insurgency operations, and large-scale conventional battles. This versatility ensures that military personnel are prepared for various types of engagements they might encounter.

In the contemporary background of military operations, characterized by complexity and rapid change, the necessity for advanced and specialized training is more pressing than ever. So, the study's primary objectives were to evaluate the impact of the JCATS simulator on soldier training and to provide recommendations for enhancing its effectiveness at the Combat Training Centre of the Lithuanian Armed Forces. By focusing on these areas, the study aimed to improve both the preparedness of soldiers and the productivity of the command staff. The findings and recommendations offer valuable insights into how simulation-based training can be optimized to meet the evolving needs of modern military operations.

2. Method of Investigation

2.1. Study Participants and Data Collection Method

The data collection process started in December 2023 and ended in January 2024. A total of 70 questionnaires were distributed and 61 valid questionnaires were obtained, with a recovery rate of 87.1%. Study participants were men (100%). Based on the information gathered on the respondents' length of service, the experience of the respondents varies from 5 years to 30 years. However, the vast majority, 39% of the respondents who completed the questionnaires, have "up to 5 years" experience. Those with the highest length of service and experience between 26 and 30 years' account for only 3%. The educational backgrounds of the survey respondents were quite diverse. Ten percent of the participants indicated that they have a Master's degree, while 34% of the Lithuanian Armed Forces personnel who participated in the JCATS exercise reported having a Bachelor's degree. This shows that more than a third of the personnel already have higher university education, demonstrating their academic knowledge and their ability to apply it in military activities. Meanwhile, 31% of the staff reported having completed secondary education, which is considered the initial requirement for a military career, indicating that this proportion of the staff meets the minimum level of education.

Prior to the start of the study, the security specialists were contacted and the study was authorized. Soldiers/respondents completed an electronically administered questionnaire, which was designed in accordance with the ethical requirements of the study. Before participating in the study, respondents were briefed on this study. They were given

a description of the purpose of the study, an explanation of the importance of the survey and an example of how to answer the questions in the questionnaire correctly. The survey adhered to the principle of voluntary participation, ensuring that all respondents were clearly informed that their involvement in the study was entirely optional. Additionally, the anonymity of the participants was rigorously maintained, with no personal identifiers being recorded, thus safeguarding the confidentiality of the respondents.

2.2. Study Design

One of the primary objectives of this research was to analyze the effectiveness of the JCATS (Joint Conflict and Tactical Simulation) system in developing soldiers' competences. According to scholars [24,25], military competencies are essential for enabling soldiers to perform their tasks efficiently and professionally [26-30]. This study identified several competencies that particularly benefit from improvement through the use of the JCATS simulation system.

The analysis focused on specific competencies grouped into two primary blocks: Block I related to the development of Commander's Individual Competences (CIC) and Block II related to Military Action Planning competences (MAP). Additionally, Block III consisted of statements regarding Continuous Professional Development (CPD) using JCATS.

Commander's Individual Competences (CIC) assessment includes six critical competencies essential for military personnel:

- Teamwork (q1). The ability to work effectively within a team, coordinating actions and communicating efficiently.
- Strategic Thinking (q2). The capacity to develop and implement long-term strategies to achieve mission objectives.
- Situational Awareness (q3). The skill to perceive, comprehend, and project the current and future status of the operational environment.
- Stress Management (q4). The ability to maintain performance and decision-making under high-pressure conditions.
- Technological Knowledge (q5). Proficiency in using advanced military technologies and understanding their applications.
- Critical Thinking (q6). The capability to analyze situations, identify problems, and devise effective solutions.

Likert's five-point scale was used to measure the statements, when 1 indicated 'did not improve at all' and 5 indicated 'has improved greatly'. The internal consistency of this block was evaluated by Cronbach's alpha coefficient which was 0.823.

Analyze the effectiveness of the JCATS according to warriors' Military Action Planning competences (MAP) assessment includes four critical competencies essential for military personnel:

- Tactical planning(q7), which involves the formulation and implementation of detailed plans to achieve specific objectives in a combat scenario. It requires a comprehensive understanding of the battlefield, resource allocation, and enemy capabilities.
- Decision making (q8). Decision making in a military context involves selecting the best course of action among various alternatives under conditions of uncertainty and pressure. Effective decision making is crucial for successful mission outcomes and operational efficiency.
- Personnel management (q9). JCATS supports personnel management by simulating scenarios that require effective coordination and management of troops. Soldiers can practice assigning roles, managing resources, and responding to personnel issues in real-time. The system provides a platform for testing various personnel management strategies and observing their impact on mission success.
- Leadership (q10). Leadership in the military context involves guiding, motivating, and directing troops to achieve mission objectives. Effective leadership is vital for maintaining discipline, morale, and operational success. JCATS enhances leadership skills by placing soldiers in command roles within realistic combat scenarios. The system challenges leaders to make critical decisions, communicate effectively with their teams, and inspire confidence under pressure. By simulating high-stress environments, JCATS helps soldiers develop the resilience and adaptability needed for effective leadership.

To measure these statements Likert's five-point scale was used, the 1 indicated 'did not improve at all' and 5 indicated 'has improved greatly'. The internal consistency of this block was evaluated by Cronbach's alpha coefficient which was 0.810.

Continuous Professional Development (CPD) and was focused on few aspects:

- *Ongoing Training*. JCATS supports continuous professional development by offering a platform for ongoing training and skill enhancement. This commitment to lifelong learning is essential for maintaining high standards of competence and readiness. So, this study was focused on training effect estimation to commander's regular participation in simulations to keep their skills sharp and stay updated on new tactics and technologies.
- *Performance Feedback*. JCATS provides detailed feedback on a commander's performance during simulations. Commanders can use this information to refine their skills, develop targeted training plans,

and track their progress over time. So, to evaluate the feedback is critical for identifying strengths and areas for improvement.

To assess warriors' CPD there were used six statements. The sample statements include 'Rate your overall experience of participating in JCATS exercises', 'Rate the JCATS feedback after the exercise', and others. The responses were recorded on a 10-point scale (1=very bad, 2, 3, 4, 5, 6, 7, 8, 9, 10=very good). The internal consistency of this block was evaluated by Cronbach's alpha coefficient which was 0.913.

2.3. Data Processing

Following the descriptive data analysis, a series of statistical tests were conducted to validate and explore the data. First was conducted the reliability testing, a crucial step in the validation of any survey or questionnaire-based research, was performed to assess the consistency and stability of the measurement instrument. This ensures that the instrument reliably measures the intended constructs. One of the most commonly used methods, Cronbach's alpha, was used for this purpose. This was used to calculate statistical coefficients to assess the internal consistency of each of the three sets of blocks used in the study, ensuring the reliability of the data collected.

Then, Kruskal-Wallis H test was used to identify statistically significant differences based on the frequency of training completion [31]. This non-parametric test was applied because the assumptions of one-way ANOVA were not met, and it helped in determining if there are significant differences between three independent groups.

Also, Exploratory Factor Analysis (EFA) was employed to identify latent factors within the data [32,33]. This technique used for uncovering the underlying structure for each of three blocks set of variables. This helped to reduce of data complexity and to identify clusters of related variables (factors). EFA helps in understanding the dimensions that the JCATS simulator influences.

Finally, a linear regression analysis was conducted to identify the key factors influencing competency development with JCATS [34,35]. This method helped in quantifying the relationship between dependent and independent variables, thus identifying which factors significantly contribute to the development of soldier competencies.

All statistical analyses were performed using SPSS Statistics software version 29.0. This comprehensive approach ensured a robust evaluation of the data, providing reliable insights into the factors affecting competency development through the JCATS simulator.

3. Study Results

3.1. Assessing the Effectiveness of the Use of JCATS by Three Blocks

Following descriptive analysis results on Commander's Individual Competences (CIC) block, can be stated that the greatest improvement was in the area of cooperation and teamwork (q1), with 66.7% of respondents reporting an improvement and 19% reporting a very large improvement, reflecting the JCATS exercise's focus on team tasks. Strategic thinking (q2) showed an improvement with 63% of respondents, and a very significant improvement with 30.4% of respondents, which may be due to the strategic planning requirements of the exercise. Situational awareness (q3) was improved in 48.6% of the respondents' opinion and very much improved in 32.4% of cases. These figures may reflect the effectiveness of the JCATS exercise in training soldiers to quickly assess and react to changing circumstances, which is necessary in real military conditions. Stress management competence (q4) improved in 54.5% of cases after the exercise with the JCATS system, while 29.5% of the respondents indicated that it improved a lot. Despite the positive overall effect, these figures also reveal that some of the soldiers did not experience a significant improvement in their stress management competence. Technological knowledge (q5) improved in 69.4% of respondents, but only 8.3% felt a significant improvement, reflecting the nature of the exercise, which focused more on general system use than on technological understanding. Critical thinking (q6) showed the smallest improvement after the JCATS exercise, with only 11.9% of respondents indicating a significant improvement and 40.5% indicating no improvement (see Table 1). This can indicate that the JCATS exercise may have focused less on scenarios that develop deeper critical thinking skills.

Table 1.
Commander's Individual Competences (CIC) block assessment results

Critical competencies	1 'did not improve at all'	2 'did not improve'	4 'improved'	5 'very improved'
Teamwork (q1)	0,0%	14,3%	66,7%	19,0%
Strategic Thinking (q2)	2,2%	4,3%	63,0%	30,4%
Situational Awareness (q3)	10,8%	8,1%	48,6%	32,4%
Stress Management (q4)	2,3%	13,6%	54,5%	29,5%
Technological Knowledge (q5)	2,8%	19,4%	69,4%	8,3%
Critical Thinking (q6)	11,9%	28,6%	47,6%	11,9%

The warriors' Military Action Planning competences (MAP) block assessments show that the JCATS exercise had a positive effect on the tactical planning (q7) competencies, with 71.8% of respondents indicating an improvement, which

may be due to the tactical tasks performed in the exercise, which require in-depth planning. Decision-making (q8) improved for 60.5% of respondents, reflecting the exercise's ability to simulate situations that encourage quick problem solving. Personnel management (q9) improved for 61.1% of respondents, but did not improve for 30.6% of respondents, suggesting that the conditions of the JCATS exercise did not provide sufficient opportunities for all participants to improve their personnel management skills. Improvement in leadership and management skills (q10) was mixed during the JCATS exercise although 55.6% experienced an improvement, it is important to note that 33.3% of respondents indicated no improvement in these competencies (see Table 2). This suggests that despite the many successful cases where this competency has improved, leadership skills development in virtual environments still faces challenges that prevent all individuals from experiencing the desired growth in competencies.

Table 2.
The warriors' Military Action Planning competences (MAP) block assessment results

Critical competencies	1 'did not improve at all'	2 'did not improve'	4 'improved'	5 'very improved'
Tactical planning(q7)	10,3%	10,3%	71,8%	7,7%
Decision making (q8)	7,0%	16,3%	60,5%	16,3%
Personnel management (q9)	5,6%	25,0%	61,1%	8,3%
Leadership (q10)	5,6%	33,3%	55,6%	5,6%

Continuous Professional Development (CPD) and was focused on six statements evaluation (see Table 3). Analysis of the JCATS exercise experience shows that the use of technology in the training context (q11) was favorably received, with 36.1% of respondents giving a score of 7-8, indicating the usual level of satisfaction with this training tool. Realism (q12) is also highly rated, with 26.2% of respondents scoring 9, suggesting that JCATS provides a realistic learning environment. Effectiveness when comparing JCATS with other training methodologies (q13) was rated quite mixed, with 16.4% of respondents scoring 9, which may reflect the advantages of JCATS in the simulation of complex operations and in the integration of hands-on training. However, 21.3% of respondents rated this area as a 6. This may indicate that although JCATS is perceived as a useful training tool, it may not be fully meeting the expectations of some soldiers, or may not always be effective compared to traditional training methodologies. The feedback following the JCATS exercise (q14) received generally positive feedback, with 36.1% of respondents rating it as 7-8, which may indicate a valuable feedback approach that encourages the learning and improvement process during the exercise. The overall experience of participating in the JCATS exercise (q15) received mixed ratings, but 21% of respondents gave it a score of 8. This indicates that a proportion of respondents were very positive about their learning experience with the system, reflecting the ability of the JCATS exercise to provide a meaningful and memorable learning experience. The use of the JCATS system for training purposes (q16) received mostly moderately positive ratings, with 18% of the respondents giving a score of 8, indicating that the system was an effective tool for training.

Table 3.
Continuous Professional Development (CPD) block assessment results

Statements	1 very bad	2	3	4	5	6	7	8	9	10 very good
Rank JCATS as a technological tool (q11)	0,0%	0,0%	0,0%	3,3%	8,2%	21,3%	36,1%	11,5%	8,2%	11,5%
Rank realism of JCATS simulation (q12)	0,0%	0,0%	3,3%	9,8%	8,2%	11,5%	34,4%	26,2%	4,9%	1,6%
Effectiveness of JCATS compared to other training methodologies (q13)	0,0%	0,0%	6,6%	4,9%	11,5%	21,3%	29,5%	9,8%	16,4%	0,0%
Rank feedback provided by JCATS (q14)	1,6%	3,3%	6,6%	1,6%	9,8%	19,7%	26,2%	16,4%	6,6%	8,2%
Rank Overall experience after JCATS exercise (q15)	0,0%	0,0%	1,6%	3,3%	8,2%	19,7%	24,6%	21,3%	14,8%	6,6%
Rank use of JCATS for training purposes (q16)	0,0%	1,6%	1,6%	1,6%	9,8%	13,1%	37,7%	18,0%	6,6%	**9,8%**

To summarise the results of the descriptive statistical analysis, it can be observed that the investigation of the data from blocks CIC and MAP shows that respondents indicated that some competences were more improved after the JCATS exercise. Reviewing the results of the CIC block, it can be seen that more than half (66.7%) respondents felt that their teamwork (q1) had improved, while 19% agreed that they felt a significant improvement. These findings suggest that the JCATS exercise effectively develops team situations, which are essential in military activities, as it promotes collaborative skills. Meanwhile, technological knowledge (q5) is also being developed using JCATS according to the respondents, as even 69.4% of the respondents indicated that their knowledge has improved and 8.3% improved a lot in the case which may

indicate that JCATS as a training platform, although it is more focused on teaching practical skills and procedures, is also helping the soldiers to develop their technological competencies.

Moreover, data from block MAP shows that tactical planning skills (q7) improved for 71.8% of respondents, indicating that JCATS exercises provide realistic situations that develop these important military leadership skills. On the other hand, while personnel management (q9) improved in 61.1% of cases, but the 30% of respondents indicated that they did not experience any improvement, which may indicate that virtual exercises do not always provide a sufficiently realistic environment for the development of personal management skills, which often require the direct involvement and interaction of people. These statistics can be explained by the individual learning styles of the participants and the specific way in which each competency is incorporated into the training exercise. JCATS, as a technological tool, can be very effective in developing certain competences, but others require additional support or other training strategies.

In addition, the data analysis in block CPD reflect that the effectiveness of the JCATS exercise is rated favorably, but unevenly in different areas. The use of technology in teaching (q11) received 36.1% of positive ratings, while realism (q12) emerged with 26.2% of the highest scores. An area where JCATS could be improved is in its comparison with other teaching methodologies (q13), as even 21.3% gave it only 6 points. Feedback (q14) and overall experience (q15) are viewed positively, with 36.1% and 21% of respondents giving scores of 7-8 respectively, indicating a strong learning experience. Use for training purposes (q16) is rated moderately positive, with 18% giving a score of 8, but the variety of feedback indicates that there is room for improvement in the use of the system. Therefore, the data in block CPD indicate successful areas of JCATS practice and potential areas for improvement.

3.2. Kruskal-Wallis H Test to Assess Differences in Respondents' Views on Competence Changes

In the analysis of the change in soldiers' competences when the JCATS simulation system is used to develop soldiers' competences, the level of competences achieved by the simulation system user was evaluated in terms of the number of exercises participated. Therefore, in this study, the initial assessment of competences was the soldier's proficiency after the first exercise with JCATS.

These perceived skills were compared with those acquired after more than one exercise, which helped to determine the impact of the simulation system in increasing soldiers' competences. Based on the Kruskal-Wallis H test data provided, an analysis was made of how the respondents rated the improvement in the CIC block competencies (Teamwork, Strategic Thinking, Situational Awareness, Stress Management, Technological Knowledge, Critical Thinking) in relation to the amount of training they had received with the JCATS system (see Table 4).

Table 4.

Kruskal-Wallis H test results for block CIC

Competences	Mean Rank			Kruskal-Wallis H Assim. Sig. (p-value)
	1 training	2-4 training	More than 5 trainings	
Teamwork (q1)	29,76	29,00	40,63	0,222
Strategic Thinking (q2)	27,86	32,70	42,75	0,069
Situational Awareness (q3)	29,54	32,23	35,63	0,604
Stress Management (q4)	29,99	31,27	35,31	0,724
Technological Knowledge (q5)	32,66	28,90	27,06	0,584
Critical Thinking (q6).	27,45	32,73	44,63	0,025

Considering the highest mean rank (MR=40.63; see Table 4), soldiers who have participated in 5 or more exercises agree that the competence Teamwork (q1) is successfully developed in relation to the number of exercises they have had. Only those who have participated in one exercise cannot yet confirm this, as the assessment of the acquired competence Teamwork (q1) after the first exercise is lower (MR=29.76; see Table 4).

Similarly, the other acquired competences 'Strategic thinking' (q2) and 'Situational awareness' (q3) are the highest rated (MR=42.75 and MR=35.63; see Table 4) among respondents who have participated in 5 or more exercises. "Stress management" (q4) also shows the highest average rank (MR=35.31; see Table 4) only in the "More than 5 trainings" group, while "Technological knowledge" (q5) has the lowest average rank (MR=27.06; see Table 4), showing that frequent participation in exercises does not always guarantee a high ranking for this competence.

Finally, Critical Thinking (q6) has the highest mean rank (MR=44.63; see Table 4) among respondents who have participated 5 or more times in the exercises, highlighting the importance and benefits of repeated participation in the exercises for the development of the different competences.

Moreover, the critical thinking, which can be described as an important intellectual skill for a soldier, is essential for a leader, as it requires him not only to understand the available information, but also to evaluate and analyse critical situations and make the right decisions. As soldiers in the army are often faced with complex and unpredictable situations that need to be managed quickly and effectively, they must make quick and correct decisions. Therefore, the statements in block MAP were evaluated in the light of the respondents' experience with the JCATS system after their first exercise and after more than five exercises. The results of the study helped to confirm that more exercises have a greater impact on the critical thinking of soldiers (see Table 5).

Table 5.

Kruskal-Wallis H test results for block MAP

Competences	Mean Rank			Kruskal-Wallis H Assim. Sig. (p-value)
	1 training	2-4 training	More than 5 trainings	
Tactical planning(q7)	27,26	32,23	46,44	0,010
Decision making (q8)	27,20	33,20	44,94	0,021
Personnel management (q9)	29,87	32,03	34,44	0,751
Leadership (q10)	28,75	34,07	35,94	0,389

The competency "Tactical planning" (q7) is best acquired after "More than 5 trainings" in terms of the highest mean rank (MR=46.44; see Table 5), as the mean rank of those respondents who participated in only one exercise is statistically significantly lower (MR=27.26; see Table 5). Meanwhile, when it comes to the success of the competency "Decision-making" (q8), the study reveals that the highest average rank (MR=44.94; see Table 5) is again found among those who have participated in five or more exercises, when compared to the lowest average rank (MR=27.20; see Table 5), which is found among those who have participated in only one exercise. The study also confirms the dependence of the increase in the competency "Personnel management" (q9) on the number of exercises, from MR=29.87 (see Table 5) for those who have participated in one exercise to MR=34.44 (see Table 5) for those who have participated in five or more exercises. However, this increase is not considered statistically significant based on the p-value of the Kruskal-Wallis test (p=0.751; see Table 5). A similar situation is found for the competency 'Leadership' (q10), although the study shows an increase in rank from MR=28.75 (see Table 5) in one exercise to MR=35.94 (see Table 5) in five or more exercises, but this difference is not statistically significant, as shown by the p-value of the Kruskal-Wallis test (p=0.389; see Table 5).

3.3. Linear Regression Modelling Results

To identify the latent factors characterizing the individual commander's skills developed using JCATS, an Exploratory Factor Analysis (EFA) was conducted. The EFA results, supported by Bartlett's test ($p < 0.001$) and a Kaiser-Meyer-Olkin (KMO) measure greater than 0.6, confirmed that the block CIC, consisting of six statements assessing the effectiveness of JCATS in developing commanders' individual skills in the Lithuanian Armed Forces, met the necessary statistical requirements. The analysis revealed that 67.7% of the variance in the extracted factors was explained by two latent factors, which were identified as crucial for the development of a commander's individual abilities: Strategic Thinking (STR) and Technological Knowledge (TEC).

Additionally, an EFA was conducted on the MAP block, comprising four statements, to evaluate the effectiveness of JCATS in developing military action planning competencies within the LMF. The EFA results confirmed that the MAP block meets the necessary statistical requirements. The analysis revealed that 78.9% of the variance in the identified factors is explained by two latent factors, which are crucial for the development of a commander's individual competencies: Tactical Planning (TAP) and Leadership (LED). As well, the EFA and Continuous Professional Development (CPD) block of six statements was administered to assess the competences acquired after the JCATS exercise in the light of the respondents' experience. The study showed that 80.52% of the variance in the extracted factors was explained by two latent factors determining the commander's individual competencies in the development: Exercise Effectiveness (EFF) and Feedback (FDB).

Table 6.

Coefficients of the JCATS competency development efficiency improvement Model

Variables	Unstandardized coefficients		t – value	Sig. p –value	95% Confidence Interval		Importance (IMP)
	β	Standard Err.			Lower	Upper	
Intercept	-0,058	0,285	-2,032	0,047	-1,153	-0,007	
TEC	0,360	0,113	3,190	0,002	0,133	0,586	0,433
STR	0,290	0,121	2,397	0,020	0,047	0,533	0,245
TST	0,064	0,028	2,286	0,026	0,008	0,120	0,223
LED	0,179	0,117	1,529	0,132	-0,056	0,414	0,100

Notes: TEC – Technological Knowledge; STR – Strategic Thinking; TST – how many times the training has been completed; LED – Leadership.

Based on the data provided on the factors influencing the effectiveness of commander's individual competencies EFF (Exercise Effectiveness with JCATS), a linear regression analysis was performed. The aim of the model was to assess how strategic thinking (STR), technological knowledge (TEC), tactical planning (TAP), leadership (LED), and how many

times the training has been completed (TST) influence the effectiveness of competency development with JCATS (EFF) and feedback (FDB). The constant in the model is statistically significant (β = -0.058; $p<0.05$, see Table 6). The competency 'Technological knowledge' (TEC) with a coefficient $\beta = 0.360$ and a p-value = 0.002 was found to be the strongest positive performance factor with the highest influence (IMP = 0.433, Table 6) on the improvement of the effectiveness of soldier competency development with JCATS (see Table 6).

Additionally, the competency 'Strategic thinking' (STR) with a coefficient of 0.290 and a INF of 0.245; and 'Time spent on exercises' (TST) with a coefficient of $\beta = 0.064$ ($p = 0.026$) were also confirmed as significant factors. However, "Leadership Skills" (LED), despite a positive trend, was not statistically significant ($\beta=0.179$; $p=0.132$), indicating that LED does not have a direct influence on the effectiveness of competence development with JCATS. The model predicts the most important areas to focus on when training soldiers to improve the effectiveness of competency development with JCATS.

A multicriteria regression model is constructed that reveals a linear relationship between the factors influencing the effectiveness of competence development and the improvement of the effectiveness of the use of JCATS. The model can be expressed by the equation:

Effectiveness of competence development with JCATS = -0.058 + 0.360 × TEC + 0.290 × STR + 0.064 × TST+ 0.179 × LED

Technological Knowledge (TEC), with the highest level of significance (IMP = 0.433, Table 6) and a statistically significant p-value ($p = 0.002$), emerged as the most significant factor for the effective enhancement of soldiers' competencies in JCATS exercises. Strategic Thinking (STR) and how many times the training has been completed (TST) also contribute significantly to the effectiveness, albeit with slightly lower influences (STR: IMP = 0.245; TST: IMP = 0.223, Table 6). Although Leadership (LED) does not reach the threshold of statistical significance in the model, it exhibits a positive trend (IMP = 0.100, Table 6), indicating potential importance for future research and the development of effective strategies for enhancing soldier competencies.

4. Conclusions

The results of this study suggest that more frequent exercises with the JCATS system can contribute to a more effective development of soldiers' competences, especially in the areas of tactical planning and decision-making. The statistically insignificant change in the number of exercises conducted in the development of competences in personnel management and leadership shows that these areas require additional methods or skill development beyond the limits of virtual exercises.

From the linear regression analysis carried out to investigate the factors influencing the effectiveness of competency development with JCATS, a number of key findings emerge. First, technological knowledge (TEC) appears as the most important component of effective soldier competence development with JCATS, while strategic thinking (STR) also shows a significant positive influence. These two competences, given their statistical significance, should be priorities in training programs and skill development initiatives when a JCATS simulator is chosen for soldier development. Next, variable that indicated how many times the training has been completed (TST) showed that practical experience is also important, which highlights the significance of continuous learning and development of practical experience when working with JCATS. Also, despite the fact that leadership skills (LED) appears not statistically significant in this model, it may still have an impact, especially in more complex leadership scenarios or as an aspect of long-term development.

Finally, this analysis helps to identify where the Army should focus its resources to maximize the effectiveness of soldiers' competency development with JCATS, as it shows that technological knowledge and strategic thinking are key competencies that are essential for effective soldier development.

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