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The Development of Intelligent Tutoring System in The Military Schools

Bobi Kurniawan[1,], Meyliana[2], Harco Leslie Hendric Spits Warnars[2], Bambang Suharjo[3]*

[1]Faculty of Engineering and Computer Science, Universitas Komputer Indonesia, Bandung 40132, Indonesia
[2]Computer Science Department, BINUS Graduate School-Doctor Computer Science,
Bina Nusantara University, Jakarta 11480, Indonesia
[3]Mathematics, Universitas Pertahanan, Jakarta 11480, Indonesia
Correspondence: E-mail: bobi@email.unikom.ac.id

ABSTRACT

The rapid and fast development of technology affects many aspects of life, especially in the field of education. The application of technology in education is needed to support a more effective and efficient learning process without any space and time constraints. An example is the implementation of the Intelligent Tutoring System (ITS) which is often known as an intelligent learning system. An ITS in the field of military education is needed to produce professional military graduates/HR. Therefore, researchers will examine trends in research development and updates on ITS technology in the military field. Efforts to achieve research objectives are carried out using the Systematic Literature Review method with bibliometric analysis or VOSviewer. The purpose of this study is to become a reference for determining research topics on ITS in the field of education, especially the military.

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1. INTRODUCTION

The rapid development in the world of technology has affected various aspects of life, especially in the field of education. The application of technology in the field of education is needed to support a more effective and efficient learning process without any space and time constraints. An example is the application of an Intelligent Tutoring System (ITS) or often known as an intelligent learning system. The ITS is a computer-based application that has intelligence in understanding the unique characteristics of students and can perform tutor functions according to the student's character (Samuelis, 2007).

The ITS has been used to meet students' learning needs, namely performing tutoring functions for students (presenting what material/information they need to learn, assigning assignments, and providing direct feedback to students) which is packaged in the form of interactive applications that utilize artificial intelligence technology. The ITS is a function of tutors who can interact with students, know how to teach, and the material being taught (Budianto & Yuana, 2019). According to Paladines, the ITS is a system that can be adaptive to students, exchange control with students, and have domain knowledge. In addition, the ITS architecture must consist of four modules, namely communication, tutorials, students, and experts (Paladines & Ramirez, 2020).

Universitas Pertahanan Indonesia (UNHAN) is a higher education institution that focuses on defense studies. The Indonesian Defense University provides extensive opportunities for TNI officers and civilians to learn and deepen defense science from military, economic, political, social, and cultural angles. Acting as a higher education institution in the military field, UNHAN must always follow the trend of technological developments in the field of education. Changes in learning patterns are needed by utilizing technological developments, especially ITS. This technology can be used. Thus, the pattern of education at UNHAN becomes more efficient and effective to produce better quality graduates in the military field. Susilaningsih in his research revealed that the development trend of design in military training in America is very meaningful for long-term investment to acquire the necessary skills and knowledge in the military field (Susilaningsih, 2017). The application of e-learning in the Australian Army is important to be aligned with the organizational culture and needs of students (Newton & Ellis, 2005).

Based on the description above, it is still very open for research on ITS in the field of military education. Therefore, researchers will study with the aim of research to find out trends in research development, state of the art, and updates to ITS technology in the military field. Efforts to achieve the research objectives were carried out using the Systematic Literature Review method with bibliometric analysis. This method is defined as a process to find out, identify, and assess all publication results found to provide answers to research questions (RQ) specifically. Bibliometrics is a literature study that is used to examine a research trend based on indexing databases to view maps of scientific developments and mapping in specific scientific fields, and also to describe in detail the period of publication, the number of articles, and the maps and graphs contained in the articles. which has been published (Tupan et al., 2018). Mapping visualization can help researchers to better understand the topic of the science being studied. The software used to visualize the mapping in this study is VosViewers. It is hoped that this research can explore and find trends in ITS research in the military field, find trends in models used, and can be published in reputable international journals.

There are many reports regarding bibliometric analysis (Al Husaeni & Al Husaeni, 2022; Al Husaeni & Munir, 2023; Al Huseni & Nandiyanto, 2022a; Al Husaeni & Nandiyanto, 2022b; Al Husaeni *et al*., 2023; Al Husaeni, 2022; Al Husaeni & Nandiyanto, 2023a; Al Husaeni &

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Nandiyanto, 2023b; Al Husaeni *et al*., 2023; Bilad, 2022; Fauziah & Nandiyanto, 2022; Firdaus *et al*., 2023; Hamidah *et al*., 2020; Hirawan *et al*., 2022; Hizqiyah *et al*., 2022; Husain *et al*., 2023; Kurniati *et al.,* 2022; Luckyardi *et al*., 2022; Maryanti *et al*., 2022; Misbah *et al*., 2022; Misbah *et al*., 2022; Mudzakir *et al*., 2022; Mulyawati & Ramadhan, 2021; Nandiyanto *et al*., 2023a; Nandiyanto *et al*., 2021; Nandiyanto & Al Husaeni, 2022; Nandiyanto & Al Husaeni, 2021; Nandiyanto *et al*., 2020; Nandiyanto *et al*., 2023b; Nandiyanto *et al*., 2022a; Nasrudin *et al*., 2022; Nordin, 2022a; Nordin, 2022b; Nugraha & Nandiyanto, 2022; Ragadhita & Nandiyanto, 2022; Riandi *et al*., 2022; Ruzmetov & Ibragimov, 2023; Sahidin *et al*., 2023; Santoso *et al*., 2022; Saputra *et al*., 2022; Setiyo *et al*., 2021; Shidiq, 2023; Shidiq *et al*., 2021; Soegoto *et al*., 2022; Solehuddin *et al*., 2023; Sudarjat *et al*., 2023; Sukyadi *et al*., 2023; Utama *et al*., 2023; Wiendartun *et al*., 2022; Wirzal & Putra, 2022).

2. METHODS

This study uses the Systematic Literature Review (SLR) method which has four objectives, namely identifying, reviewing, and evaluating the literature published to date related to the ITS in the Army. The research discussed in this Systematic Literature Review considers literature published from 1993 to 2022. By searching the databases of the five digital libraries including IEEEXplore Digital Library, ACM Digital Library, Emerald, Taylor & Francis Group, and Semantic Scholar using keywords: ITS for Military. In data collection, there are various kinds of documents such as Articles, Book Chapters, Conferences, Journals, and Technical Reports. Therefore, the researcher filtered the results of keyword searches in each relevant title in the entire database and re-screened by reading the abstracts of each article to find relevance or connection with the research objectives or not. Screening results are stored in RIS format which will be used in the VOSViewers software for analysis. Can be seen in **Figure 1** via VOSViewers displays a bibliometric map in an easy way to interpret a relationship.

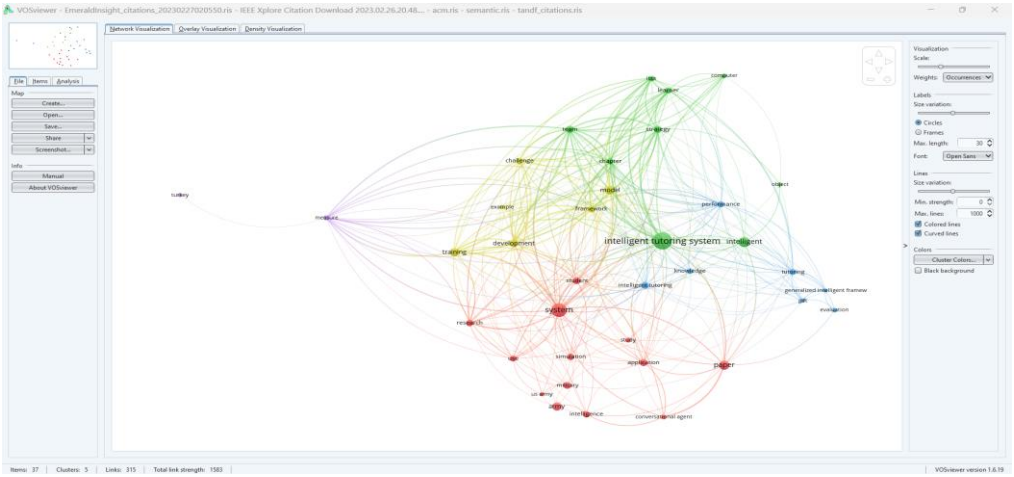

Figure 1. VOSviewer Visualization Results.

3. RESULTS AND DISCUSSION

3.1. Systematic Review Planning

In this phase, we identified the research questions to be asked. Research Question is the initial part of the Systematic Literature Review which is useful to help the process of searching and extracting literature. Some research questions were used in this study.

(i) RQ1: Trends in ITS in the Military Field from Year to Year?
(ii) RQ2: research topics that have been used for ITS technology in the military?

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3.2. Systematic Review Execution

This stage is a literature search on five digital library sources to obtain the evaluation results of studies that have been obtained by considering exclusion and inclusion. By searching the databases of the five digital libraries including IEEEXplore Digital Library, ACM Digital Library, Emerald, Taylor & Francis Group, and Semantic Scholar using keywords: ITS for Military. In data collection, there are various kinds of documents such as Articles, Book Chapters, Conferences, Journals, and Technical Reports. The search data obtained amounted to 421 "Studies Found" using the inclusion criteria, then after being reviewed by reading titles relevant to the topic sought, 64 "Candidate Found" were obtained. The results were again filtered according to exclusion criteria. Thus, in the end, 35 “Selected studies” were obtained as a whole which can be seen in **Table 1**.

Table 1. Paper Extraction Data.

Database	Studies Found	Candidate Studies	Selected Studies
Emerald	117	25	1
IEEE	9	0	0
ACM	154	0	0
Semantic	41	37	33
Taylor & Francis	100	2	1
Total	**421**	**64**	**35**

3.3. Development of The Publications on the ITS for The Military for 1993-2022

The development of publications on the topic of ITS for the Military fluctuated from 1993 to 2022. **Table 2** shows the highest number of publications relevant to the topic of ITS for the Military was in 2005, 2014, and 2017, namely 4 literature per year or as many as 11.4 %.

Table 2. Development of ITS for Military Publication.

Year	Total Publications	Percentage (%)
1993	1	2.9
1995	1	2.9
1997	2	5.7
1998	1	2.9
2000	1	2.9
2001	1	2.9
2002	1	2.9
2004	1	2.9
2005	4	11.4
2006	2	5.7
2013	1	2.9
2014	4	11.4
2015	3	8.6
2016	1	2.9
2017	4	11.4
2018	3	8.6
2019	2	5.7
2020	1	2.9
2022	1	2.9
Total	**35**	**100.0**

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Figure 2 shows the highest number of publications regarding ITS research in the Military in 2005, 2014, and 2017 as many as 4 literature each year. This proves that research on the ITS for the Military is still small.

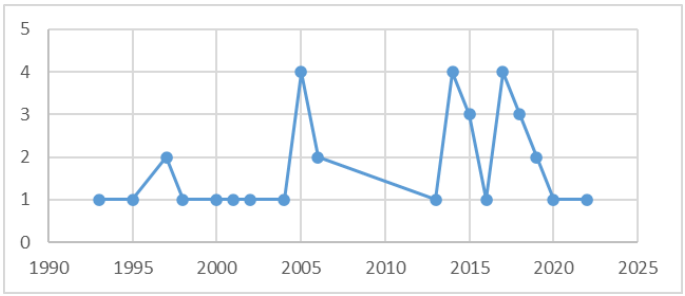

Figure 2. ITS for Military Publications.

3.4. Number of Selected Publications Based on Publication Type

Figure 3 shows the number of studies based on the type of publication. Most of the publications are published in journals as many as 17 papers (47%). Other papers published in conferences were 10 papers (18%), technical reports were 5 papers (14%), articles were 2 papers (5%), and 2 papers (6%) were from book chapters.

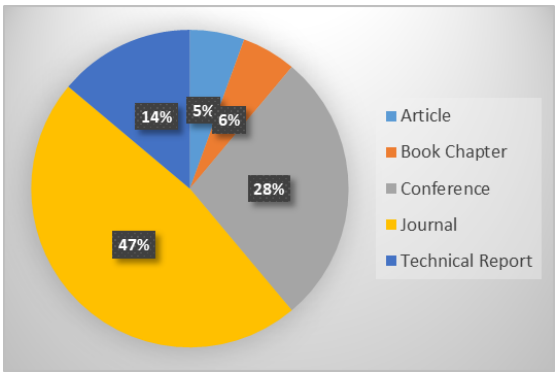

Figure 3. ITS for Military Publication-Based Publication Type.

3.5. Development of The Number of Selected Publications by Country

Figure 4 shows the geographic distribution of the selected papers. Most of the 23 papers (64%) were published in the United States. Other public publication countries are Indonesia with 4 papers (11%), Australia with 1 paper, and 8 papers (22%) of unknown geographic origin. This shows that ITS research in the military field has gained research interest in various countries.

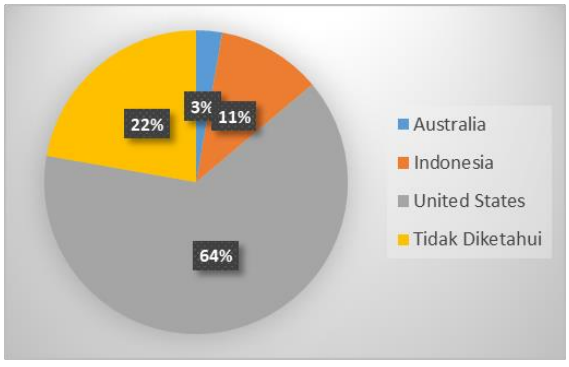

Figure 4. ITS for the Military Publication-Based Country.

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3.6. Development of the Number of Selected Publications Based on Research Topics

Figure 5 shows several research topics presented from selected papers. Most of them discussed ITS as many as 18 papers (14%). Other topics such as learning models, military technology, and GIFT tutors with 3 papers (9%), NLP with 2 papers (6%). In addition, the topic of e-learning, higher education, and smart campus is 1 paper (3%).

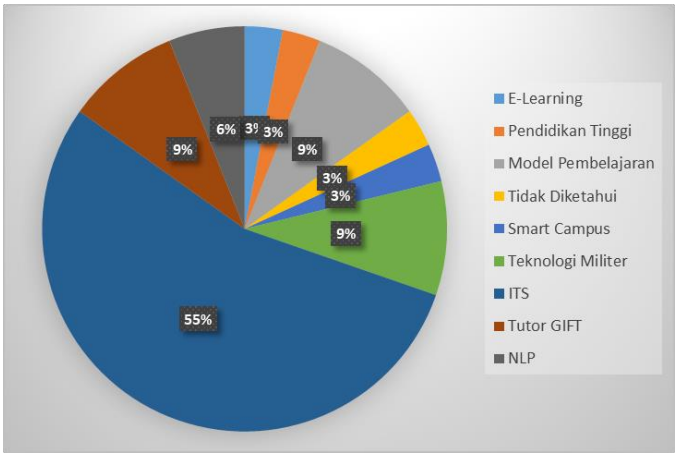

Figure 5. ITS for the Military-Based Topic.

3.7. Information Extraction from Selected Studies on The Topic of ITS for Military

Table 3 shows the studies selected in this systematic literature review, as well as information on the research that has been selected. The order of the study does not determine its importance regarding the purpose of this study.

Table 3. The General Perspective of Selected Studies.

Author	Title	Topic	Publication Year
Kaplan *et al.*	The military language tutor (MILT) Program: An advanced authoring system	Development of a dialogue learning system that uses Arabic as a base and Spanish as an addition	1998
Tafazoli *et al.*	A Description of BRIDGE, An Army Research Institute-Sponsored, NLP-Based, Foreign Language Tutor	Developing a tutor learning system that can detect language and then categorize any mistakes made by students and extensions to other languages.	2019
Newton & Ellis	Effective implementation of e-learning: A case study of the Australian Army	Identify factors influencing the implementation of e-learning in the context of Australian Army training.	2005
Wang et al.	Using augmented reality to tutor military tasks in the wild	Testing the use of augment-reality-based adaptive guidance systems for teaching in the wild, in locations where there is no formal training infrastructure, and identifying challenges that arise when developing such systems	2020
Brawner et al.	Adaptive Intelligent Tutoring System (ITS) Research in Support of the Army Learning Model-Research Outline	Inform and educate stakeholders, and focus potential collaborators on relevant issues within the adaptive guidance research space.	2017

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Table 3 (Continue). The General Perspective of Selected Studies.

Author	Title	Topic	Publication Year
Boyce *et al.*	Effect of topography on learning military tactics-integration of Generalized Intelligent Framework for Tutoring (GIFT) and Augmented Reality Sandtable (ARES)	Integrate a common intelligent framework for Tutoring and ARES Augmented Reality Sandtable in military tactic assessment.	2019
Tecuci *et al.*	Personal cognitive assistants for military intelligence analysis: Mixed-initiative learning, tutoring, and problem solving	Presenting current research on the development of a new type of cognitive assistant, called Disciple-LTA, which helps an intelligence analyst to systematically solve complex intelligence analysis tasks faster and better, an assistant who learns and uses analyst-preferred problem-solving strategies, biases and assumptions, but can also constructively challenge them and consider alternative scenarios	2018
Phillips *et al.*	Sketching as a Modality in Intelligent Tutoring Systems	Integrating sketch worksheets into GIFT as a new type of learning media	2020
Šarić-Grgić *et al.*	Intelligent Tutoring for Team Training: Lessons Learned from US Military Research	Application (ITS) in training military teams	2019
Jeanine *et al.*	Conscientiousness, Honesty-Humility, and Analogical/Creative Reasoning: Implications for Instructional Designs in Intelligent Tutoring Systems	Preliminary results from the current study to understand what factors, tools, and methods help individual military and civilian medical personnel accelerate their medical problem-solving expertise.	2019
Best & FLTLT	Intelligent Tutoring Systems (ITSs): Advanced Learning Technology for Enhancing Warfighter Performance	The introduction of ITS is intended for a broad military training, simulation, and education community.	2018
Mousavinasab	Distributed Interactive Intelligent Tutoring Simulation	The development of the developed simulation-based intelligent guidance system has three components, a simulator that allows trainees to assume the role of a firefighting team leader and direct a four-person firefighting team in the task of cleaning the building, and an intelligent tutor who assesses the trainee's actions in the simulator, determines whether corrective instructions are needed, and directs the simulator to provide those instructions as well as a generic unified knowledge structure (INKS) that serves as an expert problem-solving model.	2021

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Table 3 (Continue). General Perspective of Selected Studies.

Author	Title	Topic	Publication Year
John & James	The Virtual Schoolhouse	Integrate the DIS system with ITS in building an army infantry troop training system and firefighting team leader skills needed to cooperatively conduct military operations in urban terrain (MOUT)	1997
Poland *et al.*	Intelligent Simulation-Based Tutor for Flight Training	Application of AIS-IFT in the design of army visual authoring in flight training	2018
Zahabi *et al.*	Towards Detection of Engagement and Affect in a Simulation-based Combat Medic Training Environment	Research is in an ongoing effort to build sensor-free trainee influence and behavioural engagement detectors for vMedic, immersive software used to train military trainees in combat medical field procedures.	2020
Sandeep *et al.*	An intelligent tutoring system for simulator-based helicopter flight training	the use of ITS on how to use helicopters (manoeuvres)	1995
Mock *et al.*	An Intelligent Tutoring Simulat ion for Military Operations in Urban Terrain	The application of ITS by combining 2 learning methods according to student needs. Description: The ITS concept by combining 2 learning methods according to student needs consists of three components including expert problem-solving models, student models and pedagogic models.	2018
Brawner *et al.*	An Evaluation of the Generalized Intelligent Frame work for Tutoring (GIFT) from a Learner's Perspective	application of ITS for military training and using GIFT tutoring	2019
Biswas *et al.*	An Evaluation of the Generalized Intelligent Frame work for Tutoring (GIFT) from a Researchers or Analysts Perspective	application of ITS for military training and using GIFT tutoring	2019
William, 2006	Intelligent Tutoring Systems fo r Commercial Games: The Virtual Combat Training Center Tutor and Simulation	the application of ITS for the military using AI and by using Virtual technology	2006
Brant *et al.*	Software Instrumentation for Intelligent Embedded Training	use of ETS (Embed Training System) in the military	2001
Debbie *et al.*	Authoring adaptive tutors for simulations in psychomotor skills domains	ITS approach uses an AI model with a psychometrical domain	2017
William *et al.*	Intelligent Tutoring Systems for Commercial Games: The Virtual Combat Training Center Tutor and Simulation	Commercial Game Development intended for combat training simulation or can be called Virtual Combat Training Center (V-CTC)	2006

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Table 3 (Continue). The General Perspective of Selected Studies.

Author	Title	Topic	Publication Year
Fletcher & Kulik	Effectiveness of Intelligent Tutoring Systems: A Meta-Analytic Review	Assess the effectiveness of training military members using ITS and compare it with training using human guides	2015
Robert	Fundamentals of Adaptive Intelligent Tutoring Systems for Self-Regulated Learning	Identify how the work and technology environment of Intelligent Tutoring Systems (ITS) work towards the concept of Self-Regulated Learning (SRL).	2015
Domeshek	Intelligent Tutoring System for Teaching Battlefield Command Reasoning Skills - Phase I Final Report	Presenting the development concept of Intelligent Tutoring Systems for learning the capabilities of war zones.	2002
Goldberg *et al.*	Modelling Expert Behaviour in Support of an Adaptive Psychomotor Training Environment: a Marksmanship Use Case	presentation of validation methodologies and procedures for creating expert model representations in the domain of rifle marksmanship, using GIFT and U.S. Army marksmanship simulators.	2017
Robert	Challenges in Moving Adaptive Training & Education from State-of-Art to State-of-Practice	Adaptive training and education (ATE) systems are systems that combine intelligent guidance system (ITS) technology with external training and education, such as serious games, virtual humans, and simulations.	2005
Graesser *et al.*	ElectronixTutor: an intelligent tutoring system with multiple learning resources for electronics	Intelligent guidance system prototyping with many electronic learning resources	2018
Vladimir & Kramkowski	Moving-Target Intelligent Tutoring System for Marksmanship Training	Prototyping of guidance systems for shooters in conducting fire practice on moving targets	2022
Zhang	Rancangan Pembelajaran dan Teknologi Dalam Militer	application of ISD (in structural System Design) learning model	2022
Baro'ah	Kebijakan Peningkatan Mutu Pendidikan (Suatu Studi Tentang Pendidikan Tinggi Pada Akademi Angkatan Laut Surabaya)	Policies related to military training	2020
Syidada & Wahyuningty	Perancangan Smart Campus Sebagai Media Pembelajaran (Studi Evauasi Model Pembelajaran E-Learning Sekolah Tinggi Teknologi Angkatan Laut)	application of smart campus model on STTAL	2019
Bandono	The Effect of The Learning Model Naval Collaboration Flexible Learning (NCFL) On The Quality Of Education Outcomes: An Innovative Approach To Islamic Religious Education In The Naval College Of Technology	Application of the NCFL model in Naval High Schools while still practicing the morals of Pancasila	2020

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3.8. ITS for Military Publication Progress Map

The development of publications regarding the ITS for the Military is interpreted on a bibliometric map which can be seen in **Figure 6** which shows that there are circles (nodes) where each circle represents a keyword that often appears in the literature. The size of the circle represents the amount of literature related to that keyword. Keywords that are close together and appear frequently tend to be in positions close to one another. Obtained 37 keywords that are interrelated and produced five clusters that are differentiated by color. Clusters in red include the keywords student, system, research, simulation, use, study, application, paper, conversational agent, military, and army. The green cluster includes the keywords computer, learner, strategy, team, chapter, object, and ITS. The blue clusters include the keywords performance, tutoring, gift, evaluation, knowledge, and intelligent tutoring. The yellow cluster includes the keywords challenge, model, framework, example, development, and training. And the purple cluster includes the keywords turkey and measure.

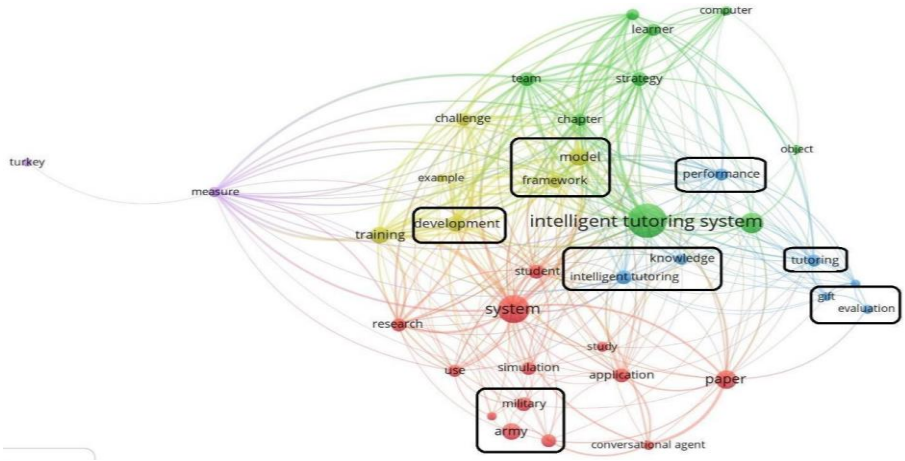

Figure 6. Development map of ITS military publications.

The bibliometric map also shows the progress of the publication year on the ITS for Military which is shown in **Figure 7**, which was widely studied from 2014 to 2016. Research on ITS that focuses on Intelligent Tutoring Some research is still little that discusses applications, frameworks, models, and measurement of tutoring performance. While the ITS for the Military is also still very little discussed, especially in applications, development, and the GIFT framework. With this, research on the ITS for the Military is still very possible to be developed in research.

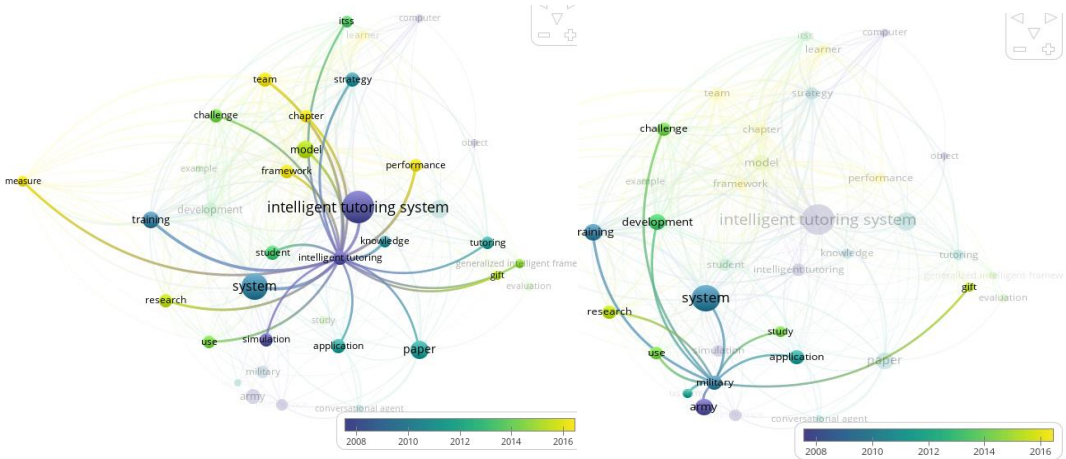

Figure 7. Development of The Publication Year on the ITS for The Military.

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4. CONCLUSION

Based on the results of the previous results and discussions, it can be concluded that, based on years of research, countries with the most research on ITS, as well as research topics around the world in the field of military education, it is found that there are not many topics and developments of ITS in the field of military education. developed, this can be seen from research from 1993 to 2002 there were only a total of 35 papers related to ITS in the field of military frameworks but the 35 papers still did not focus on application frameworks, modules, or performance measurement of ITS. Based on the research topic of military technology as much as 9%, higher education as much as 3%, learning modules as much as 9%, the topic of ITS as much as 55%, the country with the most research related to the topic of ITS for military, namely America by 64% or as many as 23 papers from a total of 35 papers but none of the topics mentioned above discusses the use of ITS for learning in military schools. This proves that research opportunities in the field of military education using ITS technology are still wide open because no one has conducted research in this field before.

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6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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