

Personalized Learning for Indian Defence SMEs: A Study on Learner Preferences and VARK Learning Styles

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Abstract:

The rapid evolution of defence technologies necessitates continuous skill development within Indian Defence Small and Medium Enterprises (SMEs). Traditional learning models often fail to address SME employees' diverse learning preferences, cognitive styles, and industry-specific skills requirements. This study explores the role of personalized learning in Indian Defence SMEs, focusing on learner preferences including language choices, duration preferences, knowledge standards, and VARK learning styles. A study was conducted in Hyderabad, encompassing three phases: initial data collection on demographics and learning preferences, adaptation of content to these preferences within a personalized learning management system (LMS), and subsequent evaluation through a survey completed by approximately 67 Defence SME employees. The results highlight significant variations in learning preferences and underscore the need for a customized e-learning framework. The findings indicate that AI-driven adaptive learning platforms may incorporate VARK-based training modules to optimize content delivery. Above highlight the importance of using multiple modes of information delivery to accommodate SME employees' learning preferences effectively as one-size-fits-all approach may not be suitable.

Keywords: *Personalised Learning, Defence SMEs, Learner Preferences, VARK learning styles*

1. Introduction

India's "Make in India" initiative is a strategic movement aimed at promoting domestic manufacturing and reducing reliance on imported defence equipment. Defence technology holds significant importance as it directly impacts a nation's security and overall stability. Engaging private industries, including both large corporations and start-ups, is vital. Such partnerships facilitate technology transfer, product development and the commercialisation of defence solutions (Das, 2024). Micro, Small and Medium Enterprises, or MSMEs, have become leading players in the defence manufacturing ecosystem of this country. The ongoing efforts by India to promote domestic production are fostering an environment conducive to innovation, design, and manufacturing for smaller enterprises in the defence industry. This

push for self-reliance is enabling these companies to develop products and solutions tailored to the military sector (Bansal, 2024). Considering the significance of Small and Medium Enterprises (SMEs) in the military industry, it is essential to provide their employees with the appropriate training to address the requirements of advancing defence technologies. The Indian Defence sector, particularly its SMEs, faces significant skill gaps due to rapid technological advancements (Sarkar & Nath, 2024). SMEs' long-term growth and success need innovation, learning, and development.

Towards this, adaptive learning facilitates SMEs to be more proactive in exploiting environmental opportunities (Bouhaleb, 2024). Further, skill gap analysis is useful to map and organise learner-centric training and targeted upskilling initiatives are required to be undertaken towards enhancing their contribution to defence manufacturing (Faeroevik, 2024). However, one of the major challenges faced by Indian Defence SMEs is the lack of structured training programs that cater to the dynamic skill requirements of the sector. As a result, these businesses often encounter difficulties in establishing formal processes, organizational frameworks, and transparent systems for managing performance, training, and compensation (Jha & Sharma, 2023). To address this issue, it is recommended that tailor-made courses specific to aerospace and defence be offered at all educational levels within Indian institutions. Such initiatives would enhance the skill sets of the workforce, aligning them with the evolving demands of the defence industry (Kumar, 2018). Digitalization has encouraged companies to integrate technology in HR management processes, such as the use of e-learning platforms and artificial intelligence-based learning to improve employee competencies (Bristol-alagbariya & Ayanponle, 2024). Conventional training programs often fail to engage employees effectively, as they do not account for differences in individual learning styles. Personalized learning, which integrates adaptive learning technologies and VARK learning preferences, presents an opportunity to revolutionize workforce training within Indian SMEs (Fake & Dabbagh, 2020).

2. Literature Review

The "Make in India" initiative has been instrumental in reshaping India's manufacturing landscape, particularly in the defence sector. Defence SMEs constitute a significant portion of industrial units in India, contributing substantially to the country's manufacturing and supply chain resilience. Defence SMEs are integral to the indigenous production of critical defence equipment. However, one of the persistent challenges faced by these enterprises is the skill gap that prevents them from fully leveraging their technological advancements (Sushil et al., 2022). Traditional training methodologies limit the potential of SMEs in the defence sector. To overcome these limitations, it is essential to adopt modern learning strategies tailored to the specific needs of defence personnel. Innovative training approaches, such as virtual, mixed, and extended reality platforms, offer flexible and cost-effective solutions that can enhance the skills of defence personnel. These technologies allow for adaptable scenarios, reducing the need for physical resources and enabling more dynamic training experiences (Defence Engage, 2022).

The Indian government has prioritized self-reliance in the defence sector under the Make in India and Atmanirbhar Bharat initiatives. The aim is to transform India into a global manufacturing hub by reducing dependence on foreign imports and promoting domestic production (Patel et al., 2023). According to the Ministry of Defence, India's goal is to achieve INR 3 lakh crore in defence production by 2029, with a substantial increase in exports (Finovista, 2025). The government has consistently pushed for policy reforms

including the Defence Acquisition Procedure (DAP) 2020, which mandates a minimum of 50% indigenous content in major procurements (IDSA, 2025).

Despite the government's push for self-reliance, Indian defence SMEs face a significant skills gap in areas like advanced manufacturing, cybersecurity, AI-driven defence systems, and digital twin technologies. Many SMEs lack technical expertise to efficiently absorb and integrate transferred technology, resulting in underutilization of advanced defence capabilities (Sushil et al., 2022). To bridge this gap, Personalized Learning (Adaptive Learning) can be a game-changer. Adaptive Learning Systems (ALS) use AI-driven tools to customize learning content based on the learner's proficiency, experience, and engagement patterns. Research suggests that Adaptive Learning enhances user satisfaction and motivation, leading to higher engagement levels and improved behavioural intention to pursue continuous learning (Kim et al., 2020).

With exponential advances and sophistication of technologies, Technology Enhanced Learning (TEL) has gradually transformed the landscape of learning environments (Adu & Poo, 2013). TEL using diverse adaptive learning technologies, can personalize or customise the learners experience and has a greater learning outcome possibility than legacy classrooms (Albatayneh et al., 2018). The term "Personalized learning" has drawn considerable attention of the researchers since 2008 (Shemshack & Spector, 2020) and become a buzzword in the education and TEL.

The aim of personalized learning (PL) is to dynamically adapt a system according to the needs and characteristics of individual students in order to overcome the disadvantages of the 'one-size-fits-all' approach in modern learning environments (Shemshack & Spector, 2020b). Xie et al. (2019) reviewed the trends and growth of adaptive/ personalized learning including research issues of learning outcomes, the parameters, learning supports, subjects and hardware (Xie, 2019a). There has been increased use of ETs in various of facets of learning and teaching. Technologies or adaptive technologies have been commented up on and discussed as a part of broader research questions in very few systematic reviews of personalized learning. The rapid advances in ETs have enabled PL to be gradually more adaptive, adaptive learning to be highly personalized. These differences and similarities coupled with in-depth analysis of PL and adaptive learning have been investigated (Peng et al., 2019). In literature, these two terms have been considered interchangeably (Xie, 2019b). A four-tier conceptual framework for smart learning, specifically designed for SMEs, highlights the AI-powered learning personalization, real-time performance analytics, and microlearning modules (Stavropoulos et al., 2021). It found that customized learning pathways lead to higher skill acquisition rates among SME employees. This research emphasizes that SMEs that invest in personalized learning solutions witness improved productivity and reduced skill gaps.

3. Statement of Problem Under Study

India's "Make in India" initiative aims to promote domestic manufacturing in the defence sector, with Micro, Small and Medium Enterprises (MSMEs) emerging as leading players in the defence manufacturing ecosystem, yet these enterprises face significant skill gaps due to rapid technological advancements that hamper their potential contribution. A major challenge confronting these enterprises is the absence of structured training programs that cater to the dynamic skill requirements of the defence sector, limiting their ability to innovate and develop products tailored to military needs. Conventional training approaches fail to engage

employees effectively as they do not account for individual learning styles, creating a disconnect between training initiatives and actual skill development needs. This research paper titled "Personalized Learning for Indian Defence SMEs: A Study on Learner Preferences and VARK Learning Styles " is thus aimed to understand the learning preferences of Indian Defence SME employees, including their language choices, module type preferences, and self-identified user proficiency levels. Furthermore, this study aims to determine the VARK learning styles of employees which aids in the development of customized learning content.

4. Objectives of the Study

The objectives of the study are given below: -

- To analyse the learning preferences of Indian Defence SME employees, including their language choices, module type preferences, and self-identified user proficiency levels
- To determine the VARK learning styles of employees to assist the development of customized learning content and design of AI-powered personalized learning solutions towards upskilling and reskilling efforts in the defence SME sector

5. Limitations

The study's small sample size significantly limits its statistical power, making it difficult to generalize the results to a broader population. Future research should expand the sample size to obtain more statistically robust insights and explore the development of an AI-powered Personalized Learning Platform specifically designed for Defence SME training. Another limitation is self-reported data, which may be subject to response bias. The survey was designed in such a way as to mitigate this bias, however future studies should consider using objective performance metrics or observational data to more comprehensively evaluate the impact of training technologies.

6. Research Methodology

This study employs a quantitative survey-based approach to analyse personalized learning preferences in Indian Defence SMEs. The research focuses on understanding how defence SME employees learn, and which instructional formats are most effective for their professional development. A study was conducted in Hyderabad, encompassing three phases. Towards analysing the intended good quality results, a good research study with appropriate research design and accurate performance is required (In, 2017). A preliminary investigation was conducted to mirror the procedures of the main research and confirm the study's viability. This was accomplished by evaluating the participants' eligibility criteria and providing training for the investigators and their assistants.

The questionnaire was *divided into three parts*. The *first part* of the questionnaire covered the demographic details of respondent's name of defence SME, gender, educational qualifications, age and experience in the firm, nature of business and type of firm. Second part included capturing learner preferences including language selection, duration of video modules. Further second section has 10 MCQs on the provided topic "Artificial Intelligence for upskilling Defence SME" for personalised learning. The performance in this classifies the learner as Beginner, Average or Advanced. Third section has 16 questions on VARL

learning style where the learner can tick all answers that apply. Learning style inventories are information-processing models that aim to identify a student's preferred intellectual approaches in assimilating and processing information. The VARK learning style model was introduced in 2006 by Neil Fleming. Acronym VARK stands for visual, aural, read/write, and kinesthetic preference for learning modalities (Khongpit et al., 2018). This educational approach categorizes learners into four distinct learning modes, each corresponding to a preferred sensory method for acquiring information: visual (V), auditory (A), reading/writing (R), and kinesthetic (K). The VARK questionnaire is designed to determine an individual's preferred sensory learning style. The sixteen-multiple choice VARK questionnaire version 8.01 was used (Do & Best, 2019). Learners were distributed into one of the following categories: unimodal with only V, A, R, or K preferences; multimodal having more than one preference. Multimodal was further classified into Bimodal-Having two preferences; Trimodal-Having three preferences; and Quadrimodal-having 4 preferences. In the second phase, the content was adapted by the researcher to suit the individual learner preferences, including VARK learning styles, and each participant was provided with a unique user ID and password to log into the personalized learning management system (LMS).

In the third phase, after completing the personalized learning modules, a survey form covering independent and dependent variables was distributed to approximately 67 Defence SME employees. The survey instrument examined several elements that affect the adoption of personalized learning, based on four independent variables: Performance Expectancy, Effort Expectancy, Facilitating Conditions, and Social Influence. The questionnaire has been designed with 4 to 5 questions on each of the variable. Scaling techniques were used to elicit responses from the SME employees and Respondents were asked to rate on a 5-point scale with 1 = Strongly Disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = Strongly Agree. Similarly dependent variables for measuring Training Effectiveness are Reaction and Behavioural Intention using similar scaling technique. Responses collected in this phase provided deeper insights into the effectiveness of personalized learning frameworks in upskilling and reskilling employees. Only Phase 1 of study analysis is presented in this paper.

7. Results and Discussion

Demographic data were deemed necessary to study an adequate sample representation of the study population of defence SME employees. The information is tabulated with the details in Table 1.

Table 1: Respondent's demographic and learner preferences

	Option	Frequency	Percentage (%)
Gender	Male	59	88.1
	Female	8	11.9
Age	30 years and below	28	41.8
	31 to 40 years	16	23.9
	41 to 50 years	15	22.4
	Above 50 years	8	11.9
Educational Qualification	Undergraduate	1	1.5
	Graduate	46	68.7
	Post Graduate	19	28.4
	PhD	1	1.5
Experience	Below 5 years	17	25.4

	6 to 10 Years	18	26.9
	11 to 20 Years	17	25.4
	20 years above	15	22.4
Language preference	English	60	89.6
	Hindi	7	10.4
Standard of Knowledge	Beginner	6	9
	Average	25	37.3
	Advanced	36	53.7
Video Module	5 min	53	79.1
	10 Min	14	20.9

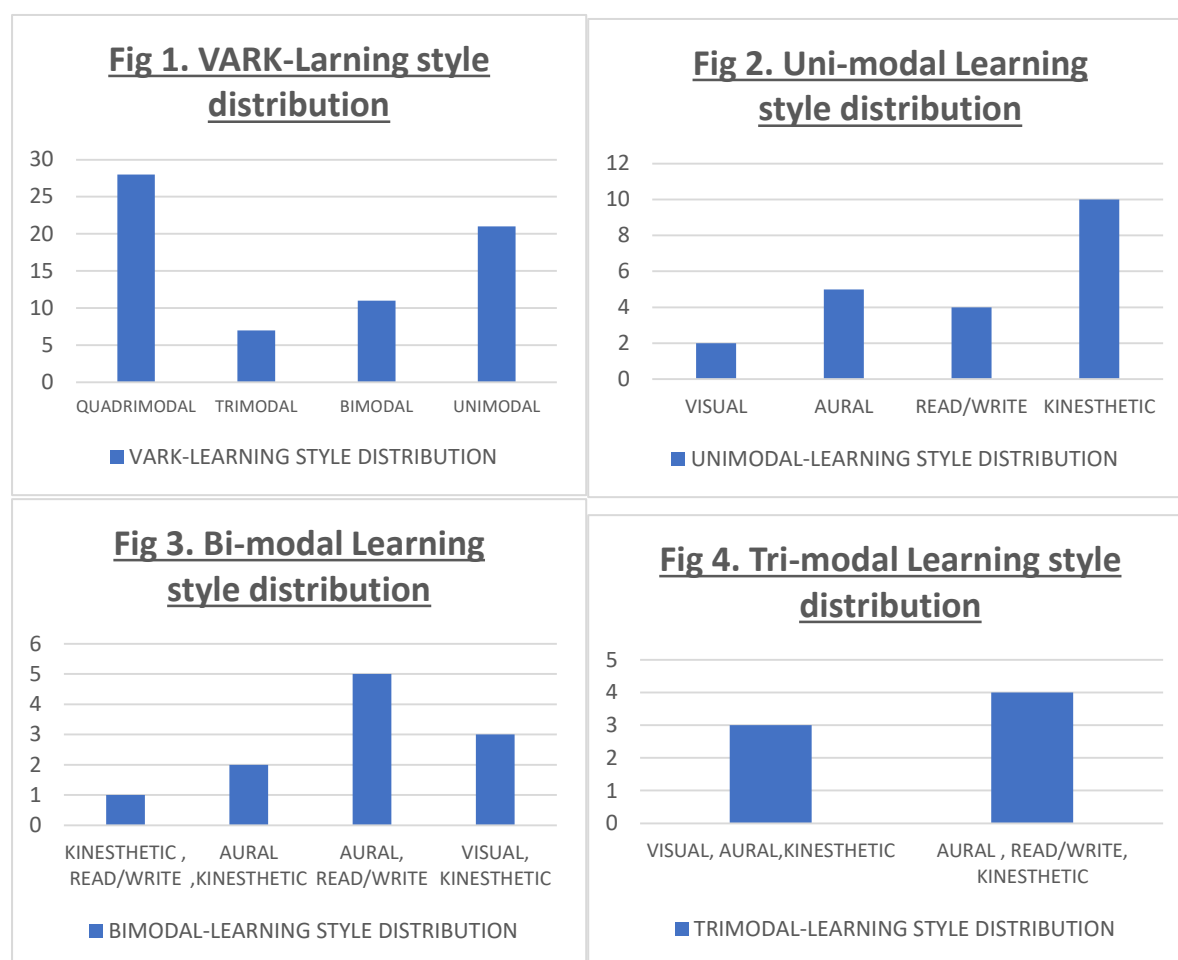
Demographic analysis revealed that 88.1% of the survey respondents were male and rest female. 41.8% of respondents are young with age of less than 30 years, 23.9% between 31 to 40 years , 22.4% between 41 to 50 and 11.9% with age more than 50 years. Educational qualifications varied, with 68.7% holding graduate degrees, while 22.4% had postgraduate degrees. Notably, respondents equally varied with less than 5 years of work experience, 6 to 10 years, 11 to 20 years and more than 20 years of work experience, indicating a workforce that requires continuous skill development to stay updated with evolving industry requirements. Furthermore, 47.8% of the surveyed SMEs were both manufacturing and service based, whereas 28.4% were involved only in manufacturing and 23.9% in service suggesting a broad application of training needs across different business models within the defence industry.

Analysis of learning preferences indicated that 89.6% of the employees preferred English for training, while 20.9% preferred Hindi, highlighting the need for bilingual course content. A significant portion of respondents (89.6%) preferred short, 5-minute video modules, emphasizing the importance of concise, engaging content delivery. The strong preference for brief videos underscores the limited attention span of employees. Short modules are less likely to overwhelm viewers, keeping them engaged throughout the content. Brief modules allow learners to fit education into their busy schedules. They can quickly view a module during a break or as part of a larger, self-paced learning program, aligning well with current trends in digital media consumption. In terms of learner classification for MCQ test conducted for AI for Defence SME, 53.7% identified as "Advanced" learners, while 37.3% classified as "Average," and 9% as "Beginner" reinforcing the necessity of multi-tiered training modules that cater to varying levels of expertise. Multi-tiered modules may better address the unique needs of each group, leading to more effective learning, higher retention rates, and improved performance in subsequent assessments. A one-size-fits-all approach may leave average and beginner learners behind, potentially compromising overall comprehension and engagement. Differentiated training ensures that each learner receives the appropriate level of challenge and support.

• **VARK Learning preferences**

In our present study, most respondents are multimodal with 69.1%. Furthermore, (41.2%) prefer a quadrimodal learning approach, meaning they use all four learning styles effectively. Unimodal learners (30.9%) are primarily kinesthetic (10 learners), showing a strong preference for hands-on learning. Remaining unimodal learners are V (Visual)- 2, A (Aural)- 5, And R (Read/Write)4. Among bimodal learners (16.2%), the AR (Aural + Read/Write) combination is the most common with 5 responses. Other bimodal learners include KR-1, AK- 2 and VK-3. Trimodal learners (10.3%) show a varied distribution, with Kinesthetic’,

Aural, Read/Write (KAR) being the most common with 4 responses. Other trimodal learners include the VAK-3. Distribution of VARK learning style, unimodal, bimodal and Quadrimodal are depicted in fig 1,2,3 and 4 respectively. Above highlight the importance of using multiple modes of information delivery to accommodate SME employees' learning preferences effectively. A learning preference refers to the most efficient and effective way an individual naturally absorbs, processes, retains, and recalls new information. Recognizing these preferences among employees calls for a transition from the traditional, teacher-centred large-group lectures to a more interactive, learner-focused personalised learning approach that integrates diverse teaching and learning strategies. The VARK learning style analysis showed that majority of employees were multimodal learners, requiring blended training approaches that incorporated various instructional methods. Kinesthetic learning modes emerged as the most common preference, underscoring the need for interactive training materials.



The VARK learning style analysis showed that 69.1% of employees were multimodal learners, requiring blended training approaches that incorporate various instructional methods. Visual and kinesthetic learning modes emerged as the most common preferences, underscoring the need for interactive and visually rich training materials. Based on these findings, it is recommended that e-learning modules be concise, interactive, and bilingual to cater to the diverse learning needs of defence SME employees. AI-driven adaptive learning systems should be implemented to adjust the training content dynamically based on learner engagement. Additionally, hybrid learning models, incorporating videos, simulations, and hands-on tasks, should be integrated effectively.

8. Conclusion and Future Scope

The primary objective of this study was to analyse the learning preferences in the defence SME, with focus on the need for customising the learning content according to the individual needs. The Survey has three phases, with analysis of Phase I, presented in this article. This study highlights the importance of Personalized Learning in enhancing skill acquisition among employees in Indian Defence SMEs. The findings indicate that AI-driven adaptive learning platforms should incorporate VARK-based training modules to optimize content delivery. Above highlight the importance of using multiple modes of information delivery to accommodate SME employees' learning preferences effectively. The VARK learning style analysis showed that majority of employees were multimodal learners, requiring personalised learning approaches that incorporate various instructional methods. Additionally, the results suggest that bilingual and modular content are essential for effective implementation. In addition, further, ensuring validity and reliability of the instrument is crucial for obtaining accurate and meaningful results. Government-industry collaboration is also recommended to promote continuous learning through policy interventions, ensuring that India's defence workforce remains competitive in a rapidly evolving technological landscape.

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