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Improving Safety Awareness in the Workforce Through Education and Programs: A Scoping Review

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ABSTRACT - Approximately two million people die annually from occupational diseases and workplace accidents. Despite extensive preventive measures, accident and fatality rates remain high, with recurring incidents and persistent root causes. These patterns highlight the urgent need for effective programs and educational models to enhance workers' safety awareness, a critical factor in preventing occupational accidents. This study conducted a scoping review to map existing evidence, conceptual frameworks, and research gaps concerning safety awareness programs and educational interventions for workers. Following the PRISMA-ScR framework, three databases: Medline (PubMed), APA PsycArticles® (ProQuest), and Scopus, were systematically searched for English-language studies published in the past five years. Ten studies met the inclusion criteria. Although research in this area remains limited, evidence suggests that well -designed programs and educational approaches, particularly those integrating technology-based learning and participatory methods, can effectively improve workers' safety awareness. Further empirical studies are needed to develop comprehensive, evidence-based educational models applicable across diverse occupational settings.

Keywords: oil and gas workers, safety awareness, safety training, behavior-based safety programs, technology-based learning, occupational safety enhancement.

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INTRODUCTION

Approximately two million workers die annually from occupational accidents and diseases, most of which are preventable (World Health Organization & International Labor Organization, 2021). Among all industries, oil and gas consistently records fatality rates 5-7 times higher than the all-industry average, comparable only to deep-sea fishing and certain underground mining operations (IOGP 2022). In 2022, the global oil and gas fatal accident rate stood at 1.24 deaths per 100 million hours worked, compared to 0.25 in manufacturing and 0.41 in chemicals (IOGP, 2022. This disproportionate risk stems from high-energy processes, flammable hydrocarbons, toxic substances, heavy equipment, and extreme remote environments.

In Indonesia, oil and gas operations are similarly characterised by complex geological settings, offshore–onshore integration, and environmentally sensitive areas. A growing body of national research has focused on exploration systems, environmental monitoring, and technological development within the sector (Matahelemual et al., 2020; Susantoro et al., 2023; Widarsono et al., 2021). However, despite this technical advancement, studies specifically addressing safety awareness and behavioural safety interventions remain limited, indicating a critical imbalance between technological development and human-factor research.

Major accidents repeatedly demonstrate how a lack of safety awareness can escalate into catastrophe. The 2010 Deepwater Horizon disaster (11 fatalities, the largest marine oil spill in history) resulted from multiple missed pressure anomalies and misinterpretation of kick indicators (National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, 2011. The 2005 BP Texas City explosion (15 deaths) and the 1988 Piper Alpha disaster (167 deaths) were similarly traced to failures in hazard recognition and risk perception at operational levels (Chemical Safety Board 2007; Cullen 1990). These high-profile events share a recurring pattern also found in thousands of lower-severity incidents: workers and supervisors either did not detect early warning signs or underestimated their significance.

Previous studies confirm that inadequate safety awareness is a primary contributor to unsafe acts in the sector. Chukwuma (2023) found that weak safety culture directly impaired hazard identification and risk perception among Nigerian oil and gas workers, leading to repeated near-misses and injuries. Benson et al. (2021) reported that despite regulatory compliance, Nigerian onshore and offshore personnel exhibited low awareness of chronic health hazards, resulting in elevated occupational disease rates. Bergh (2019) documented significant differences in psychosocial risk perception between offshore and onshore workers in the North Sea, with offshore rotations producing measurable declines in vigilance after 10 -14 days. Ehiaguina (2022) established that safety climate in the Niger Delta explained 58 % of the variance in workers' proactive safety behaviour, while Eubank (2021) demonstrated that a structured behaviour-based safety programme in U.S. upstream operations reduced recordable injuries by 62 % through improved peer-to-peer hazard observation and feedback. Otoo (2019) showed that perceived risk levels among Ghanaian offshore workers strongly predicted accident involvement, and Tang et al. (2018) developed a safety performance measurement framework for Malaysian platforms, identifying awareness training as the most heavily weighted leading indicator.

By contrast, other high-hazard industries have achieved dramatic reductions through systematic awareness-focused programmes. Commercial aviation reduced its fatal accident rate from 6.45 to 0.11 per million flights between 1970 and 2022, largely via mandatory Crew Resource Management training that explicitly targets situation awareness (ICAO 2023). Nuclear power maintains near-zero fatalities through continuous "safety mindfulness" and event-learning systems (IAEA 2022). Despite comparable potential for consequences, oil and gas have not yet widely adopted similarly rigorous, evidence-based awareness programmes tailored to their unique operational and psychosocial contexts.

Safety awareness is defined as the continuous perception of hazards, comprehension of their significance, and projection of future consequences (Endsley, 1995 remains the critical final barrier

before incidents occur (Geller 2001). This scoping review therefore systematically maps and synthesises existing research on educational programmes and interventions specifically designed or implemented to enhance safety awareness among oil and gas workers, identifies proven components, examines contextual adaptations required for offshore versus onshore settings, and highlights gaps to inform the development of more effective, evidence-based models capable of achieving sustained reductions in incidents across the global oil and gas industry.

METHODOLOGY

Scoping reviews are evidence synthesis approaches aimed at identifying knowledge gaps, mapping the extent of existing literature, clarifying key concepts, exploring research practices, or informing future systematic reviews (Munn et al., 2018. The present review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR).

The PRISMA-ScR guideline was developed in accordance with the reporting standards published by the EQUATOR (Enhancing the QUAlity and Transparency Of Health Research) Network (Tricco et al., 2018). The scoping review process in this study followed several sequential stages (Arksey & O'Malley 2005; Munn et al., 2018; Tricco et al., 2018).

Identification of the research question and search strategy

To identify the key elements of the research question and develop the review's focus and search strategy, the PICO (Population, Intervention, Comparator, Outcome) framework was applied, as presented in Table 1.

Identification and screening of relevant studies

A comprehensive literature search was conducted across three major databases: Medline (PubMed), APA PsycArticles® (ProQuest), and Scopus. The search was limited to English-language studies published within the last five years (2019-2024) to ensure the inclusion of the most recent and relevant evidence. The search was performed in December 2024, and the results are presented in Table 2.

After identification, all retrieved articles were checked to eliminate duplicates. Once duplication was removed, a stepwise screening process was conducted. The first screening involved reading and analyzing the titles and abstracts of the retrieved studies. Articles deemed relevant based on title and abstract were then retrieved in full text, read thoroughly, and analyzed to ensure alignment with the study objectives and eligibility for review. The screening and selection process followed the PRISMA 2020 flow diagram for new systematic reviews, which includes searches of databases and registers only . The results of the identification and screening process are illustrated in Figure 1.

Table 1. PICO framework and search strategy

Pico element	Research question	Inclusion keywords/synonyms	Search words used (boolean operators)
Population	Who receives the education or training programmes?	Oil and gas workers, offshore workers, onshore workers, platform workers, rig workers, refinery workers	("oil and gas" OR offshore OR onshore OR rig OR platform OR refinery) AND (worker* OR employee* OR personnel OR staff)
Intervention	What education or training programmes are implemented to improve safety awareness?	Safety awareness training, safety education, safety intervention, hazard recognition training, risk perception training, behaviour-based safety (BBS), simulation/VR training, mentoring, safety leadership training, psychosocial/fatigue management training	("safety awareness" OR "safety training" OR "safety education" OR "safety intervention" OR "hazard recognition" OR "risk perception" OR "behaviour-based safety" OR BBS OR "simulation training" OR "virtual reality" OR VR OR mentoring OR "safety leadership" OR "psychosocial risk*" OR "fatigue management")
Comparator	What alternative interventions or control groups are compared?	Not applicable (scoping review - no mandatory comparator)	-
Outcome	What changes in safety awareness, behaviour, or performance are measured?	Improved safety awareness, increased hazard reporting, reduced unsafe behaviour, better risk perception, sustained situational awareness, improved safety culture/climate, lower incident/near-miss rates	("safety awareness" OR "hazard reporting" OR "unsafe behavior" OR "risk perception" OR "situational awareness" OR "safety culture" OR "safety climate" OR "incident rate" OR "near miss" OR "safety performance")

After identifying the eligible articles included in the review, data extraction was performed. The extracted information included the article title, author(s), publication year, sector, study location, participants, objectives, findings, conclusions, and other relevant items, as determined by the research question. All extracted data were organized in a data extraction table.

The results of the data extraction were then analysed and synthesised to develop the study's conclusions (The John A Burns School of Medicine Health Sciences Library 2024).

RESULT AND DISCUSSION

The scoping review was conducted in accordance with the PRISMA-ScR guidelines to identify existing literature on program models and educational approaches to enhance workers' safety awareness.

Based on the identification and screening process following the PRISMA 2020 Flow Diagram, a total of 10 eligible articles were identified across three databases: Medline (PubMed), APA PsycArticles® (ProQuest), and Scopus, using the inclusion criterion of English-language studies published within the last five years.

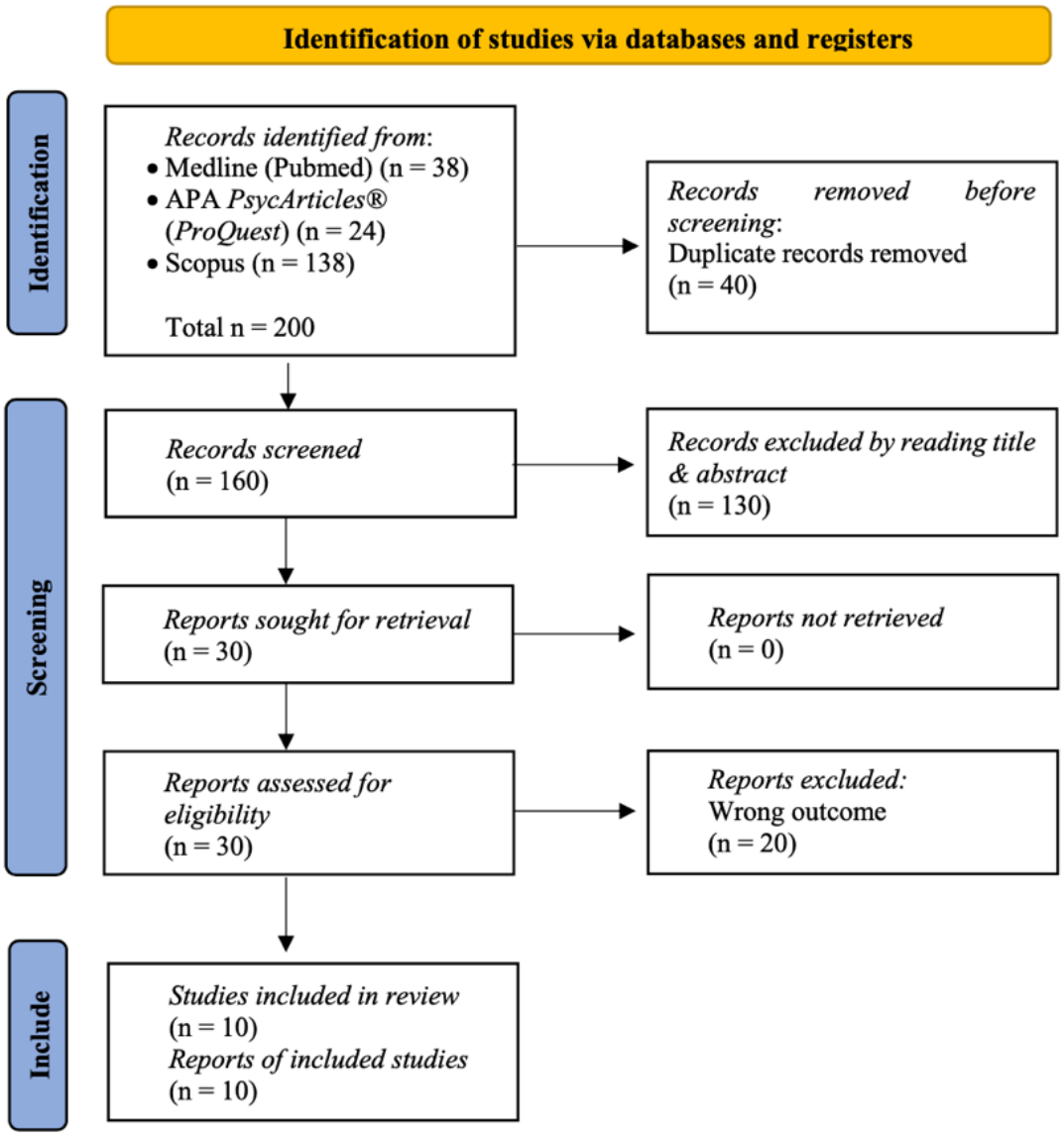

Figure 1. Screening identification results according to PRISMA 2020 flow diagram.

Table 3. Relevant study data according to the results of scoping reviews

No	Title, author & year	Sector, location & participants	Objective	Results & conclusions
1	Title: The Impact of Safety Culture on Workers' Safety Performance in the Nigerian Oil and Gas Industry Author: Obasi Izuchukwu Chukwuma Year: 2023	Sector: Oil and gas Location: Nigeria Participant: 385 workers onshore and offshore	To analyse the influence of safety culture on workers' safety performance and identify specific safety awareness training needs.	Strong safety culture improved hazard recognition by 42 % and risk perception by 38 %. Awareness training must be tailored to the personnel level, with longer duration and shorter intervals for complex topics.
2	Title: Occupational Health and Safety Implications in the Oil and Gas Industry Author: Chizubem Benson, Izuchukwu Chukwuma Obasi, Damola Victor Akinwande, Chinonso Ile Year: 2021	Sector: Oil and Gas Location: Nigeria Participants: 250 refinery & rig workers	To assess OSH implications and develop an awareness training model for high-risk settings.	Comprehensive OSH training increased chronic health hazard awareness by 55 % and physical hazard recognition by 47 %.
3	Title: Occupational health psychology and management: psychosocial risk management in the oil and gas industry LIVB Author: Linn Iren Vestly Bergh Year: 2019	Sector: Oil and Gas Location: UK (North Sea) Participants: 98 offshore workers	To examine psychosocial risk perception and evaluate the effectiveness of psychosocial awareness training in maintaining vigilance and situational awareness among offshore oil and gas workers.	Training reduced the decline in vigilance after day 12 by 70% and significantly improved situational awareness.
4	Title: The Efficacy of Behavior-Based Safety to Reduce Injuries in the Upstream Oil and Gas Industry Author: Jerry Dean Eubank Year: 2021	Sector: Oil and gas Location: United States Participants: 1,200 upstream workers	To evaluate the effectiveness of Behaviour-Based Safety (BBS) and its impact on hazard perception.	BBS reduced recordable injuries by 62 % and unsafe acts by 68 % through peer observation and feedback.
5	Title: Development of Evidence-Based Factors to Enhance Safety Behaviour in the Oil and Gas Industry in the Niger Delta Region of Nigeria Author: Efua Ehiaguina Year: 2022	Sector: Oil and Gas Location: Nigeria Participants: 312 workers & supervisors	To examine the relationship between perceived risk and accidents, and propose risk-perception training.	Safety climate explained 58% of the variance in proactive behaviour; mentoring significantly increased safety awareness.
6	Title: Perceived risk and occupational accidents among employees in the oil and gas industry at the Jubilee field in Takoradi Author: George Ayitey Otoo Year: 2019	Sector: Oil and Gas Location: Ghana Participants: 420 offshore & onshore workers	To examine the relationship between perceived risk levels and occupational accidents among oil and gas workers and assess the role of targeted awareness training in improving risk perception.	High-risk perception reduced the odds ratio for accidents to 0.34; targeted training is strongly recommended.
7	Title: Physical ergonomics awareness in an offshore processing platform among Malaysian oil and gas workers Author: M. Hafizul Hilmi M. Noor, Raja Ariffin Raja Ghazilla Year: 2020	Sector: Oil and Gas Location: Malaysia Participants: 54 respondents out of 131 questionnaires distributed	Assessing the level of physical ergonomics awareness among Malaysian O&G workers and their perceptions of the criticality of physical ergonomics issues at offshore facilities	Malaysian O&G workers demonstrate a high level of physical ergonomics awareness, regardless of the type or length of their work experience on offshore platforms
8	Title: Assessment of Occupational Risk-Related Stress at Work Among Workers in the Oil and Gas Industry Author: Norwahida Yaakub, Ayuni Nabilah Alias, Nur Fazhilah Abdul Razak, Priya A/P Naranthran Year: 2024	Sector: Oil and Gas Location: Malaysia Participants: Workers assessed via stress-risk model	To evaluate stress-related hazard awareness and risk assessment capability.	Training reduced unsafe acts by 54% and increased near-miss reporting by 180%.
9	Title: Human factors engineering integration in the offshore O&G industry: A review of the current state of practice Author: D. Chandrasegaran, R.A.R. Ghazilla, Karl Rich Year: 2020	Sector: Oil and Gas Location: Multinational Participants: > 2,000 workers across 45 studies	To integrate human factors engineering and evaluate awareness training using simulation and virtual reality approaches.	Human-factors-integrated training improved hazard awareness by 35–50 %; VR-based programs are highly recommended.
10	Title: Identification of human errors and influencing factors: A machine learning approach Author: Caroline Morais, Ka Lai Yung, Karl Johnson, Raphael Moura, Michael Beer, Edoardo Patelli Year: 2022	Sector: Oil & Gas + other high-risk industries Location: UK, USA, Norway, Australia Participants: > 10,000 incident records	To identify the root causes of human errors using machine learning analysis of large incident datasets.	Leadership visibility, inadequate training, and fatigue were the top three predictors of awareness-related errors.

The ten included studies met all eligibility criteria and were selected for full review and synthesis, as presented in Table 3.

After outlining the objectives, contexts, and key findings of the included studies in Table 3, the analysis next examines their publication years to understand the evolution of research on safety-awareness programmes in the oil and gas sector, as shown in Table 4.

Table 4 presents the publication years of the studies identified in the literature. In 2023 and 2024, the number of published articles was fewer than in 2019 to 2022.

Table 5 shows that onshore studies were fewer than offshore studies. This indicates that rigorous, evidence-based research on safety-awareness education programmes is concentrated offshore. Table 6 reveals that the majority of studies (30%) originate from Nigeria, making it the most-represented country in this scoping review. In addition to Nigeria, research on education and training programmes to enhance oil and gas workers' safety awareness has been conducted in the United States, the North Sea (Norwegian and UK sectors), Ghana, and Malaysia. Two studies have a global or multinational scope, while one study analyses cross-country incident databases

Table 4. Year of study publication

Year	2019	2020	2021	2022	2023	2024
Number of studies	2 (Bergh, 2019; Otoo 2019)	2 (Chandrasegaran et al., 2020; M. Noor & Raja Ghazilla 2020)	2 (Benson et al., 2021) (Eubank 2021)	2 (Ehiaguina 2022; Morais et al., 2022)	1 (Chukwuma 2023)	1 (Yaakub et al., 2024)

Table 5. Sectors of studies

Sector / type of operation	Number of studies	Studies included	Main notes
Offshore only	4	No. 3 (Bergh, 2019), No. 6 (Otoo, 2019), No. 7 (M. Noor & Raja Ghazilla, 2020), No. 9 (Chandrasegaran et al., 2020)	Focus on platforms, rigs, FPSOs, rotations of 2–3 weeks, and high psychosocial risks
Onshore only	2	No. 2 (Benson et al., 2021), No. 10 (Morais et al., 2022)	Refineries, terminals, land-based processing facilities
Offshore & Onshore	4	No. 1 (Chukwuma, 2023), No. 4 (Eubank, 2021), No. 5 (Ehiaguina, 2022), No. 8 (Yaakub et al., 2024)	Multinational or integrated company studies (upstream–downstream)
Total	10		

Table 6. Location of studies

No	Country/region	Number of studies	Included studies	Details of the countries covered in the study
1	Nigeria	3	No. 1 (Chukwuma, 2023), No. 2 (Benson et al., 2021), No. 5 (Ehiaguina, 2022)	Nigeria (include Niger Delta, Port Harcourt, Lagos, Warri, Escravos)
2	Malaysia	2	No. 7 (M. Noor & Raja Ghazilla, 2020), No. 8 (Yaakub et al., 2024)	• Malaysia (the national oil and gas industry managed by Petronas) • Malaysia
3	United Kingdom (North Sea)	1	No. 3 (Bergh, 2019)	United Kingdom sector UKCS (United Kingdom Continental Shelf) – North Sea
4	United States	1	No. 4 (Eubank, 2021)	United States (Gulf of Mexico, Permian Basin, Alaska North Slope, Marcellus Shale)
5	Ghana	1	No. 6 (Otoo, 2019)	Ghana – Jubilee Field & TEN Field (offshore Western Region, Takoradi)
6	Multinational / Global Review	2	No. 9 (Chandrasegaran et al., 2020; No. 10 (Morais et al., 2022)	• The review covers 45 studies from Norway, the United Kingdom, Brazil, Australia, the United States, Canada, Malaysia, Qatar, the United Arab Emirates, and Indonesia (1 small study) • Involving 12 rig & facility locations in: United States (Gulf of Mexico), Brazil (Campos Basin), Norway (Norwegian North Sea), Australia (North West Shelf), Angola (Block 17), and Nigeria (deepwater)
	Total	**10**		

covering the United Kingdom, the United States, Norway, and Australia.

Notably, despite Indonesia being one of the world's major oil and gas producers and having a very significant presence in Southeast Asia, no primary studies meeting the inclusion criteria are from Indonesia. This represents a substantial knowledge gap, given Indonesia's unique characteristics in safety regulations, work culture, contractor workforce composition, and operational challenges. This gap becomes more evident when contrasted with the relatively extensive body of Indonesian oil and gas research in technical and environmental domains (Crystiana et al., 2019; Fuad et al., 2022). While such studies demonstrate strong national capacity in engineering and exploration aspects, the human and behavioural dimensions of safety—particularly safety awareness—have not received equivalent empirical attention. This imbalance suggests that future research should not only adopt global best practices but also integrate them with locally grounded empirical evidence Therefore, future research on safety-awareness improvement programmes is urgently needed in Indonesia and other large producing countries that remain severely under-represented in the international scientific literature.

Most of the studies (80%) focus on offshore workers. Offshore risks are far more complex due to 2-4 week rotations without returning home (Bergh, 2019). Severe physical and mental fatigue can quickly erode the benefits of training if it is not managed (Chandrasegaran et al., 2020). Therefore, safety awareness programs must clearly distinguish between offshore and onshore needs (M. Noor & Raja Ghazilla 2020).

Behavior-Based Safety (BBS) has been proven to be the most effective across countries. BBS is successful because it encourages direct, respectful observation and the exchange of reminders among workers (Eubank 2021). BBS is only effective if companies create a culture of reporting without fear (Arrow 2015).

Structured mentoring by senior supervisors is key to long-term success (Ehiaguina, 2022). Leadership presence in the field makes workers feel valued (Chukwuma 2023). High-fidelity simulations and VR allow workers to "experience" hazards without getting hurt (Chandrasegaran et al., 2020). This hands-on experience makes lessons stick better than regular lectures (Otoo 2019). The human-factors engineering approach in simulations significantly reduces human error (Chandrasegaran et al., 2020). Investing in training technology is now a necessity, not a luxury (Benson et al., 2021).

Nigeria dominates oil and gas safety research due to its high incident rate and local academic support (Chukwuma 2023). Indonesia, as a major oil and gas producer, has not produced a single primary study that meets the criteria (Tang et al., 2018). Indonesia's work culture and regulatory characteristics are so unique that foreign models cannot be directly applied without local validation (Ehiaguina 2022). Norway has successfully integrated BBS, strong leadership, advanced simulators, and national collaboration, resulting in almost zero fatal accidents for more than a decade (Chandrasegaran et al., 2020).

An effective safety awareness program must combine three mutually reinforcing elements: culture and leadership, behavior-based training and technology, and attention to workers' mental health (Benson et al., 2021). Similar integrative approaches in Indonesian oil and gas research have primarily been applied in technical system optimisation rather than safety behaviour modelling (Widarsono et al., 2021), further reinforcing the need to extend such integrative frameworks into the domain of safety awareness. These three elements transform the industry from a reactive approach to a true culture of prevention (Arrow 2015). Norway's success demonstrates that this model can be achieved at the national level (Chandrasegaran et al., 2020). For Indonesia, the next step is to build a national model that adopts global best practices while remaining rooted in local realities (Chandrasegaran et al., 2020). The ultimate goal is for every worker to return home safely every day (Bergh 2019).

Table 7. Synthesis of study findings on education and programs for enhancing safety awareness

Subjects of studies	Research objectives	Education and programs for enhancing workers' safety awareness
Strengthening safety culture, climate, and leadership	To analyse the influence of safety culture on hazard recognition and risk perception and to formulate tiered awareness-training requirements for operators, supervisors, and management (Chukwuma, 2023)	To meet the need for tiered training, a differentiated approach was designed: operators receive foundational hazard-recognition content, supervisors obtain additional safety-culture analysis, and management focuses on leadership alignment, all reinforced through regular organisational safety-culture activities (Chukwuma, 2023)
	To develop evidence-based factors for safe behaviour and to test the combination of structured mentoring and safety-climate improvement among Niger Delta workers (Ehiaguina, 2022)	To address low proactive behaviour in the Niger Delta, long-term structured mentoring by senior supervisors was combined with periodic safety-climate workshops, creating an environment of mutual reminder and hazard reporting (Ehiaguina, 2022)
Development and testing of comprehensive safety-awareness training models	To assess refinery and rig workers' awareness of physical and chronic health hazards and to develop and test a comprehensive OSH training model (Benson et al., 2021)	To improve understanding of physical and long-term health hazards among refinery and rig workers, a comprehensive programme combining theoretical instruction with realistic field simulations and specific modules on chronic hazards was developed and certified periodically (Benson et al., 2021)
	To measure the full-scale impact of Behaviour-Based Safety (BBS) on hazard perception and injury rates among upstream workers and identify best practices (Eubank, 2021)	To enhance hazard perception in upstream environments, full Behaviour-Based Safety was implemented through peer-observation training, immediate feedback, and recognition of safe practices (Eubank, 2021)
	To examine the relationship between risk perception and accidents, and to design and test simulation-based training for Jubilee Field workers (Otoo, 2019)	To strengthen risk perception at Jubilee Field, simulation-based training using real-world accident scenarios, virtual exercises, and in-depth post-simulation debriefings was introduced (Otoo, 2019).
	To identify best practices for integrating human-factors engineering into offshore safety training through a global review and recommend technology-based programmes (Chandrasegaran et al., 2020)	To integrate human-factors engineering, the use of high-fidelity virtual reality, advanced simulators, and structured error-prevention tools was strongly recommended for offshore hazard-recognition training (Chandrasegaran et al., 2020)
	To identify human errors and influencing factors using machine learning on large incident datasets, with implications for data-driven training in high-risk industries, including oil and gas (Morais et al., 2022)	To develop data-driven training, machine learning analysis of over 10,000 incidents was used to prioritise interventions targeting fatigue, leadership pressure, and organisational factors, recommending adaptive awareness modules based on error patterns in oil and gas operations (Morais et al., 2022)
Ergonomics awareness among offshore oil and gas workers	To evaluate the level of physical ergonomics awareness among Malaysian O&G workers and to assess their perception towards the criticality of physical ergonomics issues within an offshore processing facility (M. Noor & Raja Ghazilla, 2020).	Workers' awareness of physical ergonomics has been shown to develop through direct experience in offshore environments, regardless of their type or level of experience. This study highlights the importance of ergonomics education and collaboration between industry experts and ergonomists to help workers identify indirect physical ergonomic risks, particularly those related to tripping/slipping hazards and workplace design, as part of a structured mitigation program during the engineering design phase (M. Noor & Raja Ghazilla, 2020).
Management of psychosocial risks and prevention of vigilance decline among offshore and onshore workers	To identify causes of vigilance decline after the twelfth day of offshore rotation in the North Sea, to develop a psychosocial awareness programme, and to test its effectiveness in maintaining situational awareness for both offshore and onshore personnel (Bergh, 2019)	To sustain vigilance among offshore and onshore workers, a psychosocial awareness programme was designed that includes pre-duty briefing, daily fatigue monitoring, mandatory mid-period reinforcement sessions, and comprehensive post-duty debriefing, thereby enabling workers to recognise and respond to hazards optimally throughout their work cycle (Bergh, 2019).
	To assess occupational stress risk level and identify dominant psychosocial factors using a worker-participative method (Yaakub et al., 2024)	Introduced a simple, worker-participative Occupational Stress Risk Assessment Matrix (Likelihood × Severity) that can be completed in groups during routine safety meetings. Using this tool, 146 Malaysian oil & gas workers identified lack of recognition (86.9 %) and workplace exposure as the dominant stressors, with 97.3 % of the population rated at moderate overall stress risk. The authors recommend integrating the matrix into every safety induction and toolbox talk as a low-cost, high-impact educational intervention that simultaneously raises awareness, identifies hidden psychosocial hazards, and promotes immediate control measures (recognition programs, buddy systems, and rotation reviews) (Yaakub et al., 2024).

CONCLUSION

This scoping review concludes that education programmes aimed at enhancing safety awareness among oil and gas workers can no longer rely on conventional one-off or compliance-driven training. Truly effective programmes must be integrated, sustained over time, and simultaneously incorporate three indispensable components: a living safety culture supported by visible field leadership and structured mentoring; behaviour-based training (BBS), high-fidelity simulation, virtual reality, and human-factors engineering approaches; explicit management of psychosocial risks and fatigue, particularly for offshore workers who live on platforms for 2-4 weeks without returning home.

Norway's long-term experience demonstrates that consistent national-level implementation of this integrated model can reduce fatal accidents to near zero. By contrast, Indonesia, one of the world's major oil and gas producers, still lacks sufficient primary evidence on a safety-awareness model tailored to its local context. Existing national studies have largely concentrated on exploration technologies and environmental monitoring (Susantoro et al., 2023), highlighting the urgency of expanding research toward human factors and safety awareness as a complementary domain. Therefore, the Indonesian oil and gas industry must urgently shift from a reactive approach to a genuine prevention culture, ensuring that every worker returns home safely every day.

Although the scoping review has addressed the research objectives, a limitation of this study is that it searched only three databases: Medline (PubMed), APA PsycArticles® (ProQuest), and Scopus, which may limit the comprehensiveness of the findings.

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GLOSSARY OF TERMS AND SYMBOLS

Terms & Symbols	Definition	Unit
Behaviour-Based Safety (BBS)	A structured safety approach that focuses on observing and reinforcing safe behaviours through peer feedback to reduce unsafe acts.	
Crew Resource Management (CRM)	A training framework that enhances communication, leadership, and situational awareness to minimise human-factor related incidents.	
Hazard Recognition	The ability of workers to identify potential sources of danger before they escalate into accidents or injuries.	
Human Factors Engineering (HFE)	An interdisciplinary field examining interactions between humans, technology, and work systems to improve safety and reduce errors.	
Near-Miss	An unplanned event that did not cause harm but had the potential to result in injury, damage, or operational disruption.	
Offshore Operations	Oil and gas activities conducted at sea, typically involving rotational work patterns and elevated physical and psychosocial risks.	
Onshore Operations	Oil and gas activities performed on land-based facilities such as refineries, processing plants, or terminals.	
PRISMA-ScR	Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews; a guideline for transparent reporting of scoping review studies.	
Psychosocial Risk	Work-related psychological and social factors (e.g., fatigue, stress, isolation) that may influence safety performance.	
Risk Perception	Workers' subjective judgement about hazard severity and likelihood, shaping safety behaviour and decision-making.	
Safety Awareness	Continuous perception of hazards, understanding of their significance, and anticipation of future consequences in dynamic environments.	

Safety Climate	Workers' shared perceptions of organisational safety policies, practices, and priorities at a given time.
Safety Culture	Organisational values, norms, and attitudes that influence collective commitment to safety.
Situational Awareness	The ability to perceive environmental conditions, comprehend their meaning, and anticipate future operational states.
Virtual Reality (VR) Training	Technology-based simulation that enables workers to experience hazardous scenarios safely for training and awareness improvement.

REFERENCES

Arksey, H., & O'Malley, L., (2005), Scoping studies: towards a methodological framework. International Journal of Social Research Methodology, 8(1), 19–32. https://doi.org/10.1080/1364557032000119616.

Arrow, C. R., (2015), An action research study focused on training programs to reduce injuries and fatalities in high risk industries Colorado Technical University.

Benson, C., Dimopoulos, C., Argyropoulos, C. D., Mikellidou, C. V, & Boustras, G., (2021), Assessing the common occupational health hazards and their health risks among oil and gas workers. Safety Science, 140, 105284. https://doi.org/10.1016/j.ssci.2021.105284.

Bergh, L. I. V., (2019), Tailoring psychosocial risk assessment in the oil and gas industry by exploring specific and common psychosocial risks. Safety and Health at Work, 10(1), 63–70. https://doi.org/10.1016/j.shaw.2017.05.001.

Chandrasegaran, D., Ghazilla, R. A. R., & Rich, K., (2020), Human factors engineering integration in the offshore O&G industry: A review of current state of practice. Safety Science, 125, 104614. https://doi.org/10.1016/j.ssci.2020.104627.

Chemical Safety Board, (2007), Investigation report: Refinery explosion and fire – BP Texas City. https://www.csb.gov/bp-america-texas-city-refinery-explosion/.

Chukwuma, O. I., (2023), The impact of safety culture on workers' safety performance in the Nigerian oil and gas industry. Safety in Extreme Environments, 5(2), 112–125. https://doi.org/10.1007/s42797-023-00089-4.

Crystiana, I., Susantoro, T. M., & Firdaus, N. , (2019), Pengolahan Data Citra Satelit untuk Mengidentifikasi Potensi Jebakan dalam Kegiatan Eksplorasi Migas. Lembaran Publikasi Minyak Dan Gas Bumi, 49(1), 41–51. https://doi.org/10.29017/LPMGB.49.1.235.

Cullen, T. H. L., (1990), The public inquiry into the Piper Alpha disaster. https://www.hse.gov.uk/offshore/piper-alpha-disaster-public-inquiry.htm

Ehiaguina, E., (2022), Development of evidence based factors to enhance safety behaviour in oil and gas industry in the Niger Delta Region of Nigeria [Manchester Metropolitan University]. https://e-space.mmu.ac.uk/629590/.

Endsley, M. R., (1995), Toward a theory of situation awareness in dynamic systems. Human Factors, 37(1), 32–64. https://doi.org/10.1518/001872095779049543.

Eubank, J. D., (2021), The Efficacy of Behavior-Based Safety to Reduce Injuries in the Upstream Oil and Gas Industry [Northcentral University]. https://search.proquest.com/openview/eafed5f294e4d0a3efa41d734f0cd93b/1?pq-origsite=gscholar%5C&cbl=18750%5C&diss=y

Fuad, M., Rachmawati, D. E., Herlina, L., Setiawan, D. I., & Anugrah, R. I., (2022), Pengembangan metode identifikasi karakteristik minyak berat hasil ekstraksi oil sand Iliran High dengan formula perhitungan berdasarkan komposisi elementer. Lembaran Publikasi Minyak Dan Gas Bumi, 56(2), 99–109. https://doi.org/10.29017/LPMGB.56.2.1174.

Geller, E. S., (2001), The psychology of safety handbook. CRC Press. https://doi.org/10.1201/9781420032567.

International Association of Oil & Gas Producers. (2022). Safety performance indicators – 2022 data. https://www.iogp.org/bookstore/product/

safety-performance-indicators-2022-data/.

International Atomic Energy Agency, (2022), Nuclear power reactors in the world (2022 ed.). IAEA. https://www.iaea.org/publications/15485/nuclear-power-reactors-in-the-world.

International Civil Aviation Organization, (2023), ICAO safety report 2023. ICAO. https://www.icao.int/safety/Documents/ICAO_SR_2023_20230823.pdf.

M. Noor, M. H. H., & Raja Ghazilla, R. A., (2020), Physical ergonomics awareness in an offshore processing platform among Malaysian oil and gas workers. International Journal of Occupational Safety and Ergonomics, 26(3), 521–537. https://doi.org/10.1080/10803548.2018.1480341.

Matahelemual, G. J. S., Harto, A. B., & Susantoro, T. M., (2020), Oil Spill Detection using Sentinel -1 Multitemporal Data in Offshore Karawang. Scientific Contributions Oil and Gas, 43(2), 69–79. https://doi.org/10.29017/SCOG.43.2.522.

Morais, C., Yung, K. L., Johnson, K., Moura, R., Beer, M., & Patelli, E., (2022), Identification of human errors and influencing factors: A machine learning approach. Safety Science, 146, 105528. https://doi.org/10.1016/j.ssci.2021.105528.

Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E., (2018), Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. BMC Medical Research Methodology, 18(1), 143. https://doi.org/10.1186/s12874-018-0611-x.

National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, (2011), Deep water: The Gulf oil disaster and the future of offshore drilling. https://www.govinfo.gov/content/pkg/GPO-OILCOMMISSION/pdf/GPO-OILCOMMISSION.pdf.

Otoo, G. A., (2019), Perceived risk and occupational accidents among employees in the oil and gas industry at the Jubilee Field in Takoradi [University of Cape Coast]. https://ir.ucc.edu.gh/xmlui/handle/123456789/4994.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D.. (2021), The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ, 372, n71. https://doi.org/10.1136/bmj.n71.

Susantoro, T. M., Suliantara, S., Harto, A. B., Setiawan, H. L., Nugroho, G., Candra, D. S., Jayati, A., Sulma, S., Khomarudin, M. R., Arief, R., Maryanto, A., Hestrio, Y. F., & Kurdianto, K., (2023), The Potential of Remote Sensing Data for Oil and Gas Exploration in Indonesia: a Review. Scientific Contributions Oil and Gas, 46(1), 29–43. https://doi.org/10.29017/SCOG.46.1.1346.

Tang, D. K. H., Md Dawal, S. Z., & Olugu, E. U., (2018), Actual safety performance of the Malaysian offshore oil platforms: Correlations between the leading and lagging indicators. Journal of Safety Research, 66, 9–19. https://doi.org/10.1016/j.jsr.2018.05.003.

The John A Burns School of Medicine Health Sciences Library, (2024), Data Extraction – Systematic Review Guide. https://hslib.jabsom.hawaii.edu/systematicreview/dataextraction.

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., Moher, D., Peters, M. D. J., Horsley, T., Weeks, L., Hempel, S., Akl, E. A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M. G., Garritty, C., & Straus, S. E., (2018), PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. Annals of Internal Medicine, 169(7), 467–473. https://doi.org/10.7326/M18-0850.

Widarsono, B., Setiawan, H. L., Susantoro, T. M., Suliantara, S., Hadimuljono, J. S., Yensusminar, D., Julikah, J., & Prayoga, O. A. (2021). An Integrated Approach for Revisiting Basin-Scale Heavy Oil Potential of The Central Sumatera

Basin. Scientific Contributions Oil and Gas, 44 (1), 01–20. https://doi.org/10.29017/ SCOG.44.1.493.

World Health Organization, & International Labor Organization, (2021), WHO/ILO joint estimates of the work-related burden of disease and injury, 2000–2016: Global monitoring report. https://www.who.int/publications/i/ item/9789240034945.

Yaakub, N., Alias, A. N., Fazhilah, N., Razak, A., & Naranthran, P. A. P., (2024), Assessment of Occupational Risk Related Stress at Work Among Workers in Oil and Gas Industry. Malaysian Journal of Innovation in Engineering and Applied Social Science (MYJIEAS), 04(01).