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Developing an educational competency model for HSE officials in the steel industry

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ABSTRACT

The aim is to develop a training competency model for HSE officials in steel industry factories. This research is practical in terms of its purpose. To conduct this research, a mixed-methods approach (combining qualitative and quantitative methods) with an exploratory design was employed. In the quantitative part, a descriptive survey method was employed, and in the qualitative part, a descriptive-analytical method was used. The statistical population of the qualitative part included theoretical and empirical experts, and according to the saturation principle and the purposive sampling method, 19 interviewees were selected. Also, in the quantitative part, the statistical population included all officials (HSE) in the country's steel industry (530 people), and using the method of calculating the minimum sample size in factor analysis, 223 officials were selected. The data collection method in the qualitative section was semi-structured interviews, and in the quantitative section, researcher-made questionnaires derived from the findings of the qualitative section were used to assess the validity of the model from the perspective of the participants in the qualitative section and also from the perspective of the respondents in the quantitative section, and the validity and reliability of the tool were examined and confirmed in both qualitative and quantitative sections. The data analysis method in the qualitative section included content analysis with MaxQDA-V2018, SPSS-V27, and SmartPLS-V3 software. The competence of officials (HSE) in the country's steel industry factories includes five main parts: "general and professional knowledge", "attitude", "skills", and "psychological and behavioral factors".

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1. Introduction

Steel cycle factories are considered one of the effective factors in the sustainable development of advanced and developing countries. So that the use of this product is one of the criteria for progress because this product is the main material of all other industries and activities (Lai et al., 2023). The steel industry is one of the valuable industries with high potential in the field of export, employment generation, and sustainable development for each country, which can be considered as a parent industry (Walker and Palaon, 2025). Iranian steel reached 30 million 600 thousand tons in 2022, making it the eighth largest steel producer in the world (Hassanzadeh et al., 2025). But these parent industries have a great impact on the environment. Pollution caused by greenhouse gases (carbon dioxide, sulfur oxides, nitrogen oxides) from the production process has had a great impact on global warming. Steel production is one of the main sources of greenhouse gases, the most important of which is carbon dioxide (air sector). According to the report of the Forensic Medicine Organization, the number of deaths of workers due to work-related accidents in the year 2022 was announced as 2,115 people. In the new management approach, the most important axis of sustainable development is the preservation preservation and maintenance of human

resources, environment, and equipment. Today, this issue has been addressed by establishing and implementing the requirements of HSE systems. The importance of HSE (Health, Safety, Environment) systems in today's industries is very special from the point of view of every industrial manager (Moradi et al., 2021). The HSE unit is mainly in charge of maintaining safety and environmental health in industries. To achieve this goal, which is the preservation of safety, health and environment, safety, health and environment (HSE), officials prioritize the discussion of education in the company's strategic and operational plans and goals, because the reason for this is: insufficient information, incorrect attitudes, lack of responsibility, etc. (Gholamnia et al., 2022). HSE training is internationally recognized as the most important cause of reducing costs related to human health and occupational disease (Zandi Doulabi and Amirkardoost, 2022). In these organizations, efforts are made to achieve their goal of creating a culture and achieving sustainable development through training, especially informal training, familiarizing them with laws, regulations, and procedures, and delegating some responsibilities to them (Delobbe et al., 2016). This issue is so important that most scientists have stated that education is the key to successfully entering and passing through the 21st century and consider its important role in creating a sustainable and safe society (Kaiser et al., 2017). Training in an organization should be able to strengthen the skills that are assigned to perform the assigned tasks and fulfill the required roles in proportion to the necessities. Human capital has been defined as an acceleration factor for long-term effectiveness and sustainability in any organization (Skorkova, 2016), and its importance is especially important with the growth of the global economy and development. Paying attention to programs to improve the professional competence of human resources in line with global developments in the era called the era of knowledge and information technology is one of the most important discussions that has attracted the attention of experts (Kartini et al., 2020). Improving educational competence leads to increased commitment and improved job performance. HSEQ stands for Health and Safety, which is about preventing. Objectives of this research: A. Accordingly, improving these qualifications required by education managers will bring higher job performance (Kartini et al., 2020).

According to the introduction, some of the backgrounds related to this research are as follows: A study entitled Systematic Approach to Improving Safety Culture, (Amer and Rashed, 2022). In the end, it was determined that safety culture is tied to human behavior and administrative parameters, and for its development, measures should be taken to address Behavior, interactions, and human competencies reflected in this report (Harris, 2023). In a study titled Key and Professional Skills for Successful Safety and Mastery, the key skills are:

1) Effective Communication Skills,

2) Interpersonal Skills (Leadership Skills). Shakeel et al., 2023 in a study titled Instructional Design with ADDIE and Rapid Prototyping for Blended Learning Validation and Adoption in the Field of TVET in Bangladesh showed that due to its adaptability, ADDIE can help and meet most of the training needs (Amer and Rashed, 2022) in a study titled Bridging the Gaps in HSE Training an excellent training program can help increase employee performance in any HSE-related job requirement and reduce the number of accidents whose main cause is employee competency. Hence, it is important to provide HSE training, which enables employees to be more aware and considerate of themselves. Redondo et al., 2021 research entitled the impact of European recommendations on the validation of lifelong learning: A quality assurance model in Spain stated that quality assurance plays a relevant role in the shift towards more knowledge-based societies. Validation is an effective way to acquire qualifications that allow workers' knowledge to be identified. However, validation mechanisms are not well understood in each country. Koivupalo et al., 2015 research entitled Health and safety management in a global steel company and the shared workplace (case study and development needs) concluded that it is crucial to establish and maintain a framework to protect employees as well as your business from harm. This comprehensive research guides the key areas of HSEQ and what you need to set up a successful strategy.

Main objective: Design and validate a model for improving the educational qualifications of

HSE officials in the country's steel industry factories B.
Sub-objectives: 1- Determine the educational qualifications of HSE officials in the country's steel industry factories. 2- Determine the priority of educational qualifications of safety, health, and environment officials in the country's steel industry factories. 3- Determine the current status of educational qualifications of safety, health, and environment officials in the country's steel industry factories

2. Material and methods

The approach of this study is applied in terms of its objective and grounded theory in terms of its methodology. Grounded theory is considered one of the most fundamental types of scientific and interdisciplinary research, especially within HSE studies. The participants included both theoretical experts, namely university professors specialized in safety, occupational health, environmental education, educational sciences, and psychology, and practical experts, such as specialists and HSE managers. Using purposive sampling and the principle of theoretical saturation, a total of 19 participants were selected for the qualitative phase. In the quantitative phase, the statistical population included all HSE officers in the country's steel industry (530 individuals). Based on the minimum sample size required for factor analysis (at least 200 respondents), a total of 223 HSE officers were selected to ensure the generalizability of the findings. The data collection method in the qualitative part was semi-structured interviews, and in the quantitative part, researcher-made questionnaires derived from the findings of the qualitative part were used to assess the validity of the model from the perspective of the participants in the qualitative part and also from the perspective of the respondents in the quantitative part, and the validity and reliability of the tool were examined and confirmed in both qualitative and quantitative parts. The data analysis method in the qualitative part included content analysis with MaxQDA-V2018 software, and in the quantitative part included statistical description (description of demographic characteristics and description of research variables) and statistical analysis (confirmatory factor analysis and one-sample t-test) of the data with SPSS-V27 and SmartPLS-V3 software. In this study, the simulation method of the MaxQDA-V2018 software was used to validate the model.
In this case, using the Monte Carlo simulation method and generating raw data, the variance and covariance matrix of the population are simulated. In this way, decisions can be made using the produced matrices and the introduced indicators for model validation. Finally, the data collected from the questionnaire are entered into SPSS-V27 software, and then the data are preprocessed and screened

3. Results and discussion

Based on the data collected through semi-structured interviews and after reaching the point of theoretical saturation through continuous comparison, the process of coding began. Table 1 presents the main research questions. Finally, according to the sub-themes (semantic units) identified from the interview texts, the table below shows the basic themes, organizing, and comprehensive themes for improving the educational qualifications of safety, health, and environmental officials in the steel industries.

Table 1. Research Questions.

ROW	QUESTIONS
1.	What are the educational competencies of HSE officers in steel industry factories?
2.	What is the prioritization of educational competencies for HSE officers in steel industry factories?
3.	What is the proposed model for enhancing the educational competencies of HSE officers in steel industry factories?

Table 2. Basic, organizing, and comprehensive themes for improving the educational qualifications of safety, health, and environmental officials in the steel industry.

Structure	Next	Component	Index	Source of articles	Interviewee code
Improving the educational qualifications of safety, health, and environmental officials in the steel industry	General and professional knowledge	Familiarity with laws and regulations	Deep understanding of upstream HSE documents and laws Choosing a degree related to HSE) Work experience in HSE in the steel sector Familiarity with international HSE standards in the steel sector Knowledge of general and specialized HSE requirements in the steel industry Knowledge of interpreting HSE laws in the steel sector Awareness of HSE legal changes in the steel sector Knowledge of HSE responsibilities and rights in the steel sector	(Amer and Rashed, 2022) (Zokaee et al., 2019)	I3, I7, I10 I1, I5, I15 I2, I8, I12 I4, I6, I14 I9, I11, I19 I3, I5, I16 --- I2, I6, I17
		Risk assessment techniques	Knowledge of hazard identification Knowledge of risk analysis Knowledge of risk prioritization Knowledge of environmental impact assessment Knowledge of reporting	(Zandi Doulabi and Amirkardoost, 2022)	I4, I7, I10 I9, I12, I15 I3, I8, I14 I1, I4, I11 I2, I5, I19
		Crisis management	Knowledge of identifying HSE crises in the steel sector Knowledge of designing emergency response plans Awareness of HSE scenario simulations in the steel sector Knowledge of managing crisis teams		I6, I10, I18 I7, I12, I13 I1, I8, I15 I2, I3, I16
		Health	Familiarity with the principles of occupational health in the steel sector Knowledge of assessing working conditions in the steel sector Ability to identify occupational diseases in the steel sector Knowledge of providing improvement solutions Knowledge of designing and supervising the creation of ergonomic workstations Knowledge of personnel health indicators Knowledge of measuring harmful factors and subsequent control measures Knowledge of ergonomics Knowledge of accident and near-accident indicators Knowledge of familiarity with chemical safety data sheets	(Yari and Shobeiri, 2023)	I4, I6, I11 I1, I10, I14 I3, I5, I19 I2, I8, I16 I6, I7, I12 I4, I9, I15 I1, I3, I10 I5, I8, I17 I2, I6, I13
		Environment	Environmental awareness in the steel production industry Knowledge of familiarity with the principles of environmental protection Knowledge of the continuous reduction of pollutants and the replacement of environmentally destructive materials in steel factories Knowledge of reducing the consumption of resources and raw materials in the steel sector Knowledge of preserving and maintaining the existing green space of steel factories Knowledge of implementing the principles of an effective energy and natural resources management system Knowledge of skills in reducing waste production, separating, and recycling it	(Kartini et al., 2020) (Yari and Shobeiri, 2023) (Skorkova, 2016)	I4, I11, I18 I7, I12, I19 --- I1, I2, I15 I4, I5, I16 I8, I10, I11 I6, I7, I19 I2, I3, I13 --- I4, I9, I15 I5, I10, I18 I6, I7, I12 I3, I1, I19 I2, I8, I16 I4, I5, I11 I1, I3, I14 I9, I10, I17

		Knowledge of sustainability concepts and developing sustainability programs for the steel industry		I2, I6, I15 I8, I12, I18 I4, I7, I19
		Knowledge of the ability to assess environmental impacts		
		Knowledge of identifying opportunities for environmental improvement in the steel industry		
		Knowledge of the effects of climate change on steel industries		
		Knowledge of strategies for reducing carbon in the steel industries		
		Knowledge of developing adaptation programs for steel industries		
		Knowledge of developing protection programs for steel industries		
		Knowledge of raising awareness in the field of environmental protection in the steel industries		
		Knowledge of the concepts of social responsibility		
		Knowledge and ability to identify community needs		
		Knowledge of developing social responsibility programs for the steel industry		
		Knowledge of assessing the social impacts of steel industry projects		
		Awareness from social participation opportunities		
		Knowledge of identifying safety hazards		
		Knowledge of evaluating safety equipment and compliance with standards		
		Knowledge of compiling safety guidelines for steel industries		---
	Safety	Knowledge of preparing a matrix of personal protective equipment	(Amer and Rashed, 2022)	I2, I5, I16 I6, I10, I15
		Knowledge of training in the use of personal protective equipment in the steel industry		I4, I9, I14 I1, I2, I19
		Knowledge of skills in course supervision in the steel industry		I3, I8, I12 I5, I7, I18
		Knowledge of accident indicators, especially severity, recurrence of accidents, and their analysis		I4, I6, I11 I2, I3, I10
		Knowledge of the safety of equipment used in the steel industry		
		Knowledge of continuous improvement in safety in the steel industries		
		Knowledge of the content and subject materials of the steel industry safety		I1, I8, I16
		Knowledge of teaching-learning approaches		I5, I9, I17
		Knowledge of teaching methods		I3, I4, I19
		Knowledge of educational materials and resources		I1, I2, I11
	Educational strategies and technologies	Knowledge of learning and teaching experiences	(Gholamnia et al., 2022)	I5, I8, I15
		Knowledge of media, information, and communication technology		I4, I6, I13 I1, I10, I18
		Knowledge of classroom management		I3, I7, I12
		Knowledge of methods for motivating learning		I2, I5, I14
		Knowledge of lesson planning		I4, I9, I16
		Knowledge of educational evaluation		
		Internal satisfaction from learning about HSE issues for steel industry personnel		
		Ability to understand the cultural and social conditions of the steel industry		I8, I11, I19
	Moral and technical values	Negotiation to learn from colleagues about HSE issues	(Delobbe et al., 2016)	I1, I2, I15 ---
		A health-centered perspective for the steel industry	(Zandi Doulabi and Amirkardoost, 2022)	I4, I10, I18
Attitude		A democratic perspective in the steel industry		I6, I8, I12 I1, I3, I19
		Being trusted and trusted by the HSE manager in the steel industry		
		Cooperation in improving the HSE knowledge of steel industry personnel		I2, I5, I16
	Commitments	Cooperation in improving the HSE skills of steel industry personnel	(Yari and Shobeiri, 2023)	I4, I9, I11 I1, I8, I14
		Continuous training		I3, I7, I15

Skill	Orientation towards education	Creating a cooperative attitude in solving safety and health issues for steel industry personnel	(Amer and Rashed, 2022)	I2, I10, I18
		Creating HSE content networks in the steel industries		I4, I6, I13
		Positive self/other beliefs in HSE training		I5, I9, I19
		Intrinsic satisfaction from problem-solving in HSE teaching		I1, I3, I16
		Creating motivation for personnel to train in HSE		I2, I4, I12
		Exchanging information with other safety officials		---
		Creating an attitude of training among personnel in the steel industry		
	Instructional design skills	Analysis of HSE training needs in the steel industry		I6, I7, I14
		Introduction to determining HSE training goals in the steel industry		I1, I2, I19
		Ability to analyze participants and job roles in the steel industry		I3, I5, I11
		Determine and implement the HSE training calendar in the steel industry		---
		Ability to identify personnel talents and interests		I9, I10, I18
	Teaching skills	Familiarity with and use of various teaching approaches and methods	(Delobbe et al., 2016)	I1, I2, I14
		Familiarity with and use of teamwork skills		I3, I6, I15
		Familiarity with long-term teaching and effectiveness in worker behavior		I4, I9, I19
		Having persuasion and trust-building skills (HSE), the steel industries		I5, I7, I12
		Familiarity with cognitive processes (attention, learning concepts)		---
		Familiarity with learning psychology and different learning styles (physical or motor learner, social and interpersonal learner, individual and intrapersonal learners, ...)		I3, I4, I11
		Familiarity with individual differences (thinking and learning styles, motivation)		I2, I5, I13
		Familiarity with questioning, interpretation, and analysis skills		I6, I10, I15
		Ability to be innovative and creative while teaching		I1, I3, I19
		Having skills in using body language while teaching		I4, I8, I16
		Skill in using a constructivist approach in teaching (HSE) Steel industries employees (active and experience-based learning, self-control, and self-monitoring in the learning process)		I5, I9, I18
		Having analytical skills (HSE) in the steel industries		I2, I7, I14
		Familiarity with idea generation (HSE), steel industries		I1, I3, I12
		Having responsibility for teaching (HSE) in the steel industries		---
		Ability to select basic methods to create a detailed vision for organizing HSE training programs in the country's steel industries		
	Educational management and planning	Training time management	(Moradi et al., 2021)	I2, I5, I19
		Skills in developing training planning and HSE implementation manuals, and how to coordinate and integrate them		I6, I8, I11
		Ability to plan in terms of time of action (short-term to long-term teaching program)		I1, I3, I16
		Skills in demonstrating the link between HSE education and training of learners with educational standards		---
		Skills in developing a program for integrating HSE education in steel industry training programs		I2, I5, I18
		Coordination of quantitative development of employee training with the growth and quality improvement of the steel industries		I3, I10, I12
		Planning in terms of scope and scope of action (macro planning, units)		I6, I7, I19
				I1, I4, I15

				I3, I5, I11

				I4, I6, I19
				I2, I7, I14

Educational technology	Planning in terms of how to act (focused-guidance-motivational program, problem-solving-case program)	(Yari and Shobeiri, 2023)	I3, I8, I16
	Ability to use the dimensions of the training planning process (qualitative: training philosophy, objective-quantitative: number of learners)		---
	Ability to work with general training planning methods (planning based on workforce needs, Human, Employer)		I4, I10, I12
	Ability to apply the six-step process of implementing educational planning		I2, I3, I19
	Planning for educational implementation is first linked to the content theoretically and then empirically in the learning environment.		I6, I9, I14
	Ability to use a variety of technical and engineering tools for HSE training in the steel industry and train learners to use them correctly and safely		---
	Identify and use various locations for health, safety, and environmental training appropriate to the subject matter.		I4, I5, I11
	Select and provide infrastructure and support for HSE training in the steel industry.		I2, I10, I15
	Have qualifications related to the educational environment for HSE training in the steel industry		I3, I7, I19
	Ability to produce content in the context of new HSE educational technologies		I1, I6, I12
	Ability to use social media in HSE training		I4, I8, I16
	Ability to use educational websites for HSE training		
	Ability to use scientific visits for employees		
	Familiarity with educational simulations		
	Creating a portal or blog for the use of educational audiences		
	As much as possible, familiarity with artificial intelligence in HSE training		
Compilation and organization of educational content	Skill in identifying and evaluating educational materials and resources using specific criteria	(Rshidi et al., 2019)	---
	Fairness and accuracy in compiling and organizing content in HSE training for the steel industry		I3, I10, I15
	Depth of content provided in HSE training for the steel industry		I1, I4, I19
	Content development tailored to learners		I2, I8, I13
	Emphasis on building skills in HSE training materials for the steel industry		---
	Promoting operational orientation and civic responsibilities in HSE training for the steel industry		I5, I7, I12
	Skill in compiling content based on structural techniques (inclusive structure, connection to learners' daily lives, extensive learning environment) in the field of steel		I1, I2, I14
	Skill in organizing HSE content for the steel industries that can be used		I4, I10, I16
	Documentation of the HSE training process in the steel industries		---
	Skill in organizing content with the requirements of safety and health standards		I1, I6, I15
Educational evaluation	Ability to use initial, process, and final evaluation techniques	(Qorbali et al., 2021)	I2, I8, I19
	Be familiar with assessment tools and related test types		I4, I9, I12
	Be familiar with online tests and assessments		I3, I10, I18
	Clarify goals and expectations from learners at the beginning of an HSE training activity or instruction.		---
	Be familiar with production evaluation		I5, I7, I15
	Be familiar with organizational behavior		I4, I8, I19
	Be familiar with comparative and sequential testing		I3, I6, I14
			I1, I2, I12
			I5, I10, I18
			I4, I7, I11

			I1, I9, I15

		Be familiar with participatory evaluation		I6, I8, I19
		Be familiar with performance evaluation		---
		Be familiar with the direct observation of activities		I3, I5, I11
		Be able to describe the reasons for evaluating HSE training programs for the steel industry		I1, I2, I18
		Be able to list the types of data collection methods used in evaluating an HSE training program		I4, I7, I12
		Be able to develop a program for integrated evaluation in the overall program design process using criteria		---
		Be familiar with examining post-training indicators over a specific period and evaluating performance		
		Identify and value techniques for encouraging learners to evaluate their own and others' work		
		Organize, interpret, and use the results of different types of evaluation to help refine and improve future instruction		
		Seek opportunities to reflect on their teaching practices, both individually and collectively. Group		
		Ability to differentiate between program outputs and impacts and explain how they relate to the overall program objectives and goals		
		Systems thinking capabilities of HSE officials in the steel industry		
	Technical and professional	Targeting and integrating the health, safety, and environmental management system	(Kartini et al., 2020)	I5, I8, I19
		Ability to set HSE improvement plans in the steel industry		I1, I10, I14
		Planning and budgeting the health, safety, and environmental management system in the steel industries		I2, I6, I15
				I4, I3, I19
		Self-confidence of HSE officials in the steel industry		
		Determination of HSE officials in the steel industry		
		Avoidance of the revenge of HSE officials in the steel industry		
		Forbearance of HSE officials in the steel industry		---
		Kindness and tolerance of HSE officials in the steel industry		I2, I5, I18
		Overcoming the anger of HSE officials in the steel industry		I3, I9, I11
		Openness of HSE officials in the steel industry towards educational audiences		I4, I10, I15
	Psychological	Active listening of HSE officials in the steel industry towards educational audiences	(Pradhan et al., 2017)	I1, I7, I16
		Teamwork and the partnership spirit of HSE officials in the steel industry		---
Psychological and behavioral factors		Conscience and responsibility of HSE officials in the steel industry towards educational audiences		I5, I8, I14
		HSE officials in the steel industry are being honest with educational audiences		I4, I6, I12
		The active listening ability of HSE officials in the steel industry towards educational audiences		---
		Idealism and realism of HSE officials in the steel industry		I3, I5, I15
		Ethical skills in training HSE officials in the steel industry		I2, I8, I19
		Sharing and integrating knowledge between HSE officials in the steel industry and experts		I4, I9, I14
		Ability to adapt to changes in the educational environment		I1, I3, I12
	Behavioral	Culture of learning and innovation in HSE, and increasing employee interaction and communication	(Pourkrimi et al., 2017)	I5, I10, I16
		Active and systematic application of HSE lessons learned, standards, and proven methods by HSE officials in the steel industry		I2, I6, I18
				I4, I8, I15

				I3, I7, I14

According to Table 2, improving the educational qualifications of safety, health, and environment officials in the steel industries includes four main dimensions: general and professional knowledge, attitude, skills, and psychological and behavioral factors. In the general and professional knowledge dimension, components such as familiarity with laws and regulations, risk assessment techniques, crisis management, health, environment, safety, and educational strategies and technologies have been considered. In the attitude dimension, components of ethical and technical values, commitments, and orientation towards education have been identified. Also, the skill dimension includes components of educational design skills, teaching skills, educational management and planning, educational technology, development and organization of educational content, and educational evaluation, and the psychological and behavioral factors dimension includes psychological and behavioral aspects. In this study, skewness and kurtosis indices were first used, and the findings indicated that the data distribution was normal. The results can be seen in Table 3.

Table 3. Output of data distribution indicators and the Shapiro-Wilk statistical test to examine the assumption of normality of data distribution of the validation questionnaire from the perspective of qualitative section participants.

Significance level	Degree of freedom	W statistic	Elongation statistic	Skewness statistic	Variable
0.123	18	0.964	-0.2	0.3	External validity
0.098	18	0.957	-0.3	0.5	Internal validity

Table 4. Results of the KMO and Bartlett tests to examine the assumption of sample size adequacy.

KMO exam		
Result	Calculated value	
Suitable for factor analysis	0.911	
	Bartlett test	
Result	Calculated value	Statistics
	335.69	Q2
Suitable for factor analysis	152	Degree of freedom
	0.00	Significance level

According to Table 4, the KMO value of 0.911 indicates that the sample size is adequate for confirmatory factor analysis. When confirmatory factor analysis is used, the most appropriate criteria for examining the normality of the error distribution (data) are the Shapiro-Wilk test, as well as calculating skewness and kurtosis. The results of examining the normality of the data distribution are given in Table 5.

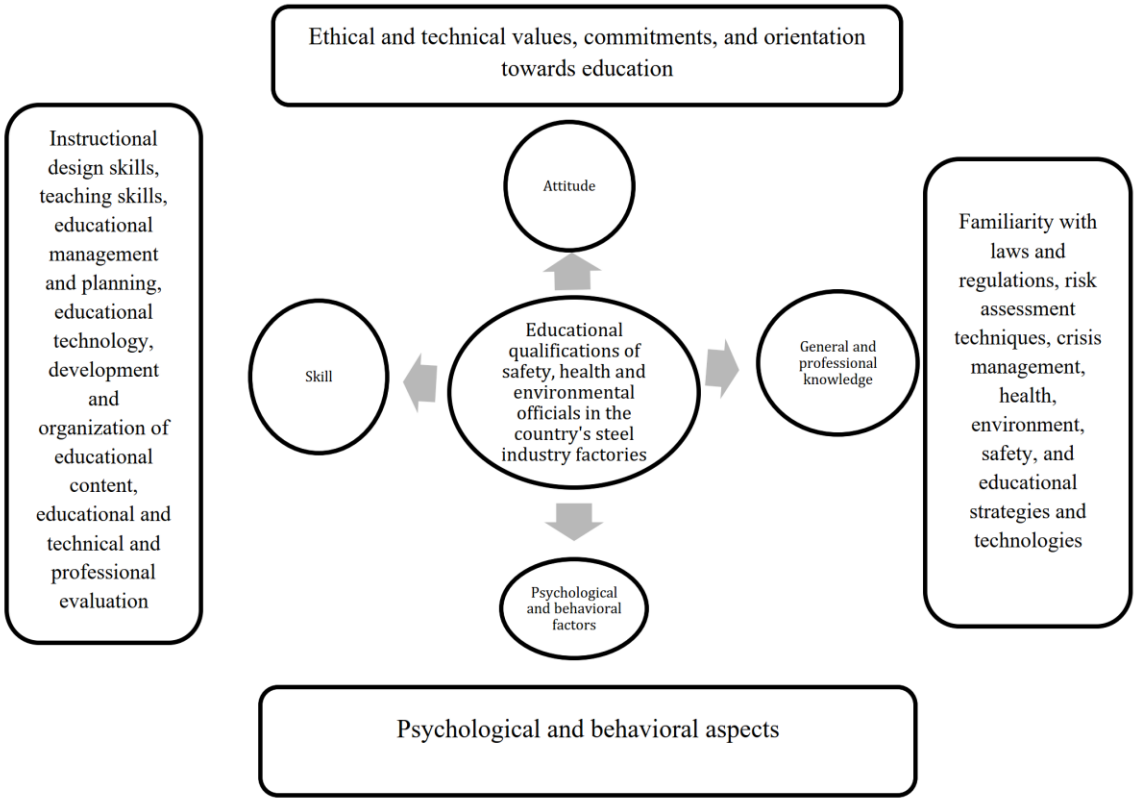
Table 5. Output of data distribution indicators and the Shapiro-Wilk statistical test to examine the assumption of normality of questionnaire data distribution from the perspective of quantitative section respondents.

Significance level	Degree of freedom	W statistic	Elongation statistic	Skewness statistic	Variable
0.229	222	0.985	-0.4	0.5	General and professional knowledge
0.149	222	0.978	-0.2	0.3	Attitude
0.319	222	0.990	-0.3	0.4	Skill
0.184	222	0.982	-0.1	0.2	Psychological and behavioral factors

The results of the Shapiro-Wilk test in Table 5 to examine the normality of the distribution of errors in 4 different variables show that the data distribution is generally normal. Considering the significance level for the variables of general and professional knowledge (0.229), attitude (0.149), skill (0.319), and psychological and behavioral factors (0.184), it can be concluded that none of these variables is significantly far from the normal distribution. Model validity, as a key part of research, not only reflects the accuracy and correctness of the results of the designed model, but also its applicability in real environments. Therefore, to present a model for improving the educational qualifications of safety, health, and environmental officials in the country's steel industry factories, the validity of this model was assessed. For this purpose, a 34-item questionnaire with a 5-point Likert scale from very low to very high was distributed among 25 experts (participants of the qualitative section). This questionnaire was used to measure the external validity of the presented model with

the target components, research method design, control of interfering variables, and adaptation and internal validity of the presented model, with the components of logical review, expert feedback, and sensitivity analysis. The significance level for external and internal validity and all components of each of the external and internal validity are less than 0.001, and the calculated means are in the range of 4.65 to 4.1, which clearly indicates the statistical significance of the findings with 99% confidence. This means that the findings obtained were not obtained by chance and confirm the high validity of the model. In addition to the above, according to the experts, the internal validity of the designed model, with an average of 4.45 and a calculated t of 10.20, is higher than the external validity. Also, among the external validity components, the research method design with an average of 4.35 and a calculated t of 9.8 has the highest validity, and on the other hand, among the internal validity components, the sensitivity analysis component with an average of 4.65 and a calculated t of 11 has the highest validity. According to the research findings, the educational qualifications of safety, health, and environment (HSE) officials in the country's steel industry factories were 174 indicators, 19 components, and 4 main dimensions. In the general and professional knowledge dimension, several key components have been identified, including familiarity with laws and regulations, risk assessment techniques, crisis management, health, environment, and safety. These components help HSE officials to have a deep understanding of upstream documents and laws in the HSE field in the steel sector and to acquire the ability to identify and analyze risks, design crisis response plans, and assess environmental impacts. For example, familiarity with international standards and knowledge of interpreting HSE laws are among the basic requirements for success in this field. Using thematic analysis, key themes and the relationships between them were identified. This analysis showed that the indicators of improving the educational qualifications of safety, health, and environmental officials in steel industry factories are significantly influenced by general and professional knowledge, attitudes, skills, and psychological and behavioral factors. Finally, according to the items given in the figure below, the final research model derived from the identified elements has been schematically drawn (Fig. 1).

Fig. 1. Final research model derived from identified factors.



In the attitude dimension, ethical and technical values, commitments, and orientation towards education have been identified as key components. These components emphasize the importance of developing a positive attitude towards learning, collaborating in improving HSE knowledge and skills, and creating content networks in the steel industry. The ability to understand the cultural and social conditions of the steel industry and develop a collaborative attitude in solving health and safety issues is also an important aspect of this dimension. The skills dimension refers to the skills of educational design, teaching, educational management and planning, and educational technology. These skills include the necessary abilities to analyze educational needs, select appropriate teaching methods, use modern technologies, and evaluate educational performance. The ability to develop and organize educational content and educational evaluation is also considered an essential skill for HSE officials. Finally, psychological and behavioral factors are introduced as key components in this analysis. These factors include self-confidence, assertiveness, openness, and the ability to listen actively, which help to strengthen positive communication and interactions in the educational environment. Also, with the results of a study conducted in 2021 entitled "The Impact of European Recommendations on the Validation of Lifelong Learning: A VET Quality Assurance Model in Spain" by (Redondo and Castillo, 2021), the results of that study were: Lifelong learning plays a relevant role in the shift towards more knowledge-based societies, the results of which are similar to the model in some points and the items are also used in this model. It is also similar to the results of (Mokhber Dezfouli et al., 2024) on a model for developing empowering personal, social and ethical attitudes, in terms of personal, social and ethical attitudes, and is consistent with the results of (Salmah et al., 2020) on the importance and strengthening of education in the petrochemical industry. The results of this study are consistent with the results of a study conducted in 2019 entitled "The Effect of Educational Competence on the Performance of Economics Teachers in Conservatories in Makassar City" by, the results of that study were: The direct effect of educational competence on school climate on the performance of economics teachers. Which has been used in the educational qualifications model for HSE officials in the steel industry, and is consistent in some issues. Also, with the results of a study conducted in 2016 called "Providing a model to improve the professional qualifications of university educational managers" by (Amani et al., 2020), the results of that study were: The success of an educational organization is also in having efficient, competent, capable and expert managers, which results are similar in some points to the educational qualifications model for HSE officials in the steel industry and the items have also been used in this model.

4. Conclusion

In general, these results have well identified the different dimensions of the educational qualifications of HSE officials and emphasize the importance of improving these qualifications to improve safety, health, and the environment in the steel industry. This analysis shows that developing skills and knowledge in the field of HSE not only helps to improve the individual performance of officials but also leads to the overall improvement of the HSE culture in industrial organizations. Considering the prevailing problems in the steel industry in the fields of safety, health and environment, especially its environmental aspect, which has been neglected by those involved in this field of responsibility (according to documentary reviews and scientific sources), and on the other hand, the important role of safety, health and environment officials in resolving these problems, especially in the context of playing their educational role for employees in various sectors of this industry, which itself depends on the level of their technical qualifications and competencies and professional skills, the implementation of this research is relevant and necessary.

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