International Journal of Innovative Research in Education

Volume 11, Issue 1, (2024) 1-11

www.ijire.eu

# The synergistic relationship between experiential learning and safety culture in industrial engineering students during the pandemic

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**Suggested Citation:**
Cortés-Peña O.F., Pulcha-Honores J.R., Poma-Chávez J.J. & Villanueva-Blas L.F. (2024). The synergistic relationship between experiential learning and safety culture in industrial engineering students during the pandemic. *International Journal of Innovative Research in Education*. *11*(1), 1-11. https://doi.org/10.18844/ijire.v11i1.9290

Received from January 11, 2024; revised from March 23, 2024; accepted from April 24, 2024.
Selection and peer review under the responsibility of Prof. Dr. Zehra Ozcinar, Ataturk Teacher Training Academy, Cyprus


**Abstract**

The objective of this research was to analyze how experiential learning is synergistically related to the development of a safety culture, under the special conditions of the COVID-19 pandemic in university students. The methodological approach was focused on a triangulated mixed design perspective, which allows integration of the qualitative and quantitative results derived from the educational experience of the pilot implementation of the model with a sample of students of the VII cycle of the Industrial Engineering program. The results obtained showed the relevance of the application of experiential learning to achieve the development of a safety culture in students. It was observed that active experimentation was the experiential learning factor that was most closely related to training in safety and skills. In this way, experiential learning through dynamism and experiential experiences manages to generate a safety culture. In conclusion, experiential learning manages to be an adequate strategy for the development of a culture of safety in students.

***Keywords:*** Experiential learning; industrial engineering; pandemic; risks; safety culture.

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## 1. INTRODUCTION

University education with the exponential increase in technology faces challenges in adapting to the changes posed by the knowledge society (Ayala, 2020; Levis, 2023). In this sense, learning theories have gone from a behavioral conception to a constructivist position, granting a different epistemological, theoretical, referential, and contextual framework. In this transformational process, it was determined that learning should be constructive, experimental, and permanent. However, there are exogenous and endogenous factors that affect the learning of students at the higher level (Bacilio, Pulcha & Poma, 2020).

Based on the unique biosafety conditions associated with the health contingencies resulting from the COVID-19 pandemic, the Industrial Safety subject in the Industrial Engineering program aims to develop in the student the ability to identify the risks that affect safety and hygiene in the work environment and apply the necessary measures to control them. This will allow the student to develop a culture of safety. Likewise, this subject is of a theoretical and practical nature, for which field practices are of the utmost importance for the achievement of the proposed capacities in the students, the same ones that will be reflected in their professional actions (Onge, et al., 2013; Chaparro, 2020; Fuentes et al., 2019; Baena, 2019; ILO, 2020; Palmer, et al., 2021).

There is little concern on the part of certain industries about the development of work safety, which generates a general dilemma in the country. The application of experiential learning techniques to increase awareness, create preventative behaviors that are a part of the safety culture, and sensitize people is considered relevant in the context of this research (Stuart, 2014; Ramirez-Asis, et al., 2020; Rojas, 2019).

Among the main theoretical and empirical references associated with this study are the contributions, initially from Kolb (1984) who defined experiential learning as "the process by which knowledge is created through the transformation of experience, which results from the combination of understanding and transformation experience". In this way, experiential learning is a knowledge construction process that implies creativity in the four moments proposed: concrete experience, abstract conceptualization, reflective observation, and active experimentation, which respond to contextual demands (Kolb & Kolb, 2005).

Alarcón-Díaz et al., (2019) implemented the model of experiential learning from a mixed methodological perspective, highlighting the relevance in its quantitative and qualitative contribution, from the appreciation of the farmers exposed to the program based on experiential learning, and showing the significant importance of learning based on this strategy. Briceño et al., (2019) argue that experiential learning makes use of the integration of knowledge, skills, and attitudes, articulated with the development of skills aimed at transferring what is learned within the educational environment and applied in different everyday contexts. COA (2018), and Love (2024) asserted that experiential learning is closely related to the commitment to safety and responsibility that students must develop, to respond appropriately to risks and develop prevention practices by nature and biosafety conditions in their work, especially when exposed to real experiences that generate a cognitive, emotional, and behavioral impact against the risks and prevention of occupational accidents.

Given the above, in the analyzed sample, the field practices are aimed at identifying possible existing occupational risks, defining preventive measures to reduce or avoid possible existing risks in each of the jobs, and evaluating the risks that may exist based on concrete experience, reflective observation, abstract conceptualization, and active experimentation. In this way, experiential learning allows the individual to develop the ability to be the creator and connector of his own life, build his knowledge to develop skills, and reinforce his values directly from experience (Bacilio et al., 2020).

Experiential learning proposes an active attitude of the student, which is established by starting from their relationship with the contents from an angle that arouses greater interest, which favors their motivation in the process and the retention of knowledge (Stemn et al., 2019; Salas, 2018). In this context, virtual reality and virtual laboratories increase and reinforce the learning processes in university students and design enterprise software as a technology for learning and knowledge applied to safety culture in topics then laboral and prevention risk (Gavitte et al., 2024; Afsharipour & Maghoul 2024; Stemn et al., 2019; Sofri et al., 2024; Díaz-López et al., 2020; Velandia, 2020; Toyoda et al., 2022).

### *1.1.* Purpose of study

Through probing this phenomenon, the research problem was able to uncover how, in the VII cycle of a private university in Lima, experiential learning supports students' development of a safety culture from their subjective and intersubjective perceptions (Bacilio et al., 2020). Consequently, the central problem of the research arises: How is the experiential learning model synergistically articulated with the development of a safety culture aimed at identifying risks and promoting preventive behaviors in industrial engineering students in times of pandemic?

## 2. METHODS AND MATERIALS

The methodological approach was focused from a triangulated mixed design perspective (Kelle et al., 2019), which allows integration of the qualitative and quantitative results, applied in this case from the educational experience of the pilot implementation of the model with a sample of students of the VII cycle of the Industrial Engineering program (Bacilio et al., 2020).

### *2.1.* Data collection tools

As a result of the mixed methodological perspective, a semi-structured interview was designed and validated by judges based on the formulation of a consistency and operationalization matrix with the indicators associated with the safety culture and its synergistic articulation with the experiential learning model (Guldenmund, 2007; Canchola, et al., 2021). The interview was made up of (16) items aimed at qualitatively and quantitatively assessing the components of experiential learning with their associated dimensions (concrete experiences, reflective observation, abstract conceptualization, and active experimentation); articulated with the safety culture component, associated dimensions were also identified (hazard and risk management, safety and skills training, accident investigation, and safety and responsibility commitment).

### *2.2.* Procedure

At the procedural level, the experiential learning model and the semi-structured interview were implemented under the virtual modality due to the context of the national state of emergency due to COVID-19. The first contact was made with the students to coordinate their participation and the time of the interview. Informed consent was requested previously to ensure compliance with ethical standards in social and educational research.

The interview was held on weekends for the convenience of the participants. In this way, through the Zoom platform, the interviews were conducted, which were recorded before agreement with the interviewees. The moderators of the interview were the authors of the thesis. The information obtained from the interviews was systematized, and then the categorization and segmentation of the terms and phrases was conducted.

Additionally, the assessments associated with the student's perception of their experience in the development of the course were analyzed.

## 3. RESULTS

The main findings derived from the pilot implementation of the experiential learning model synergistically articulated with the culture of safety are presented below, based on the conceptions and assessments reported by the students in the items of the semi-structured interview. In the first instance, the qualitative analysis of the emerging categories derived from the content analysis of the interviews is presented, in the second instance the main quantitative perceptual assessment reports are presented and finally an integrative design is presented that illustrates the synergistic relationship between the learning model experience and the development of a safety culture.

### 3.1. Experiential learning

1. Concrete Experiences: As part of experiential learning, the category of concrete experiences is linked to the affective and emotional world of the student. It is considered a main category since the experiential learning process is based on assimilation, understanding, and transformation which indicates that the student generates an emotional bond with the content. Students, who perceive that concrete experiences are more effective for their learning, are characterized by being close and affectionate in their interpersonal relationships.

2. Reflective Observation: As part of experiential learning, reflective observation gains insight into experience. This allows for sharpening the analysis and reaching an inferential and critical level. It is a process where observation is used to understand the logic of a situation and the meaning of ideas. The student, within an experiential learning method, generates ideas and builds a critique of situations that involve deep analysis; in this way, it manages to consolidate the information it receives with a solution to a problem.

3. Abstract Conceptualization: It is a process of theorizing, classifying, or generalizing the student about a topic, to produce added information. Within this process, the student organizes their thoughts to identify norms and patterns. In addition, they prioritize rationality over emotionality, so they enjoy a planned, systematized system, based on quantitative analysis and discipline.

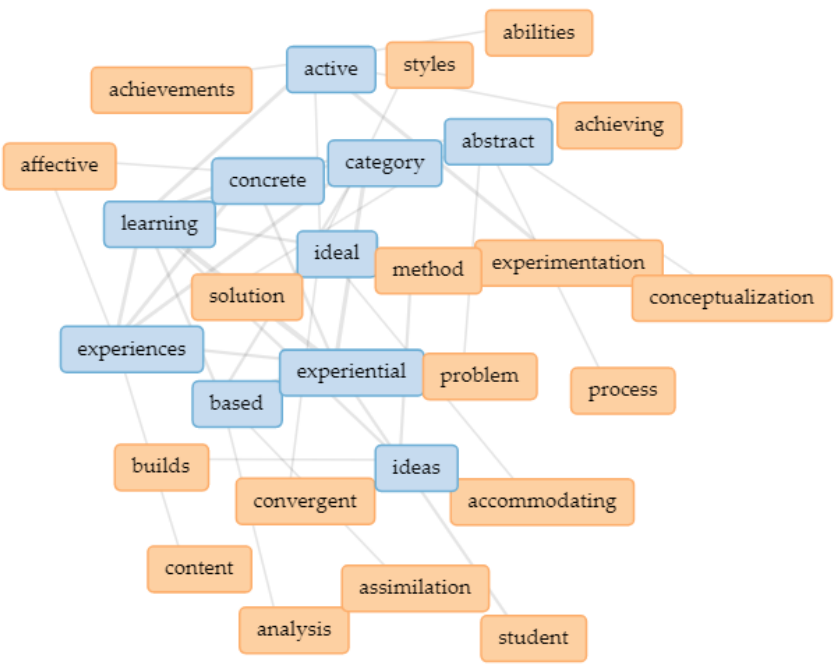
4. Active Experimentation: The students surveyed have shown answers where they show the application of knowledge in front of a real case. This allows them to develop new qualities and abilities. The formation of active experimentation in experiential learning is aimed at achieving achievements, meeting objectives, and obtaining results. active experimentation was related to behaviors, feelings, and thinking. Therefore, accommodating, and convergent learning styles are ideal for learning through active experimentation. These findings are illustrated in Figures 1 and 2 below.

**Figure 1**

*Experiential learning: categories and educational conceptions*


**Figure 2**

*Experiential learning: semantic map of analytical categories*



### 3.2. Safety culture

1. Hazard and Risk Management: As part of the training and development of safety culture, students face various situations where experiential learning exposes them to events to stimulate firsthand learning. Within this category, it is noted that the use of experiential learning in class allows learning about evaluation and assessment to propose safe solutions to risk situations so that accidents in personnel can be avoided.

2. Training in Safety and Skills: For the category of training in safety and skills, the answers were focused on two types of activities in which a video and a role-play were used to observe that the experiential learning used in the classes drives the training of the students. From this perspective, stimuli should be used in class to generate knowledge and help to reflect and apply strategies in dangerous situations. Training in safety and skills requires a systematized and applicative structure, which is theoretically related to experiential learning.

3. Accident Research: Within the safety culture is the accident investigation category that is characterized by problem identification processes: causes and consequences. This allows for managing and preventing future accidents. That is why the student must be immersed in the development of accident research procedures to achieve results for the benefit of safety.

4. Commitment to Safety and Responsibility: The last category of safety culture ensures that the student generates commitment and responsibility in situations of risk and danger. So, the culture benefits when the student manages to develop these characteristics. Students must know about security procedures and their measurements. If the student does not generate commitment, he will be showing disinterest and carelessness, which would affect his professional life and cause future accidents. These findings are illustrated in Figures 3, 4, and 5 below.

**Figure 3**

*Safety culture: categories and educational conceptions*

**Figure 4**

*Safety culture: semantic map of analytical categories*

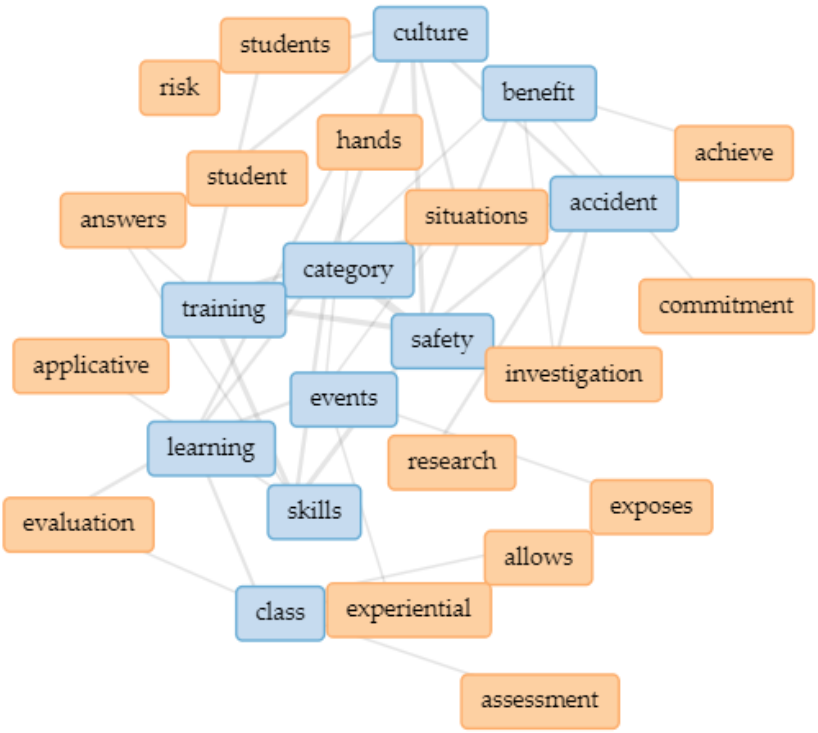



**Figure 5**

*The general profile of experiential learning & safety culture: perceptual assessment*


## 4. DISCUSSION

Experiential learning contributes to the development of safety culture, so the results show that the direct connection of experiential learning with safety culture is through active experimentation and safety training since both categories are dynamic and experiential characteristics (Kolb, 2005). Experiential learning through active experimentation needs stimuli. The students indirectly argued the importance of experiential learning, they used their methods to highlight its relevance. When the student is exposed to group dynamics or experiential drills, he begins to understand and assimilate theoretical information. In this way, theoretical learning solidifies and manages to establish itself as learning. This allows the student to avoid making learned mistakes and prevent risky behaviors.

The students showed that the use of experiential learning allows them to better understand the evaluation and assessment that are made of hazards and risks. This allows for proposing solution strategies and preventing accidents. Exposure to photographs as a method of experiential learning is effective since it predisposes the student to better learning. On the other hand, the application of the IPER matrix is necessary in the safety culture because it helps to know the measurement indicators and achieve better management.

## 5. CONCLUSION

The synergistic relationship between the experiential learning model and training in the safety culture, experiential learning, and safety training, constitutes an innovative framework for the efficient development of skills, highlighting that the experiential methodology promotes and strengthens the student. comprehensive prevention of occupational hazards.

Training in safety and skills is an adequate method to learn about the risks. The authorities are called to manage massive processes on the expansion of the security culture; and in turn, Industrial Engineering students should be in charge of giving talks on safety to the different careers that are unaware of these aspects, in this context of a pandemic.

**Conflict of Interest:** The authors declare no conflict of interest.

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**Ethical Approval**: Informed consent was sought to guarantee adherence to ethical guidelines in social and educational research.

**Funding:** This research received no external funding.

**REFERENCES**

Afsharipour, M., & Maghoul, P. (2024). Towards Education 4.0 in Geotechnical Engineering Using a Virtual Reality/Augmented Reality Visualization Platform. *Geotechnical and Geological Engineering*, *42*(4), 2657-2673. https://link.springer.com/article/10.1007/s10706-023-02697-x

Alarcón-Diaz, H., Alcas Zapata, N., Alarcón Díaz, M., Ocaña Fernández, Y., M Hernández, R., & Rodríguez Fuentes, A. (2019). Influence of a program for the development of experiential learning in farmers.

Ayala, R. (2020). *Immersive learning and virtual worlds in university education*, (Master's Thesis), Universidad César Vallejo, Perú.

Bacilio, J., Pulcha, J., & Poma, J. (2020). *Experiential Learning Research and Development of the Safety Culture in Students of Industrial Engineering Program (VII – Cycle) of a Private University*, (Master's Thesis), Universidad Tecnológica del Perú.

Baena, V. (2019). *Experiential learning as a teaching methodology*. Madrid, España: Narcea S.A. Ediciones.

Briceño, J.; Rivas, J; & Lobo, H. (2019). Experimentation and its Integration in the Teaching-Learning Process of Physics in Secondary Education. *Revista Latino-Americana de Estudos em Cultura e Sociedade, 5*(2). https://periodicos.claec.org/index.php/relacult/article/view/1512/1111.

Canchola, A., Pinto-Santos, A., Cortes-Pena, O., Laborda, J., & Robles, J. (2021). Validation of the attitudinal scale of open educational practices in university teachers. *Cypriot Journal of Educational Sciences, 16*(4), 1517–1532. https://doi.org/10.18844/cjes.v16i4.6009

Chaparro, C. (2020). *Design for the Implementation of the Occupational Health and Safety Management System for Compañía Ingeaceros de Colombia S.A.S.* (Master's Thesis). Universidad Nacional Abierta y a Distancia, Colombia.

COA (2018). *plunges into the academic year*. College of the Atlantic. https://www.coa.edu/live/news/1626-coa-plunges-into-academic-year

Díaz-López, L., Tarango, J., & Romo-González, J. R. (2020). Virtual Reality in learning processes in university students: motivation and interest to awaken scientific vocations. *Cuadernos de Documentación Multimedia, 31*, 1-14. https://doi.org/10.5209/cdmu.68958

Fuentes, D.; Toro, J.; Ahumada, P.; Espinoza, M. I.; & Oyarte, M. (2019). Change of attitude of Nursing students towards mental illness through experiential learning. *Revista Cubana de Educación Médica Superior. 33*(1), 1-13. https://www.medigraphic.com/cgi-bin/new/resumenI.cgi?IDARTICULO=90798

Gavitte, S. B., Koretsky, M. D., & Nason, J. A. (2024). Connecting affordances of physical and virtual laboratory modes to engineering epistemic practices. *Journal of Computing in Higher Education*, 1-35. https://link.springer.com/article/10.1007/s12528-024-09403-7

Guldenmund, F. W. (2007). The use of questionnaires in safety culture research–an evaluation. *Safety Science, 45*(6), 723-743. https://www.sciencedirect.com/science/article/pii/S0925753507000239

International Labour Organization (ILO). (2020). *Safety and health at work in the face of the pandemic*. https://www.ilo.org/global/publications/lang--en/index.htm

Kelle, U., Kühberger, C., & Bernhard, R. (2019). How to use mixed-methods and triangulation designs: An introduction to history education research. *History Education Research Journal, 16*(1):5-23. https://journals.uclpress.co.uk/herj/article/id/2200/

Kolb, A.; & Kolb, D. (2005). Learning Styles and Learning Spaces: Enhancing Experiential Learning in Higher Education. *Academy of Management Learning & Education, 4*(2), 193-212. https://journals.aom.org/doi/abs/10.5465/AMLE.2005.17268566

Kolb, D.A. (1984). *Experiential Learning: Experience k the Source of Learning and Development*. Englewood Cliffs, NJ: Prentice Hall.

Levis, M., Hyland, C., & Zartman, J. (2023). Engineering Distance Learning: The Promise and Challenges of Microfluidics. *Biomedical Engineering Education*, *3*(2), 267-278. https://link.springer.com/article/10.1007/s43683-023-00117-3

Love, T. S. (2024). A closer look at the relationship between course enrollment size and accident occurrences in hands-on engineering design-based STEM courses. *International Journal of Technology and Design Education*, 1-26. https://link.springer.com/article/10.1007/s10798-024-09910-9

Onge, J. S., Hodges, T., McBride, M., & Parnell, R. (2013). An innovative tool for experiential learning of nursing quality and safety competencies. *Nurse Educator, 38*(2), 71-75. https://journals.lww.com/nurseeducatoronline/fulltext/2013/03000/an_innovative_tool_for_experiential_learning_of.13.aspx

Palmer, L. E., Pagoto, S. L., Workman, D., Lewis, K. A., Rudin, L., De Luna, N., ... & Waring, M. E. (2021). Health and education concerns about returning to campus and online learning during the COVID-19 pandemic among US undergraduate STEM majors. *Journal of American College Health, 1*-8. https://www.tandfonline.com/doi/abs/10.1080/07448481.2021.1979009

Ramirez-Asis, E., Palma, M., Huerta-Soto, R., & Lázaro, R. (2020) Labor behavior and safety at work in construction companies in Peru. *Revista de Investigación en Gestión Industrial, Ambiental, Seguridad y Salud en el Trabajo- GISST, 1*(1), 30-42. https://scholar.archive.org/work/ohicxsj4pjd2lmov7jsvrnfubu/access/wayback/https://www.editorialeidec.com/revista/index.php/GISST/article/download/18/10

Rojas, J. (2019). *Design of a management tool to assess the culture of safety at work,* (Master's Thesis). Universidad Nacional Mayor de San Marcos, Perú.

Salas, M. (2018). *Application of experiential learning to develop the social skills of the students of the II Cycle of the Accounting Professional School of the Huánuco branch ULADECH – 2017*, (Master's Thesis), Universidad Católica Los Ángeles de Chimbote, Perú.

Sofri, S., Reddy Prasad, D. M., Azri, M. H., & Raja Sekhar, Y. (2024). Undergraduates' process safety knowledge development with virtual reality game. *Interactive Learning Environments*, 1-19. https://www.tandfonline.com/doi/abs/10.1080/10494820.2024.2371938

Stemn, E., Bofinger, C., Cliff, D. & Hassal, M. (2019). Examining the relationship between safety culture maturity and safety performance of the mining industry. *Safety Science, 113,* 345-355. https://www.sciencedirect.com/science/article/pii/S0925753518305976

Stuart, A. (2014). A blended learning approach to safety training: Student experiences of safe work practices and safety culture. *Safety Science, 62*, 409-417. https://www.sciencedirect.com/science/article/pii/S0925753513002300

Cortés-Peña O.F., Pulcha-Honores J.R., Poma-Chávez J.J. & Villanueva-Blas L.F. (2024). The synergistic relationship between experiential learning and safety culture in industrial engineering students during the pandemic. *International Journal of Innovative Research in Education*. *11*(1), 1-11. https://doi.org/10.18844/ijire.v11i1.9290

Toyoda, R., Russo-Abegão, F., & Glassey, J. (2022). VR-based health and safety training in various high-risk engineering industries: a literature review. *International Journal of Educational Technology in Higher Education*, *19*(1), 42. https://link.springer.com/article/10.1186/s41239-022-00349-3

Velandia G., H. (2020). *Virtual laboratories (LV): a didactic tool for practical learning of electricity in basic and secondary education institutions* (Master's Thesis), Universidad de la Sabana, Colombia.