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Using Design Thinking to Identify Training Needs in CPR Education: A Qualitative Study with Nursing Students and Professionals

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Abstract

Background: Despite the importance of cardiopulmonary resuscitation (CPR) in improving survival rates after cardiac arrest, nursing students often experience challenges related to skill retention, emotional readiness, and confidence. Innovative pedagogical strategies, such as simulation-based learning and the use of virtual reality (VR), have been suggested as potential tools to enhance CPR training. This study explores training needs and emotional barriers from the perspective of students and healthcare professionals using a Design Thinking approach.

Methods: An exploratory qualitative study was conducted as part of the preliminary phase of a larger randomized controlled trial. Structured group sessions using empathy mapping—a core tool of Design Thinking—were held with 120 undergraduate nursing students and 20 healthcare professionals. Data were analyzed thematically following Braun and Clarke's six-phase method. Two independent coders ensured reliability through consensus**.**

Results: Four major themes were identified: [1] need for increased hands-on practice, [2] lack of self-confidence during emergency scenarios, [3] disconnect between theory and real-life application, and [4] emotional stress related to fear of failure. Participants expressed that immersive tools like VR could offer a safe environment for repeated exposure, helping to reinforce technical and emotional competence in CPR.

Conclusions: This study highlights the potential of using Design Thinking to identify experiential learning needs in CPR education. Findings suggest that virtual reality may act as a complementary tool to traditional simulation-based training, enhancing emotional safety and learner confidence. These insights may inform the development of a user-centered educational intervention to be tested in a subsequent phase of the project. The findings will inform the design of a user-centered intervention to be evaluated in a subsequent randomized controlled trial.

Keywords

Cardiopulmonary Resuscitation, Nursing Education, Design Thinking, Virtual Reality, Simulation-based learning, Empathy mapping, Qualitative research.

Abbreviations

The abbreviations and definitions used throughout this manuscript are summarized in Table 1.

Abbreviation	Definition
CPR	Cardiopulmonary Resuscitation
VR	Virtual Reality
AR	Augmented Reality
ERC	European Resuscitation Council

AHA	American Heart Association
RCT	Randomized Controlled Trial

Table 1. List of abbreviations and definitions used in the manuscript.

1. Introduction

Cardiopulmonary resuscitation (CPR) is a critical procedure in emergency care, with the potential to significantly improve survival rates in both out-of-hospital (OHCA) and in-hospital (IHCA) cardiac arrest [1-3]. According to the European Resuscitation Council (ERC) and the American Heart Association (AHA) [5,6], rapid and effective administration of CPR can double or triple the probability of survival. However, time remains the most decisive variable; each minute of delay in defibrillation reduces survival odds by 3% to 6% and negatively impacts success in ventricular fibrillation. Current evidence indicates that 15.1% to 29% [7] of prehospital deaths are potentially avoidable if management errors and recognition delays—such as misinterpreting agonal breathing or convulsive movements as signs of life—are addressed. Lott et al. [8]stated that in the use of the defibrillator and advanced life support are also attributed to inadequate interactions with the devices and a lack of leadership within the team. This persistent disconnect is recognized as a 'theory-practice gap,' where clinical simulation serves as a critical pedagogical tool to enhance knowledge transfer and clinical judgment [9].

These challenges are often exacerbated by traditional training methodologies that rely on passive theory and infrequent practice, leading to rapid skill decay and a lack of responder confidence [4,5]. In contrast, recent 2025 studies demonstrate that intensive two-hour focused courses can achieve success rates of up to 75% in complex procedures like ECPR, while repeated simulation and innovative tools, such as video decision aids, significantly bolster self-perceived competence compared to conventional methods [10,11]. Maintaining these competencies is vital, as prolonged resuscitation efforts without effective skill maintenance are negatively correlated with favorable neurological outcomes [12]. Furthermore, specialized training in airway devices and team leadership is crucial to minimize technical errors and the lack of coordination frequently observed in real-life high-stakes situations [13].

The clinical failures and delays described above are closely linked to the rapid decline in technical competence following initial training. Recent studies have shown that between 50-80% of students experience a significant reduction in the quality of chest compressions within a 6-month post-training period [14, 15]. Furthermore, emotional factors, such as anxiety and fear of error, further compromise CPR performance in real-life scenarios. This highlights the need for innovative teaching methods that move beyond traditional models to

reinforce both technical proficiency and the psychological preparation of responders [16, 17].

Simulation in virtual environments has emerged as an effective strategy to address the limitations of traditional CPR teaching. Technologies such as Virtual Reality (VR) and Augmented Reality (AR) facilitate knowledge acquisition and skill retention in critical areas like Basic Life Support (BLS) and Advanced Life Support (ALS) [18]. By offering interactive and realistic scenarios, these immersive tools improve clinical performance and responder confidence in high-pressure situations [19, 20]. Evidence demonstrates that VR bridges the gap between theoretical knowledge and practical application, enhancing team coordination and decision-making without clinical risk [21, 22]. Moreover, VR-based training has been associated with superior long-term skill retention and higher user engagement compared to conventional methods [23]. Recent studies indicate that these immersive approaches foster learner satisfaction and persistence, which are critical factors for ongoing professional development [24]. Beyond individual learning outcomes, VR and AR also allow for the standardization of training protocols across varying geographical locations, providing equitable skill development opportunities regardless of local resource availability [25,26]. Ultimately, the potential of these technologies to transform medical education and enhance patient care, particularly within high-stakes emergency situations, highlights their significance in preparing a more competent and resilient healthcare workforce [21, 27].

The application of Design Thinking, a user-centered approach to creative problem-solving, enables the design of educational programs tailored to students' needs [28,29]. The present study aims to identify and analyze the training needs of nursing students in CPR using an empathy map, a Design Thinking tool that allows exploring what students think, feel, see, hear, and do in relation to their CPR training. Based on these findings, an innovative educational tool proposal will be developed based on virtual reality simulations, with the aim of improving training, increasing skill retention, and strengthening confidence in CPR performance.

This qualitative study corresponds to the preliminary exploratory phase of a broader randomized controlled trial (RCT) funded by Comillas Pontifical University. The project seeks to compare the effectiveness of augmented reality (AR) and simulation-based clinical learning (SBCL) in cardiopulmonary resuscitation (CPR) education. In this initial stage, a qualitative approach was employed to identify training needs and barriers from the perspective of key informants, including nursing students and healthcare professionals from the regional public health system. The Design Thinking methodology was selected to guide this phase, as it facilitates structured problem identification and the

iterative development of educational tools. The professional informants are external to the university, and no participants from this design phase were involved in the subsequent RCT to prevent familiarity bias and ensure the objectivity of the evaluation.

2. Methodology

A qualitative exploratory approach was adopted, based on the Design Thinking methodology. Emphasis was placed on the empathize phase through the construction of an empathy map to identify the perceptions and needs of students and healthcare professionals regarding CPR [30].

2.1 Study Design

This study followed an exploratory qualitative design based on the Design Thinking methodology, focusing on the empathize phase to explore perceptions, emotional responses, and training needs related to cardiopulmonary resuscitation [30].

Empathy mapping was used as the primary data collection tool, as it allows a structured exploration of participants' experiences across key dimensions: thoughts and feelings, observed environment, information received, actions and behaviors, perceived barriers, and expectations. This approach is particularly suitable for educational settings where emotional and experiential factors influence learning.

Data collection was conducted in two sequential phases. In Phase 1, undergraduate nursing students participated in facilitated group sessions in which they collaboratively completed empathy maps reflecting their CPR training experiences. In Phase 2, healthcare professionals with clinical CPR experience took part in similar sessions using the same structure, with prompts adapted to their professional context.

All sessions were conducted in person and moderated by members of the research team trained in qualitative research and simulation-based education. Written reflections and field notes generated during the sessions constituted the qualitative dataset. The information obtained through empathy mapping informed the subsequent thematic analysis and guided the design of a user-centered educational intervention, which will be evaluated in a later randomized controlled trial.

2.2 Sample and Participants

The sample included 120 second-year undergraduate nursing students (mean age 22.5 years; 75% female, 25% male) enrolled in the 'Physiology of the Critical Patient and Life Support' course. All participants had previously completed official basic life support (BLS) training.

Regarding the professional cohort, 20 active healthcare providers from hospital and out-of-hospital emergency services in the Community of Madrid participated (65% female, 35% male). These professionals possessed an average clinical experience exceeding 25 years and were subject to continuous CPR training according to regional protocols. Participant selection was conducted through convenience sampling, ensuring representation across different clinical backgrounds and professional seniority. All participants provided written informed consent prior to their involvement in the study.

2.3 Data Analysis

The data collected from the empathy mapping sessions were analyzed using thematic analysis, following the six-phase process described by Braun and Clarke [30]:

- Familiarization with the data (reading notes and reflections from each group).
- Generation of initial codes from written and verbal content.
- Searching for potential themes among codes.
- Reviewing themes for internal consistency and distinctiveness.
- Defining and naming themes aligned with the research questions.
- Producing a narrative report supported by representative quotes and summaries. Two researchers independently coded the data and subsequently discussed the themes to ensure inter-coder reliability.

A consensus-based approach was used to resolve discrepancies. The analysis was conducted manually using coding matrices and field notes, without the use of qualitative software tools.

Clinical trial number: not applicable.

3. Results

Data interpretation note: The themes presented below emerged from structured empathy mapping sessions conducted with nursing students and healthcare professionals. Data analysis followed a qualitative interpretive framework using thematic analysis. Frequency-based descriptors are used to reflect thematic prevalence; however, these are strictly descriptive and do not derive from inferential statistical procedures.

The thematic analysis of the empathy maps revealed four overarching themes: (1) perceived gaps in clinical training, (2) anxiety and fear of clinical error, (3) interest in immersive technologies, and (4) the requirement for real-time feedback. These themes manifest according to the participant profile, as detailed below.

3.1. Detailed Results by Participant Profile:

Results in Nursing Students

The analysis of students' reflections, as illustrated in Figure 1, revealed several recurring themes:

- **Practical training:** Lack of repetitive practice was identified as the primary factor limiting confidence.
- **Emotional barriers:** Anxiety regarding mistakes and potential physical harm to the patient predominated in the discourse.
- **Technology and feedback:** Virtual reality was proposed to provide safe environments, alongside a high demand for real-time correction.

Figure 1. Presents the empathy map based on nursing students' reflections, capturing their perceptions, emotions, and training-related needs in the context of CPR.

Results in Healthcare Professionals

As illustrated in Figure 2, the empathy map based on healthcare professionals' reflections highlighted the following points:

- **Experience, confidence and knowledge currency:** While higher confidence levels were observed compared to students, it was noted that infrequent practice reduces CPR quality. Specifically, the lack of updated training was identified as a significant barrier to maintaining clinical proficiency.

- **Focus on teamwork:** Effective team coordination during resuscitation was highlighted as a critical success factor in clinical settings.
- **Simulation and pedagogical efficiency:** Immersive tools were emphasized for their potential to optimize teaching time and foster proactive learning, facilitating better adaptation to real-world scenarios.
- **Fatigue and stress in clinical environments:** Despite their experience, several professionals acknowledged that high-stress conditions and fatigue during emergencies affect their execution of CPR procedures.

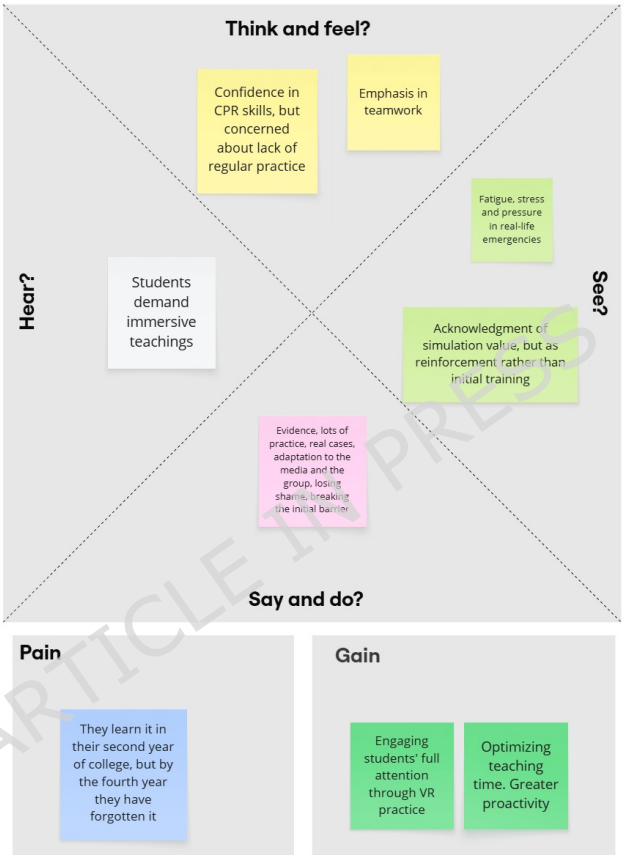

Figure 2. Empathy map summarizing healthcare professionals' perceptions, experiences, and expectations regarding cardiopulmonary resuscitation (CPR) training.

Comparison Between Both Groups:

- Nursing students emphasized the importance of repeated practice and real-time feedback, while professionals focused more on teamwork and skill maintenance over time.
- Both groups saw value in immersive tools such as virtual reality, though professionals viewed it more as reinforcement, and students as foundational learning.
- **Distinct emotional barriers were identified:** students were primarily concerned with fear of error and personal anxiety. In contrast,

professionals focused on the pedagogical challenge of breaking initial barriers in learners and managing high-pressure situations through better instructor-led adaptations.

4. Discussion

The results of this study reflect findings consistent with previous research in CPR training. It was identified that both students and healthcare professionals consider practical training insufficient, which agrees with previous studies indicating that CPR skill retention decreases significantly within a few months without continuous reinforcement [5,15]. In this context, recent systematic evidence by Daneshfar & Moonaghi [9] emphasizes that clinical simulation is a critical pedagogical tool to bridge the theory-practice gap, directly enhancing knowledge transfer and clinical judgment. Students reported high levels of anxiety and fear of error, factors that have been documented as significant barriers to effective CPR performance [17, 31]. Simulation in controlled environments, especially through the use of virtual reality, has proven effective in mitigating these negative effects and improving self-confidence in the application of resuscitation maneuvers [18-20].

On the other hand, healthcare professionals highlighted the importance of teamwork and the need for continuous training, which supports the literature emphasizing the relevance of regular training and interdisciplinary drills to optimize emergency response [2,16]. Additionally, stress and fatigue in clinical environments were identified as factors affecting the quality of intervention, which coincides with recent studies on the importance of training that integrates stress management in CPR training [14]. This also aligns with the findings of Hao et al. [31], whose work describes the experience of CPR as a dynamic process where a sense of powerlessness and the need for psychological resilience are prevalent among emergency staff.

The incorporation of the Design Thinking methodology in the design of CPR training programs represents an innovation with great potential. Recent studies have shown that this approach allows developing solutions focused on the real needs of learners, increasing learning effectiveness and participant [28,32]. The application of active learning strategies, such as the gamification and visual mapping techniques described by Chiu et al. [33], has further demonstrated efficacy in simplifying complex clinical systems and reinforcing learning outcomes in nursing education. The combination of this methodology with immersive simulation tools could transform CPR teaching, ensuring more tailored and effective training for different levels of experience in the healthcare field.

Based on the results obtained, the progressive incorporation of VR is proposed at the beginning of nursing studies as a complement to traditional teaching.

This tool would allow students to familiarize themselves with emergency scenarios in a controlled environment, thus reducing anxiety and strengthening decision-making. To maximize its effectiveness, it is recommended that these be accompanied by immediate feedback [27, 34].

5. Limitations

This study has several limitations. Voluntary participation may have introduced selection and response biases, potentially affecting the representativeness and validity of the data. In addition, the group-based empathy mapping sessions may have led to social desirability bias, whereby participants moderated their responses due to peer presence or perceived expectations.

The context-specific setting—limited to one academic institution—restricts the generalizability of findings to other educational or healthcare environments. As a qualitative and exploratory study, the results are intended to identify perceptions and training needs, not to establish causality or measure learning outcomes.

Importantly, no quantitative data were collected regarding CPR skill acquisition, performance, or knowledge retention, limiting the ability to assess the effectiveness of immersive tools. The implementation of immersive technologies may also have been constrained by limited access to devices, time availability, and resource constraints, which could have influenced the scope and depth of participants' perceptions.

6. Conclusions

This study underscores the relevance of advancing CPR education through innovative and learner-centered strategies that respond to both technical competencies and emotional readiness. Through the use of Design Thinking, the research uncovered a set of perceived barriers and training needs voiced by nursing students and healthcare professionals. These insights may serve as a valuable guide for shaping future educational interventions.

Rather than replacing traditional mannequin-based simulation, virtual reality (VR) appears to offer a promising complement—providing learners with immersive, repeatable, and psychologically safe environments for practicing complex scenarios. While VR may enhance aspects such as decision-making, emotional regulation, and situational awareness, it remains essential to maintain direct hands-on training for skill acquisition.

As this is an exploratory component within a larger research initiative, the study does not evaluate educational outcomes or efficacy. Instead, it provides insight into user needs that may inform the design of a future educational intervention. The upcoming randomized controlled trial will further evaluate the effectiveness of this intervention.

The upcoming randomized controlled trial will further test the effectiveness of the educational intervention informed by these findings.

7. Ethics approval and consent to participate

Ethical approval for this study was granted by the Ethics Committee of Comillas Pontifical University. Written informed consent was obtained from all participants prior to data collection. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki (2024 revision, World Medical Association) and complies with the provisions of the Spanish Organic Law 3/2018 of December 5, on the Protection of Personal Data and Guarantee of Digital Rights (LOPDGDD).

8. Consent for publication

Not applicable.

9. Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

10. Competing interests

The authors declare no competing interests.

11. Funding

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12. Authors' contributions

M.J.J. led the design and conceptualization of the study, oversaw ethical approvals, coordinated the research process, and prepared the final version of the manuscript as corresponding author.
E.M.ªL.T. provided expert supervision, contributed to methodological design, and approved the final version for submission.
M.G.L., J.F.B.G., E.G.G., and V.M.A. collaborated in the analysis of qualitative data and reviewed drafts of the manuscript.
D.F.A. contributed to drafting and critical revision of the manuscript.
A.S.R. contributed to the initial conceptualization, data collection and coordination of fieldwork, and reviewed the final draft.
All authors read and approved the final version of the manuscript.

13. Acknowledgements

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14. List of Figures

15. References

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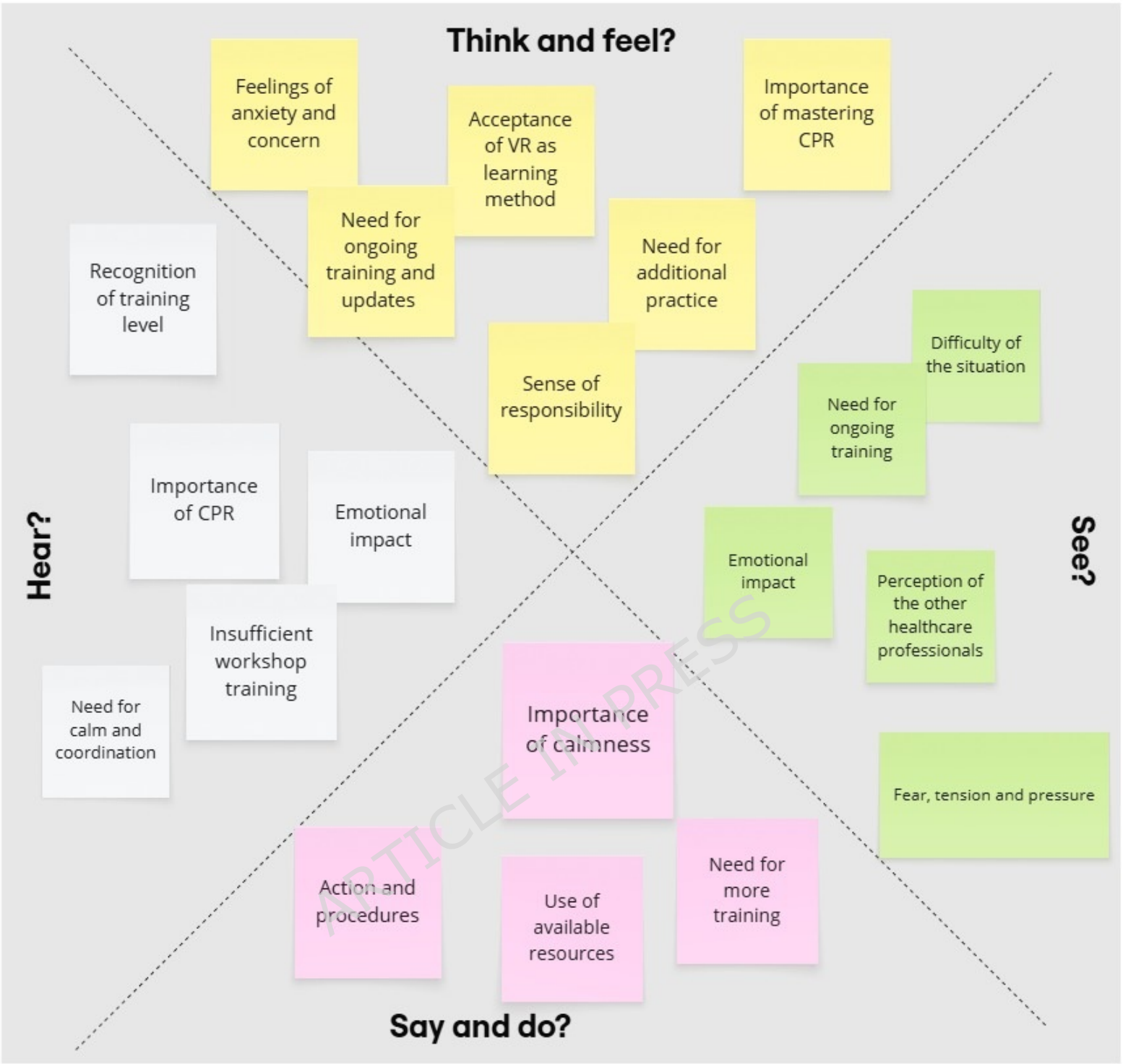
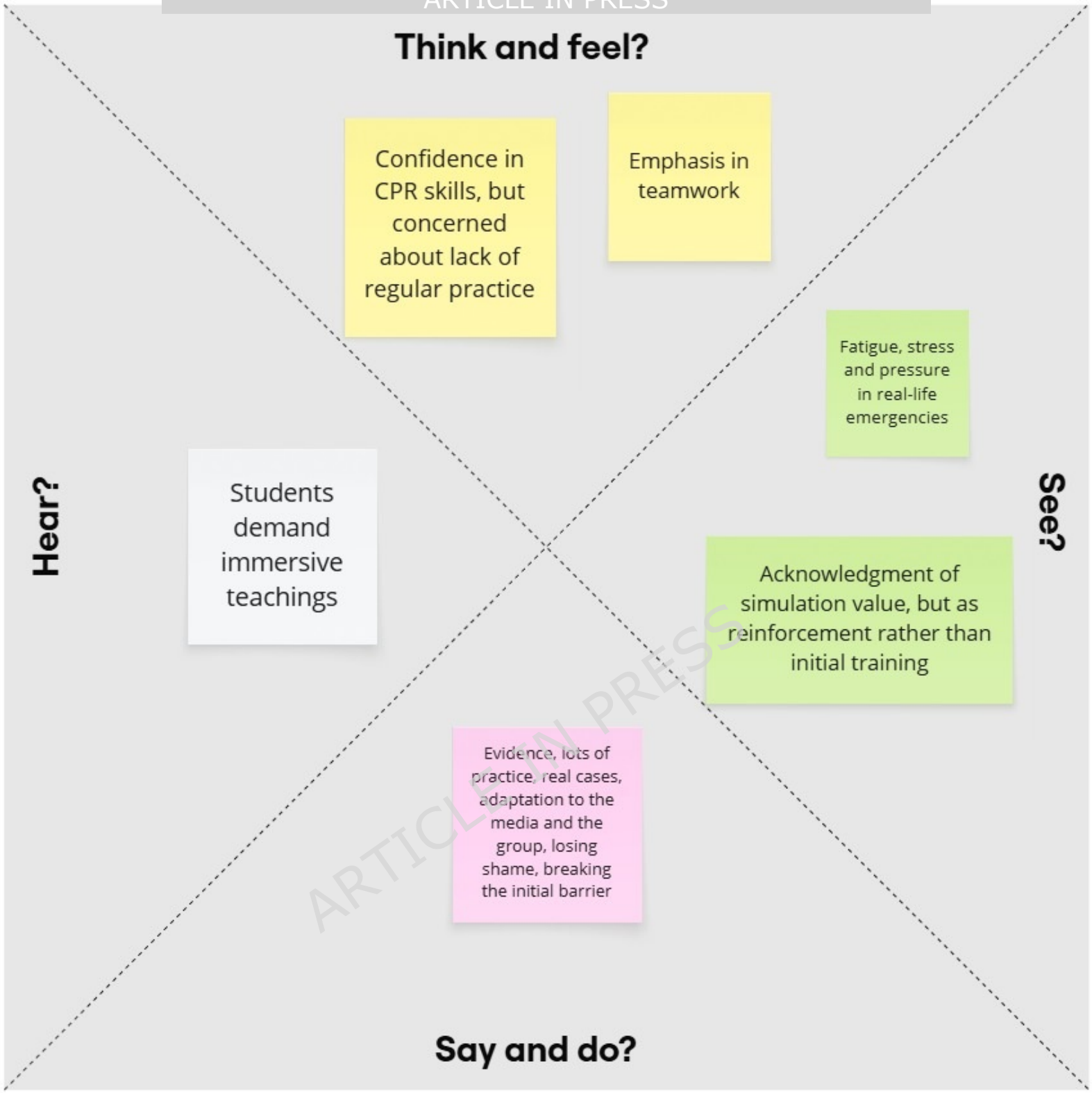


Pain

- Fear of failure
- Pressure of responsibility
- Need for more training
- Use of available resources
- Emphasis on practice

Gain

- Skill development and confidence
-Saving lives
- Practice and simulation
- Ongoing training
- Emotional support and stress management
- Patient-centered focus



Pain

They learn it in their second year of college, but by the fourth year they have forgotten it

Gain

Engaging students' full attention through VR practice

Optimizing teaching time. Greater proactivity