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JKEscape360: Integrating 360° Visual Immersion in Technical Safety Education

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ABSTRACT

This paper presents JKEscape360, an innovative immersive learning tool that leverages 360-degree visual technology to enhance first-semester students' understanding of emergency escape routes within the context of OSHA education. Designed to address the limitations of traditional 2D maps and text-based instruction, JKEscape360 provides an interactive virtual walkthrough of key evacuation paths in campus buildings, accessible via mobile devices. The study involved 31 students and 10 lecturers, employing pre- and post-tests, as well as perception surveys to evaluate the tool's effectiveness. Results showed a 29.08% increase in average test scores after the intervention, with 74.2% of students rating the tool as "Very Helpful". Lecturers similarly reported a high satisfaction level, highlighting its practicality and minimal implementation challenges. The positive reception by both students and educators underscores the pedagogical potential of immersive technologies in technical and vocational education. By simulating real-world scenarios and enhancing spatial awareness, JKEscape360 contributes meaningfully to the broader discourse on integrating AR/VR tools into modern curricula. This work aligns with the ICAREIS2025 theme on "Emerging Technologies in Education" by demonstrating how immersive media can improve learning outcomes, particularly in safety-related disciplines.

1. Introduction

Immersive technologies such as 360° video and virtual reality (VR) have revolutionized education by significantly enhancing learner engagement, spatial awareness, and experiential learning. Studies have shown that 360° videos promote strong learning outcomes and positive subjective experiences [1]. In early education, immersive videos have been shown to boost students' understanding of environmental content [2], and support immersive learner engagement [3].

Beyond early education, 360° video has proven effective in technical and safety-related domains. Structured virtual lab pathways enhance safety training experiences [4], and embedded skill demonstrations in virtual lab tours further support this effectiveness [5]. Additionally, immersive video improves learning outcomes when compared to traditional instruction [6].

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In vocational and environmental engineering training, virtual field trips have been reported to deepen contextual understanding [7]. However, challenges related to institutional strategies and infrastructures continue to affect VR adoption [8], [9]. Other studies have reported successful use of immersive environments in craft-skill learning [10] and have identified limitations in K–12 VR integration [11].

A recent systematic review confirmed that immersive technologies significantly increase STEM student engagement and motivation [12]. In the Malaysian context, 360° video has been applied to improve oral communication among vocational students [13], and higher levels of immersivity have been found to enhance learning retention [14]. Its use has also expanded into hospitality and tourism education [15].

Despite these advances, there remains a need to explore immersive tools within safety-specific training contexts such as OSHA. This study introduces JKEscape360, a mobile-accessible 360° visual teaching aid designed to improve students' understanding of emergency escape routes. The research aims to (i) evaluate students' spatial comprehension before and after using JKEscape360, (ii) assess their perceptions of tool interactivity and effectiveness, and (iii) gather instructors' feedback on its pedagogical suitability and implementation practicality in OSHA-related learning.

2. Methodology

The development flow of the JKE Escape 360 Trainer, as illustrated in Figure 1, begins with identifying the problem, followed by a comprehensive literature review and the definition of research objectives. Subsequently, the process splits into two concurrent paths: identifying critical locations and escape routes for panoramic shooting using an iPhone 14 Pro and designing pre- and post-assessment questionnaires. The captured images are edited using Orbix 360-Degree software, and an APK link is generated through Appsgeyser for mobile accessibility. Meanwhile, a pilot test is conducted using the designed questionnaires, followed by an analysis of the pilot results. The pilot study involved 10 students and 5 lecturers, whose feedback helped, assess the clarity, usability, and instrument reliability. If necessary, adjustments are made before proceeding. Upon successful evaluation and collection of feedback, the findings are documented, and the final JKE Escape 360 Trainer is produced. This iterative and structured approach ensures the developed tool is pedagogically effective and user-centered.

Figure 2 shows the trainer installed on a student's mobile device. Its accessibility through a dedicated icon reflects the tool's mobile compatibility and low-barrier implementation. By leveraging everyday devices, the trainer provides an immersive yet cost-effective learning experience that supports digital inclusion in technical education.

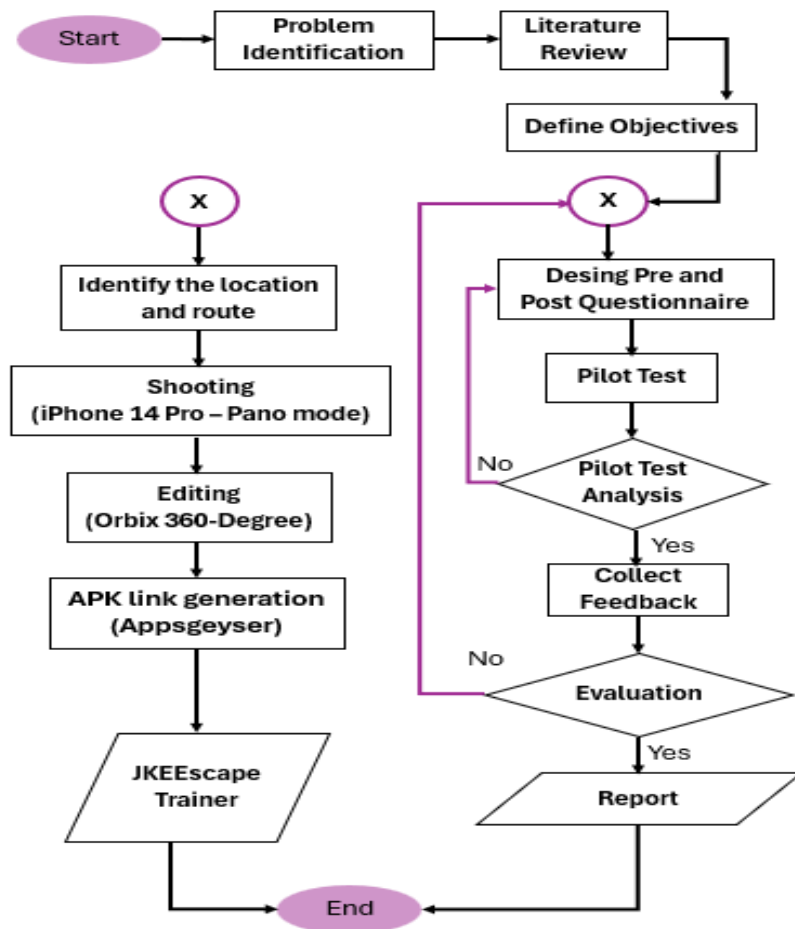


Fig. 1. Flowchart of the research process in evaluating the effectiveness of the JKE Escape 360 Trainer.



Fig. 2. The trainer is installed on a student's mobile device.

3. Results

3.1 Reliability Analysis

Prior to the actual implementation, a pilot study was conducted to evaluate the reliability of the questionnaires designed for students and lecturers. The Cronbach's Alpha coefficient was recorded at 0.782 for the student instrument, indicating acceptable internal consistency. Meanwhile, the lecturer questionnaire demonstrated excellent reliability with a coefficient of 0.970. These values confirm the instruments' suitability for assessing user feedback and comprehension outcomes.

3.2 Students' Pre- and Post-Test Performance

A total of 31 first-semester students participated in the pre- and post-test assessments. The pre-test results yielded a mean score of 3.20 with a standard deviation of ± 0.46 , whereas the post-test mean increased significantly to 4.13 with a reduced standard deviation of ± 0.42 . This reflects a 29.08% improvement in student comprehension levels following the intervention using JKEEscape360. Figure 3 illustrates the shift in performance distribution, where no students remained in the "low" category after the intervention. The paired-sample t-test confirmed the statistical significance of this improvement ($t = 6.83$, $p < 0.05$).

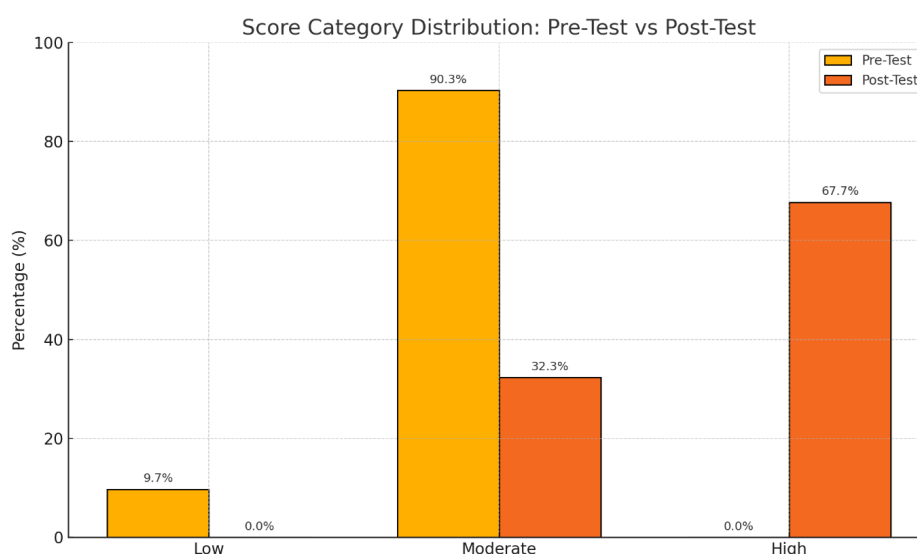


Fig. 3. Comparison of score categories before and after intervention.

3.3 Students' Perception of JKE Escape 360

As illustrated in Figure 4, the post-intervention survey results indicate overwhelmingly positive student feedback, with approximately 74.2% rating the JKEEscape360 tool as Very Helpful and 22.6% as Helpful. The overall mean perception score was recorded at 4.70 out of 5.00, reflecting a high level of engagement and satisfaction with the immersive 360° instructional approach.

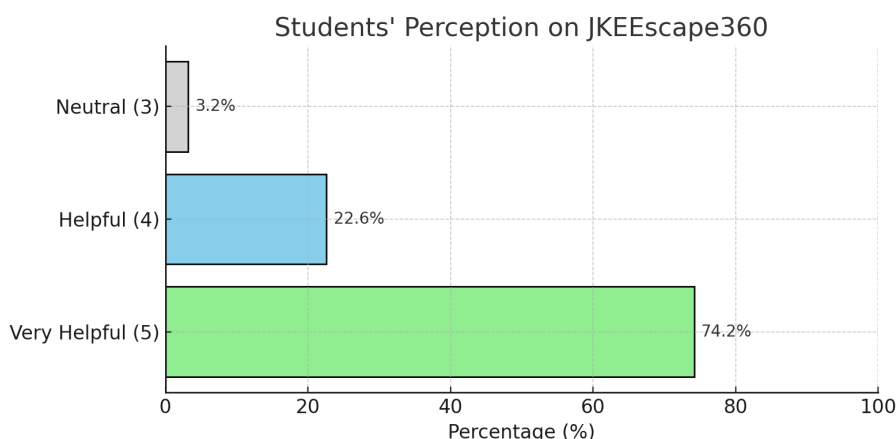


Fig. 4. Displays students' perceptions of the effectiveness of JKEEscape360

3.4 Lecturers' Perception of JKE Escape360

As depicted in Figure 5, lecturers' responses further corroborated the effectiveness of the JKEscape360 tool. The average rating for overall effectiveness was 4.90 out of 5.00, while the mean difficulty score remained low at 1.80, indicating minimal barriers to implementation. All lecturers either agreed or strongly agreed that the tool enhanced students' understanding of emergency escape routes and contributed to increased engagement during instructional sessions.

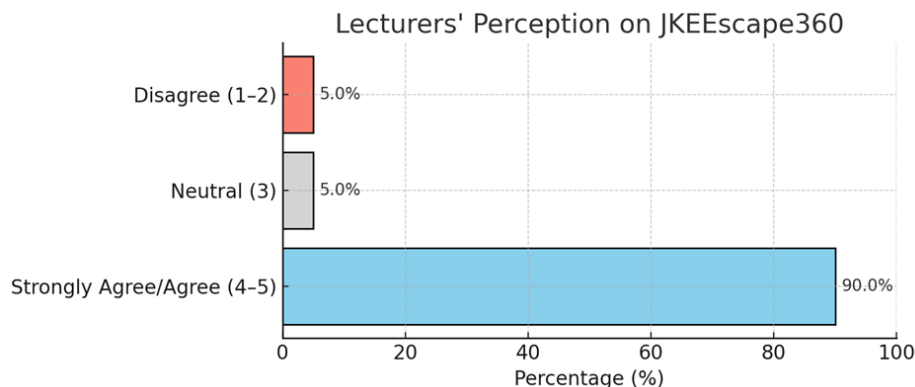


Fig. 5. Lecturers' perceptions of the effectiveness of JKEscape360

3.5 Discussion

The results from both statistical analysis and user perception surveys clearly demonstrate the pedagogical value of the JKEscape360 tool in enhancing emergency preparedness education. The 29.08% increase in average student scores following the intervention affirms the effectiveness of immersive visual learning in improving comprehension of spatially dependent content, such as campus evacuation routes. This finding aligns with previous studies that emphasize the cognitive advantages of 360° and VR-based tools in technical and safety education [1], [3], [4].

In addition to improved average performance, a notable reduction in score variability, evidenced by the lower post-test standard deviation, indicates that the tool contributed to more consistent learning outcomes across the student cohort. The elimination of the "low performance" group post-intervention further supports the inclusivity of the instructional approach, suggesting that JKEscape360 effectively supports learners with varying levels of prior knowledge or experience.

The lecturers' feedback provides further validation of the tool's practicality and instructional merit. With an average effectiveness score of 4.90 out of 5.00 and a low difficulty score of 1.80, JKEscape360 was perceived as highly usable with minimal barriers to adoption. The instructors' unanimous agreement on its usefulness, and their endorsement for extending its application to other OSHA-related topics, highlight the scalability and adaptability of the platform within broader safety training contexts.

Collectively, the convergence of improved student performance, positive learner perceptions, and favourable instructor evaluations suggests that JKEscape360 not only enhances cognitive understanding but also fosters student engagement and instructional confidence. These outcomes support the growing body of literature advocating for immersive and spatially contextualized learning tools in technical and vocational education. In particular, the tool shows strong potential for first-year learners who are unfamiliar with institutional facilities, where clear and memorable visual orientation is critical for emergency response readiness.

4. Conclusions

This study validates the educational efficacy of immersive 360° visual technology by applying JKEscape360, a mobile-compatible digital instructional tool, to facilitate OSHA-related education for first-semester technical students. The substantial rise in students' post-test scores and favourable perception ratings from both students and lecturers confirms that JKEscape360 efficiently improves understanding of emergency escape routes and promotes active participation.

Incorporating spatially interactive video information diminished the learning disparity, as indicated by the decreased standard deviation, and fostered uniform comprehension among varied learner profiles. Furthermore, lecturers' feedback suggested that the tool is practical and scalable, presenting few obstacles to classroom integration.

This study builds upon prior research demonstrating immersive learning environments' cognitive and motivational advantages by situating these technologies within the realm of safety-oriented technical education. JKEscape360 exhibits significant promise for further applications in other modules, necessitating spatial reasoning and procedural awareness. Future research may investigate the long-term effects and further gamification strategies to enhance learning retention..

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