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COOKING UP SUCCESS: INTEGRATING AUGMENTED REALITY IN TEACHER TRAINING FOR FOOD PREPARATION AND PRODUCTION SUBJECTS

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Abstract:

This study addresses the critical need for augmented reality (AR) in upper secondary vocational education teacher training programs and focuses on food preparation and production subjects. Rapid technological advancements and evolving industry requirements necessitate innovative teaching methods and competent Technical and Vocational Education and Training (TVET) teachers. Using the PRISMA (The Preferred Reporting Items for Systematic Reviews and Meta-Analyses), this study selected articles from two leading databases, namely Scopus and Science Direct articles, to identify three key themes: technological integration, teacher competency, and professional development, and pedagogical approaches and curriculum development. Technological integration, particularly AR, enhances teaching and learning outcomes. Teacher competency and professional development are vital for equipping educators with industry-relevant skills and digital competencies. Pedagogical approaches like project-based learning and aligning curricula with industry standards ensure effective and relevant education. The study emphasizes the importance of understanding the need for AR in teacher training programs. By integrating advanced technology and ensuring continuous professional development, TVET can better prepare students for the modern workforce, enhancing the overall quality of vocational education.

Keywords:

Augmented Reality, Food Preparation and Production, Teacher Training, TVET

International Journal of Modern Education
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Introduction

In today's era of rapid technological advancement, the field of education continues to evolve along with the needs of the industry and to improve the learning experience. One of the most promising technological innovations in education today is augmented reality (AR), which offers a fun and interactive learning experience. The integration of augmented reality (AR) into TVET teacher training presents several key challenges and opportunities. One critical issue is the development of teacher competencies necessary for effectively integrating AR technologies into vocational education, as highlighted in studies emphasizing the role of teacher training programs (Abba & Rashid, 2023). The role of TVET teacher training institutes is also pivotal in equipping educators with the skills required to deliver technology-enhanced instruction, particularly in settings like food preparation and production subjects (Aripin et al., 2023). Additionally, blended learning approaches, which combine face-to-face and digital teaching methods, pose challenges in ensuring their efficacy and accessibility for vocational educators and the evaluation of in-service vocational teacher training programs, especially those incorporating AR, is essential to assess their impact on teaching effectiveness and learner outcomes (Asghar et al., 2023). These issues underscore the need for focused research to address competency gaps, institutional roles, and the effectiveness of AR-enhanced training. This study addresses the critical need to incorporate AR modules in teacher training programs for upper secondary vocational education, particularly focusing on food preparation and production in Technical and Vocational Education and Training (TVET). The integration of AR in education has been shown to significantly improve learning outcomes and increase student engagement. Lahn and Berntsen, (2023) assert that AR creates an interactive learning environment that facilitates a deeper understanding of complex concepts, making learning more effective and enjoyable. Likewise, Dhar et al., (2021) emphasized that the ability of AR to simulate real-world scenarios provides students with hands-on and practical experience which is invaluable in vocational training. In addition, teacher competence and continuous professional development are essential to successfully implementing AR and other technological tools in education. Educators must have industry-relevant skills and digital competencies to integrate AR effectively into their teaching practices. Chinedu et al., (2023) and Sharapova, (2024) stress the significance of ongoing professional growth, asserting that it guarantees educators remain abreast of current technological advancements and industry benchmarks, thus enhancing the standard of education they deliver. Pedagogical approaches and curriculum development are also important in ensuring the effectiveness of the TVET program. Project-based learning and curriculum that aligned with industry standards have been identified as one of effective teaching strategies. Asad et al., (2023) and Karlberg & Bezzina, (2022) support this method by arguing that it can increase the relevance and applicability of the education provided and ensure that teachers are competent in teaching and learning sessions. This systematic literature review utilizes the PRISMA framework to synthesize findings from reviewed articles, identifying three key themes: technological integration, teacher competency, and professional development, and pedagogical approaches and curriculum development.

Objective

This study is to meticulously examine and synthesize existing research based on these three main objectives:

i. Analyzing the role and implications of technology integration in technical and vocational education
ii. Assessing teacher competence in technical and vocational education

International Journal of Modern Education
IJMOE
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iii. Reviewing pedagogical approaches and curriculum development in technical and vocational education.

It also emphasizes the necessity of understanding and addressing the need for AR in teacher training programs. By integrating advanced technology and promoting continuous professional development, TVET can better prepare students for the demands of the modern workforce, ultimately enhancing the overall quality of vocational education. Technological integration in Technical and Vocational Education and Training (TVET) enhances learning by offering practical training through simulations and virtual labs, complementing hands-on experience in fields such as culinary arts and automotive (Fals & Brennan, 2023). It expands access to educational resources like online modules and interactive content, caters to diverse learning needs, and ensures continuity beyond traditional classroom settings. Digital assessment tools enable real-time evaluation of practical skills, while integration of industry-specific software prepares students with current technological skills demanded by the workforce. Teacher competencies encompass a set of knowledge, skills, and behaviors that teachers must possess, practice, and control to perform their professional duties effectively (Fabre & Osias, 2024).Continuous professional development is essential for enhancing teacher competencies and ensuring they meet evolving industry standards and technological advancements. However, changing traditional teaching habits, particularly among less digitally native generations of teachers presents challenges. Pedagogical approaches and curriculum development are critical components of effective Technical and Vocational Education and Training (TVET). Pedagogical approaches refer to the teaching methods and strategies employed by TVET educators to facilitate learning and skill development among students (Seherrie & Mawela, 2022). Some effective pedagogical approaches for TVET include project-based learning, inquiry-based learning, problem-based learning, and collaborative learning. The methodologies employed involve teachers in resolving authentic challenges, fostering critical analysis and exploration, and cultivating fundamental competencies such as collaboration and effective communication, all of which are imperative for achievement in contemporary professional environments. On the other hand, curriculum development encompasses the process of selecting, organizing, executing, and evaluating learning experiences based on the needs, abilities, and interests of the learners and the job market requirements. For TVET, it is essential to align curricula with industry standards and involve industry experts in the design process to ensure that programs remain relevant and responsive to the needs of the job market. Incorporating practical, hands-on components such as internships and apprenticeships helps bridge the gap between theory and practice, while regularly reviewing and updating curricula to keep pace with technological advancements and evolving industry requirements is crucial for maintaining the quality and relevance of TVET programs. By adopting student-centered, industry-aligned teaching methods and curricula, TVET institutions can be a better place to prepare students for success in the modern workforce. In conclusion, the incorporation of AR in TVET teacher training programs is essential for meeting the contemporary demands of industry and technology. This study aims to provide a comprehensive understanding of how AR can be effectively utilized in vocational education, contributing to the development of a skilled and competent workforce capable of thriving in an increasingly technological world.

Literature Review

There are three themes will be discussed in the literature review which are technology integration, teacher competency and professional development; and pedagogical approaches and curriculum development.

International Journal of Modern Education
IJMOE
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Technological Integration

AR technology has significantly impacted the way vocational training is delivered, providing immersive and interactive learning experiences. The need for creative teaching resources that can boost student learning and skill development is increasing in the field of Technical and Vocational Education and Training (TVET). The engagement and participation needed for difficult subjects are frequently lacking from traditional teaching techniques, especially in practical areas like food production and preparation subject. By providing immersive and engaging learning experiences that can mimic real-life scenarios and enable hands-on practice without the limitations of physical resources, augmented reality (AR) offers a possible solution. Though AR has many potential advantages, its use in TVET programs is still restricted because of several issues, such as a lack of pedagogical models, high implementation costs, and the requirement for teacher preparation to successfully incorporate AR (Candido et al., 2023). Similarly, Kandoli, (2022) mentioned that enhancing teaching and learning processes through the integration of Information and Communication Technology (ICT) in educational settings is a generally acknowledged component. Many ICT integration plans fall short of their goals, especially in developing countries like Indonesia, even with large investments and efforts. There are many obstacles when it comes to using ICT in vocational education, particularly in the culinary arts field. These include inadequate infrastructure, a lack of support for teachers to effectively use technology in the classroom, and a lack of knowledge and awareness on the part of teachers about ICT integration. As such, the standard of vocational education continues to be below par, impeding teacher capacity to gain the abilities and information required to function in the digitalization of teaching and learning. Boaventura et al., (2022) stated that modern engineering requires integrating scientific, social, cultural, political, and economic knowledge. However, engineers entering teaching positions in Technical Vocational Education at the High School Level (EPTNM) need extensive pedagogical preparation. The lack of legislative requirements for specific pedagogical training creates a workforce of ill-prepared teacher engineers. This study aims to overcome the pedagogical deficit in training by assessing current pedagogical training frameworks, defining fundamental abilities needed for teaching engineers, and suggesting changes to current models.

Teacher Competency and Professional Development

The effectiveness of teaching and learning depends greatly on the competence of the teacher. In the context of TVET, teachers must continue to develop their knowledge and skills through effective professional development programs. Some research showed that there is a significant positive correlation between professional development and teacher competence, where elements such as active learning, focus on teaching content, and collective participation are the main predictors of teacher competence. Asghar et al., (2022) stated that blended learning approaches which combine face-to-face, online, and offline learning, significantly enhance the efficacy of in-service vocational teacher training programs by incorporating AR. Developing teacher competency in using AR is crucial for the successful integration of this technology in vocational education. Xie (2022), addresses the need for targeted training programs to equip teachers with the skills to effectively utilize AR technologies in their teaching practices. It highlights a gap between the availability of AR resources and teachers' ability to use them effectively. Kamal et al., (2023) discuss the challenges teachers face such as adapting to curriculum changes and the lack of detailed teaching guidelines, emphasizing the necessity for comprehensive training and support to overcome these barriers. These findings illustrate the importance of continuous professional development and institutional support in enhancing teachers' competencies and confidence in using AR in their instructional strategies.

International Journal of Modern Education
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IJMOE
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Pedagogical Approaches and Curriculum Development

A comprehensive teacher training program is needed to ensure that teachers can develop sustainability literacy among students, which is important to achieve the Sustainable Development Goals (SDG). The integration of AR into pedagogical approaches and curriculum development offers innovative ways to enhance vocational education (Vojvodić & Sredanović, 2020). Many professors have not received formal pedagogical training during their academic studies which highlighting a broader institutional neglect. The lack of guidance and awareness about the importance of pedagogical training for engineers also limits their preparedness to take on teaching roles. Furthermore, it illustrates how AR can be adapted for teaching various techniques, highlighting its versatility in different educational contexts and its ability to make learning more interactive and engaging. Hassan & Baloch, (2020) mentioned that the COVID-19 pandemic has necessitated a shift to virtual clinical teaching methods, posing challenges such as achieving learning outcomes, ensuring student engagement, and replicating practical clinical experiences. This study aims to identify successful online small-group clinical bedside teaching strategies to ensure excellent instruction, student engagement, and achievement. It also argues that the interactive elements of AR significantly improve engagement and retention in vocational training by making abstract concepts tangible and providing real-time feedback. Meanwhile, Aripin et al., (2021) explore the role of AR in creating engaging and interactive learning experiences that can improve student motivation and retention, demonstrating its potential to transform vocational training by providing real-time visualizations and interactive tutorials. These studies emphasize the need for curriculum designers to integrate AR activities that align with learning objectives and outcomes, ensuring that AR content is pedagogically sound and enhances the overall learning experience.

Methodology

According to Tranfield et al., (2003) systematic literature review is a specific methodology that searches for existing studies, selects and evaluates contributions, analyzes and synthesizes data, and reports the evidence in a way that allows clear conclusions to be reached about what is known and what is not known.

Identification

The systematic review process consists of three basic phases used to select many relevant papers for this study. The first phase involves identifying keywords and finding terms related to using a thesaurus, dictionary, encyclopedia, and previous research. After selecting all related terms, a search series for the Scopus and Science Direct databases (see Table 1) has been developed. The significance lies in the identification and prioritization of features like Search & Selection and Collaboration, essential for augmenting the efficacy and efficiency of Systematic Literature Review (SLR) procedures(Hassler et al., 2015). Current research has successfully obtained 696 working papers from both databases during the first phase of the systematic review process.

Table 1

Scopus	(TITLE-ABS-KEY (technical AND vocational AND education AND training AND augmented reality) AND TITLE-ABS-KEY (teacher AND training))
Science Direct	(TITLE-ABS-KEY (technical AND vocational AND education AND training AND augmented reality) AND TITLE-ABS-KEY (teacher AND training))

Source: June 2024(Scopus and Science Direct

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Screening

In the context of a systematic literature review (SLR), the process of screening is deemed crucial, encompassing two primary phases: screening of titles and abstracts, succeeded by screening of full texts. During the initial phase, researchers discard irrelevant studies based on titles and abstracts, whereas the subsequent phase entails a thorough evaluation of full texts against predetermined eligibility criteria, with rationales for exclusions meticulously recorded (Polanin et al., 2019). The exclusion of 650 papers in the first phase and the evaluation of 46 articles in the subsequent phase were guided by a set of inclusion and exclusion criteria formulated by the researchers. The primary criterion was the utilization of literature, particularly research articles, as a fundamental source of valuable knowledge. Moreover, this study precluded publications such as systematic reviews, meta-analyses, reviews, meta-synthesis, book series, books, chapters, and conference proceedings. Furthermore, the scope of the review was confined to studies published in the English language exclusively. The timeframe for the study was delineated for a span of five years (2020–2024), a detail of significance to bear in mind. Additionally, to align with the analytical objectives, only research conducted on a global scale was considered. In total, 23 publications were identified based on the predetermined criteria.

Table 2 : The Selection Criterion Is Searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Timeline / Years	2020 – 2024	< 2020
Literature type	Journal (Article)	Conference, Book, Review
Publication Stage	Final	In Press

Source: June 2024(Scopus and Science Direct)

Eligibility

For the third step, which is referred to as eligibility, a total of 46 articles have been meticulously prepared. During this phase, all titles and key content of the articles were comprehensively scrutinized to ensure that they met the inclusion criteria and aligned with the research objectives of the current study. This process is based on the researcher's research on the title and abstract of the article. Consequently, 23 reports were excluded as they did not meet the full-text criteria, either due to being out of scope, having insignificant titles, or containing abstracts that were not pertinent to the study's objectives based on empirical evidence. As a result, 23 articles remained for further review (Figure 1).

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IJMOE
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Data Abstraction and Analysis

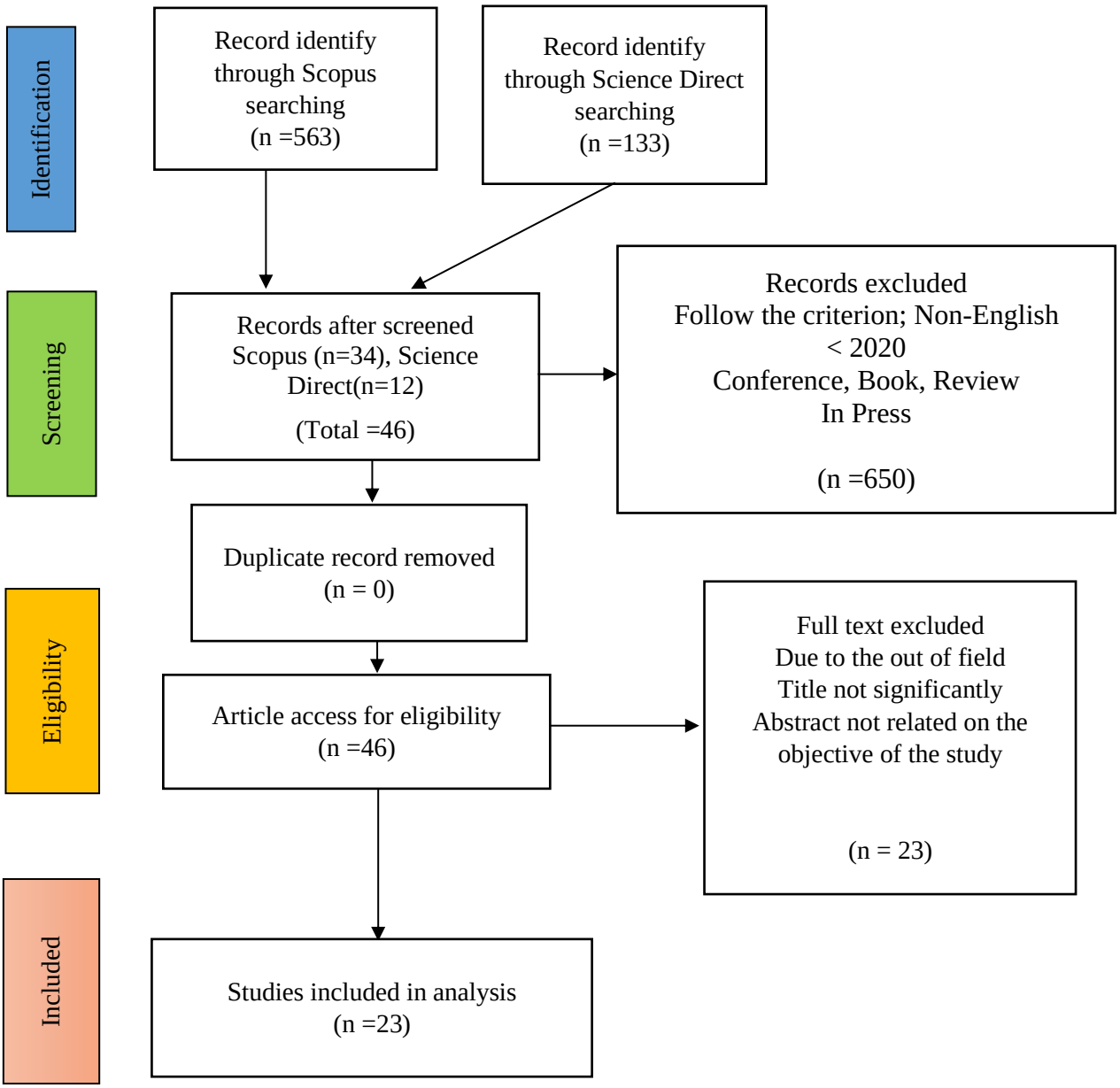

Figure 1: Flow Diagram Of The Proposed Searching Study

Source:(Scopus And Science Direct)

An integrative analysis was employed as a key assessment strategy in the present study to scrutinize and amalgamate various research designs (quantitative, qualitative, and mixed methods). The primary aim of the proficient investigation was to pinpoint pertinent topics and subtopics. The initial phase of data collection marked the inception of theme development. The meticulous examination conducted by the authors, as depicted in Figure 1, encompassed a thorough review of publications for assertions or information relevant to the primary focus areas of the study. Subsequently, the authors assessed the noteworthy existing studies about TVET and teacher training categorization. The methodology utilized across all studies, alongside the research findings, is under scrutiny. Subsequent to this, the authors collaborated

International Journal of Modern Education
IJMOE
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Volume 6 Issue 23 (December 2024) PP. 532-543
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with co-authors to delineate themes grounded in the evidence within the contextual framework of this study. A detailed log was maintained throughout the data analysis process to document any analyses, perspectives, puzzles, or other insights pertinent to data interpretation. Ultimately, a comparison of results was conducted to identify any discrepancies in the thematic design process. It is imperative to highlight that in cases of conceptual discrepancies, the authors engage in internal discussions. The formulated themes were subsequently fine-tuned to ensure coherence. The selection of analysis was overseen by two experts, one specializing in Educational Technology And Media with a decade of experience, and the other in TVET with a decade of experience to ascertain the validity of the issues. The phase of expert assessment ensures the clarity, importance, and relevance of each theme by defining the scope.

Research Findings

The integration of technology in TVET (Technical and Vocational Education and Training) has shown significant potential in enhancing educational outcomes. Effective technology use in TVET requires a robust understanding of technological, pedagogical, and content knowledge (TPACK). According to research by Richard et al., (2023) art teachers in Ghana revealed that the mastery of technological tools and technologically driven instructional approaches are crucial for skill development in TVET, underscoring the importance of teacher training institutions focusing on these areas to improve teaching quality and learning outcomes. The application of AR and hyper video technologies in vocational training, as discussed by Boaventura et al., (2022), supports procedural learning, helping students grasp complex operational skills through interactive and immersive learning experiences. Professional development plays a critical role in enhancing teacher competency in TVET. Continuous professional development (CPD) is essential for teachers to keep pace with technological advancements and pedagogical innovations. According to Ithnain & Saidin, (2021), a study on vocational teachers in Malaysia highlighted that professional development focusing on active learning, content-specific teaching, and collaborative participation significantly correlates with improved teacher competencies. Furthermore,Jafar et al., (2020) emphasize the development of a professional competency framework tailored to the demands of Industry 4.0. Such frameworks should encompass technical and non-technical skills, personal attributes, and a commitment to lifelong learning to prepare educators for the evolving educational landscape. Pedagogical approaches and curriculum development are vital in fostering sustainability literacy and critical thinking in TVET. A curriculum framework for sustainability literacy proposed by Rahimah, (2020) TVET teacher training programs in Malaysia emphasize the need for educators to integrate environmental, social, and economic considerations into their teaching practices. Additionally, the NERDVET project, discussed by Sartori et al. (2022), aims to enhance students' critical thinking and media literacy through innovative pedagogical strategies, highlighting the importance of equipping students with soft skills necessary for the modern workforce. Integrating these pedagogical frameworks and technological tools can significantly improve the effectiveness of TVET programs, ensuring that they produce competent and adaptable graduates ready to meet the demands of the digital age.

Summary

A new and promising area is the incorporation of augmented reality (AR) into food production and preparation for teacher training. According to recent studies, AR improves TVET teachers' motivation and engagement by offering realistic and interactive simulations of food preparation procedures (Majil et al., 2022). Additionally, AR enables safe and regulated practice settings where educators can make errors and learn from them without facing repercussions in the real

International Journal of Modern Education
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world, enhancing their competence and confidence (Lin et al., 2024). Moreover, AR provides tailored learning experiences to accommodate various learning velocities and styles(Chai et al., 2022).There are several obstacles to overcome when integrating AR into TVET teacher training despite its benefits. Technical problems that could restrict AR's adoption include the expensive nature of AR gadgets and the requirement for a strong IT infrastructure (Çöl et al., 2023). With AR technology, teachers must also overcome a learning curve and pick up new digital abilities (Salleh et al., 2022). Moreover, there are major obstacles to the broad application of AR pedagogy, including instructors' aversion to change and the absence of pedagogical models tailored to AR (Omar & Mohmad, 2023).Future research should concentrate on creating affordable AR systems and user-friendly interfaces to make adoption in educational settings easier in order to fully realize the promise of AR in TVET teacher training. To evaluate the long-term effects of AR on teacher competency and student results, longitudinal research is required (Mohamed et al., 2021). Furthermore, investigating how AR might be integrated with other cutting-edge technologies, including virtual reality and artificial intelligence, could result in extensive training programs that improve vocational education even further (Salleh et al., 2022).

Recommendation

Therefore, in order to improve the professional competence of VET teachers, it is advised that policymakers and educational institutions provide enterprise support and hands-on training a higher priority than theoretical approaches. Lastly, it is suggested that more funding be allocated to assist teachers in putting into practice efficient classroom assessments in order to address the issues raised in the study on classroom assessment in TVET disciplines. This entails offering sufficient instruction and resources to properly manage time and make use of digital resources. By tackling these issues, the Ministry of Education's objectives can be more successfully met and improving learning outcomes results. These recommendations aim to bridge the gap between theoretical knowledge and practical application, enhance teacher training and readiness, and improve the overall quality of TVET programs.

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