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A Case Study on the Implementation of Experiential Learning Integrated with Virtual Reality Technology in Teacher Education*

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ABSTRACT

In this study, the implementation of experiential learning integrated with virtual reality (VR) technology in teacher education was investigated. The study involved 29 pre-service teachers selected through purposive sampling for its case study design. Within the study, the participants first received an informative training session on experiential learning theory and VR technologies. Subsequently, they engaged with two different scenarios, each offering three degrees of freedom, using cardboard VR glasses. This process aligned with the stages of Kolb's Experiential Learning Theory, encompassing concrete experience, reflective observation, abstract conceptualization, and active experimentation. Data collection employed semi-structured interviews, metaphor analysis, and unstructured researcher observations. The data were then analyzed using content analysis techniques. The results revealed that 19 pre-service teachers encountered VR technology for the first time, whereas 7 had previously experienced VR only for gaming purposes. None of the participants had prior experience using VR technology for educational purposes. Participants generally responded positively to the VR-integrated experiential learning implementation, finding it engaging. VR appears to hold potential for widespread use in education, particularly during challenging periods like pandemics. Additionally, VR could prove effective in adapting instruction to individual differences and fostering inclusive education. The potential benefits of integrating VR technology into teacher education programs were highlighted. However, the frequent citation of unequal technology access by participants was noted as a disadvantage. This criticism, rather than targeting the VR-integrated experiential learning practice itself, underscores socioeconomic barriers that may hinder its widespread adoption.

Keywords: Virtual reality in education, technology-enhanced learning, experiential learning, teacher training

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Introduction

Technological advancements are steering teacher education toward more innovative models, transitioning from traditional approaches to ones that actively engage teacher candidates in their learning journeys. This shift emphasizes practical, experiential learning, and reflective thinking (Clarke & Hollingsworth, 2002), fosters collaborative environments (Kimmelmann & Lang, 2018), and integrates technology effectively (Laxmi & Gure, 2016). However, the evolution of teacher education, globally and in Turkiye, struggles to reach the anticipated standards in these areas (Bala, 2018; Girvan, Conneely, & Tangney, 2016; Yıldırım, 2013). Humanity's inherent openness to innovation has ushered in the "age of experience" via digitalization. In this era, digital technologies transform traditional educational content into vivid virtual experiences, allowing learners to actively engage and craft their narratives within these settings. This age highlights the role of interactive virtual platforms in simulating real-life experiences to deepen learning. Consequently, training teachers skilled in leveraging technological advancements to enrich educational experiences is deemed essential (Hu & Lee, 2008; Wadhera, 2016).

Built upon the foundational works of pioneers such as Dewey, Lewin, and Piaget, experiential learning has gained widespread acceptance globally through a comprehensive and holistic model developed by Kolb. Experiential Learning Theory posits that learning is not merely an outcome but a process of re-learning, where the learner shapes the learning under their own responsibility (Kolb, 2015). The experiential learning cycle is characterized by two primary dimensions—comprehension and transformation—and unfolds in four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation. This cycle suggests that concrete experiences provide the basis for reflective observation, leading to the transformation of insights into abstract concepts. These concepts, in turn, catalyze new experiences in the active experimentation stage (Evin Gencel, 2020; Evin Gencel, Erdogan, Kolb & Kolb, 2021; Kolb & Kolb, 2017). By adhering to the experiential learning cycle, individuals are supported in adapting to various learning approaches, utilizing the strengths of their prevalent learning styles and enhancing less dominant ones. Over time, this approach facilitates the evolution of learners' styles toward a more developed state. Kolb's Experiential Learning Cycle is compatible with diversified instructional methodologies integrated with technology. Moreover, the techno-pedagogical approach holds a pivotal position in teacher education in the rapidly advancing information technologies of the 21st century (Fox-Turnbull & Snape, 2011). The COVID-19 pandemic has highlighted the necessity of using technology in teaching, transitioning its status from optional to essential (Zakrzewski & Newton, 2022).

Changes in the global economy have increased the demand for individuals skilled in technology. In meeting this demand, integrating technology into teacher education holds distinct importance. However, it is observed that research on various dimensions of advanced technology use in teacher education is lacking (Dursun, 2019). On the other hand, experiential learning is seen as a promising approach to meet the demands of the era in pre-service teacher training (Girvan et al., 2016; Harfitt & Chow, 2018). However it is observed that a significant portion of studies focus only on the learning styles of teacher candidates, overlooking the comprehensive aspects of the experiential learning cycle (Akbulut, 2021). Research indicates that the experiential learning cycle has the potential to enhance learning outcomes by leveraging the strengths of individuals' preferred learning styles and encouraging the development of less dominant styles (Evin Gencel, 2020).

The integration of technology into teacher education requires careful consideration of its broad curriculum incorporation, relevance to specific pedagogical contexts, and the cultivation of enriched learning environments through innovative technologies. The Association for Information Technologies and Teacher Education emphasizes that innovative technologies can elevate learning beyond conventional tech use, making experiences more impactful and significant (Laxmi & Gure, 2016). Virtual reality (VR), as a leading-edge technology, embodies these principles, offering immersive, three-dimensional, and interactive settings that simulate real-world scenarios in a controllable virtual space. It transports users to new realms, enabling them to navigate, influence narratives, and interact within a fully virtual environment, detached from everyday life's constraints. n VR, individuals immerse themselves in this alternate universe using devices such as goggles or headsets, exploring and interacting as if they were truly part of that world, despite being physically elsewhere (Bown, White, & Boopalan, 2017).

The VR experience immerses users in a 360-degree panorama, allowing exploration in all directions. Depth perception is enhanced through stereoscopic vision, achieved by presenting slightly different images to each eye. Head movement sensitivity and image adaptation are facilitated by gyroscopes in head-mounted devices, which can be either standalone or integrated into smartphones. Beyond visual engagement, VR experiences incorporate auditory elements to heighten realism and immersion, highlighting sound technologies (Marougkas, Troussas, Krouska & Sgouropoulou, 2023; Wright, 2014). This multisensory integration creates an inclusive, interactive experience. Interaction with the VR environment, essential for realism, involves choices, manipulation, and movement. Choices, made through controllers, eye movements, or gestures, enable users to interact with virtual objects (Fox, Park, Borcar, Brever & Yang, 2018). Manipulation, or modifying objects, can include moving, resizing, or reshaping (Poupyrev, Billinghurst, Weghorst & Ichikawa, 1996). Movement within VR, achieved by teleportation or virtual walking, enriches the experience, enhancing user satisfaction (Wright, 2014; Lege & Bonner, 2020).

VR technology is becoming increasingly prevalent in teaching situational, adaptable, and complex skills across various professional fields and has been rarely utilized in teacher education since 2010 (McGarr, 2020). Studies have shown that learning environments leveraging VR technology have positive effects on teacher candidates' digital literacy levels (Huh, 2020), reflective thinking skills (Stavroulia & Lanitis, 2020), and abilities to interpret classroom incidents (Kosko, Ferdig, & Zolfaghari, 2021). In Turkiye, however, no other studies have explored the use and impacts of virtual reality technology in teacher education, apart from an Erasmus+ Project (Vr4Gifted), in which the researchers also participated as part of the project team. In this study, two of the VR scenarios, which are among the intellectual outputs of the mentioned project aimed at enhancing teacher candidates' competence in organizing inclusive educational environments, were utilized. The implementation process, detailed in the method section, was designed in accordance with the experiential learning cycle, integrating the stages of concrete experience and active experimentation with VR technology. Essentially, the purpose of this study was to examine teacher candidates' views on experiential learning supported by virtual reality technology, their metaphors related to the experiential learning scenarios they experienced with virtual reality support, and an analysis of researcher observations.

Method

Research Model

This research, exploring the integration of VR technology into experiential learning within teacher education, utilized the case study approach, a qualitative research method. The case study method focuses on understanding the functioning and operations of a system by gathering information via various data collection tools (Mills, Durepos, & Wiebe, 2010). Given the limited availability of literature on the utilization of VR technology in teacher education in the current research, the illustrative case studies design is deemed appropriate. The illustrative case studies, also referred to as explanatory or descriptive case studies, represent a qualitative research approach that examines a specific situation or phenomenon through in-depth analysis of one or two cases. In this design, a confined unit or phenomenon can be examined either at a specific point in time or over an extended duration. This methodology particularly valuable for investigating uncommon or under-researched phenomena where data is scarce (Gerring, 2007; Guetterman & Fetters, 2018). The illustrative case study design was chosen for this research due to its suitability for examining underexplored or novel areas within a specific context. This approach allows for a focused investigation of the nuances and complexities involved in integrating VR technology with experiential learning in teacher education. By centering the study on specific cases, researchers can gain a more in-depth understanding of the unique challenges and opportunities presented by this emerging field. Additionally, this method supports a comprehensive analysis by capturing real-world experiences and contexts, which is essential for developing practical insights and guiding future research in the field.

Participants

This study involved the participation of 29 prospective teachers who were recruited from a Faculty of Education at a state university located in Turkey's Marmara Region. These participants had all successfully completed a course on Teaching Principles and Methods and volunteered to participate in the research study. The selection of participants was conducted using criterion sampling, a purposeful method that ensures participants meet specific predefined criteria, such as educational background and readiness to engage with the research topic. Moreover, the convenience sampling method was also employed as participants were chosen from an institution that was easily accessible to the researchers, streamlining the logistical aspects of the study (Robinson, 2014). This combination of criterion and convenience samplingmethods allowed for the recruitment of a specific, yet accessible, group of participants who were equipped with relevant educational experience and willingness to contribute to the study, thus enriching the research outcomes.

Participants were recruited through a promotional poster shared on social media platforms, which provided details about the study's objectives, eligibility criteria, and contact information. The poster also included a Google Forms link for registration, which garnered 58 applications: 55 via the Google Forms link and three via email. From these applicants, 31 were initially selected based on their suitability for the study's focus and criteria. A WhatsApp group was created to facilitate communication and coordination among consenting participants, streamlining logistical arrangements and ensuring efficient dissemination of information. Preliminary interviews resulted in the exclusion of two applicants due to health and logistical reasons, leaving a final sample size of 29 participants. For privacy and confidentiality, each participant was assigned a code such as P01, P02, and so on. A table was maintained that listed their code, age, gender, and department.

This careful selection and organizational process ensured a diverse and manageable group of participants for the study. The characteristics of the participants are shown in Table 1.

Table 1. Participants characteristics

Code	Age	Gender	Department
P01	23	Male	Geography Education
P 02	25	Male	English Language Education
P 03	22	Male	English Language Education
P 04	23	Female	Primary School Education
P 05	22	Female	Primary School Education
P 06	20	Male	English Language Education
P 07	21	Female	Art Education
P 08	24	Male	Computer and Instructional Technologies Education
P 09	21	Female	Pshycological Counseling and Guidence
P 10	21	Female	Art Education
P 11	22	Female	Pshycological Counseling and Guidence
P 12	25	Female	Early Childhood Education
P 13	21	Male	Turkish Language Education
P 14	23	Male	Computer and Instructional Technologies Education
P 15	22	Female	Geography Education
P 16	24	Male	Computer and Instructional Technologies Education
P 17	23	Male	Computer and Instructional Technologies Education
P 18	23	Female	Geography Education
P 19	23	Male	Computer and Instructional Technologies Education
P 20	26	Female	English Language Education
P 21	24	Male	Computer and Instructional Technologies Education
P 22	22	Male	English Language Education
P 23	22	Male	Computer and Instructional Technologies Education
P 24	23	Male	English Language Education
P 25	24	Male	Computer and Instructional Technologies Education
P 26	21	Male	English Language Education
P 27	21	Female	English Language Education
P 28	27	Male	Computer and Instructional Technologies Education
P 29	21	Male	Pshycological Counseling and Guidence

Table 1 reveals that 18 males and 11 females' prospective teachers volunteered for the study, encompassing a diverse group from eight different departments. This variety included 9 participants from Computer and Instructional Technologies Education, 8 from English Language Education, 3 from Geography Education and Psychological Counseling and Guidance, 2 each from Art Education and Primary School Education, and one each from Early Childhood Education and Turkish Language Education. The age range of participants was between 20 and 27 years. The inclusion of students from a broad spectrum of departments was seen as a strength, bringing varied perspectives and interests to the study. Notably, while three participants were of foreign nationality, their Turkish descent and education in Turkish ensured proficiency nearly equivalent to native speakers.

Data Collection Tools

The study employed a semi-structured interview form and participant-created metaphors as data collection tools. The interview form was developed after reviewing literature on experiential learning and virtual reality in education, drafting an initial version, and obtaining feedback from experts in Educational Sciences and Turkish Education. This process led to the finalization of the interview form, which included nine questions. A metaphor form was also utilized, allowing participants to complete the sentence "The experiential learning application integrated with virtual reality is like … because …" to share their views. Furthermore, the researcher documented observations before, during, and after the interviews, both on the interview forms and through computer notes.

Data Collection

Interviews were conducted in a faculty member's office, with only the researcher, participant, and a research assistant (witness) present. Audio and video recordings were made with participants' consent. Prior to the interviews, an informed consent form was distributed to participants through a WhatsApp group. This form was read and signed by each participant before the interview. The interview setting included a desktop computer with a webcam for video and audio recording, the researcher's laptop for audio recording, and a 27” monitor to display presentations to the participant. An illustration of the interview setup is shown in Figure 1.

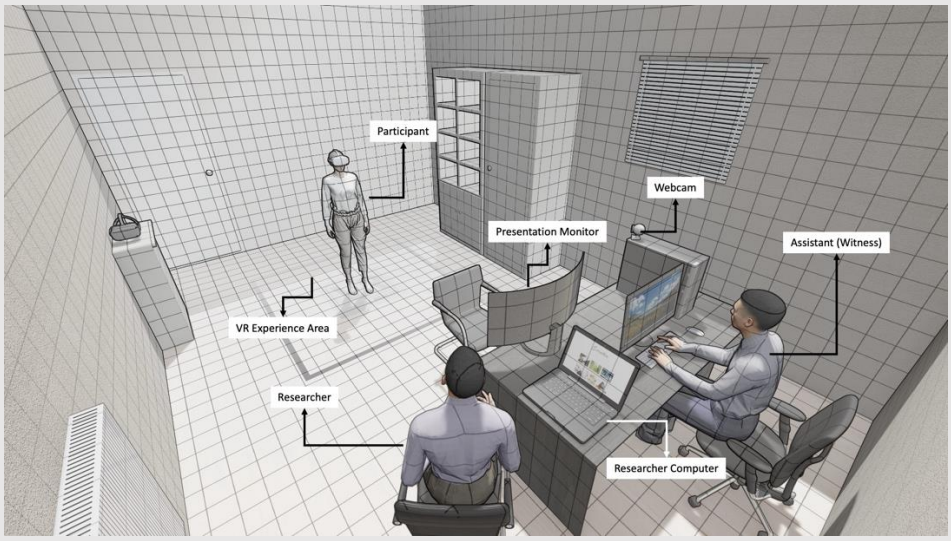

Figure 1. Setting of the interviews

In the setup depicted in Figure 1, the room was arranged with necessary desks, chairs, and devices for the research, along with additional space for a comfortable and safe virtual reality experience. Interview durations varied, with the shortest at 39 minutes and the longest at 54 minutes, averaging 46 minutes across all interviews. The first interview phase averaged 15 minutes, ranging from 11 to 18 minutes. The second phase averaged 14 minutes, with durations between 12 and 18 minutes. The third phase was longer, averaging 17 minutes and varying from 11 to 28 minutes. Total durations were 7 hours and 15 minutes for the first phase, 7 hours, and 6 minutes for the second, and 8 hours and 32 minutes for the third, culminating in 22 hours and 23 minutes for all 29 interviews. Figure 2 illustrates the start, end, and duration of each interview phase.

Figure 2. Phase Durations of Interviews

The interviews began with discussions on experiential learning and virtual reality technology, Participants then engaged in virtual reality scenarios to explore personalized education planning. The final phase was dedicated to reflections on the experience and the creation of metaphors. Audio recordings were made on a laptop, and both audio and video recordings were captured on a desktop computer. Throughout the process, the researcher observed and recorded significant insights related to participants' responses and personal reflections both on observation forms and electronically.

Data Analyses

In the study, content analysis was utilized to systematically examine the data, enabling the generation of codes, categories, and themes to elucidate the relationships among concepts. This process began with the digitization of all audio and visual materials. Segments pertinent to the study within the audio recordings were isolated using Audacity and saved for further coding. Instead of transcribing the interviews in their entirety, annotations and codings were directly applied to the audio files using Audacity, enhancing the efficiency of the analysis. For the initial coding, audio recordings were listened to once, and preliminary codes were extracted. Following the completion of co-coding, the researcher and the co-coder, an expert in educational sciences, convened to discuss the coding. Further reviews led to the refinement of codes, and the development of categories and themes aligned with the study's objectives. The Excel application facilitated a structured coding process, offering clear visualization of the coding framework and precise relationships between codes and categories. Codes from audio recordings, along with associated participant references, were organized in Excel. New codes were added, some merged, and categories redefined as the analysis evolved. In addition to the table regarding codes and participants, notes kept on Audacity were amalgamated into an Excel file. This consolidation facilitated easy access to query all responses provided by each participant to every question. As a result, a total of 1,095 annotations were identified from the data across 29 participants.

Validity and Reliability

The high level of agreement among the codings made by co-coders during the data analysis process indicates the internal consistency of the research. 93% reliability is obtained between coders according to Miles and Huberman coders reliability formula Miles & Huberman (1994). The presentation of findings through direct quotations from participant and obtaining approval from participants regarding the data enhances the credibility of the study. The preservation of all data by the researchers contributes to the verifiability of the work. Moreover, the detailed description of the data collection and analysis processes demonstrates the transferability of the research.

Examples of screenshots from the virtual reality environment

Ethics committee approval process

The study was carried out with the approval of Canakkale Onsekiz Mart University Ethics Commission dated 14/04/2022 and numbered 08/13.

Results

Upon analyzing the data obtained from the interviews, three main themes emerged. These themes are "virtual reality," "experiential learning," and "teacher education." Under these three themes, a total of 32 categories and subcategories have been identified. The themes and categories resulting from the research are summarized in Figure 3.

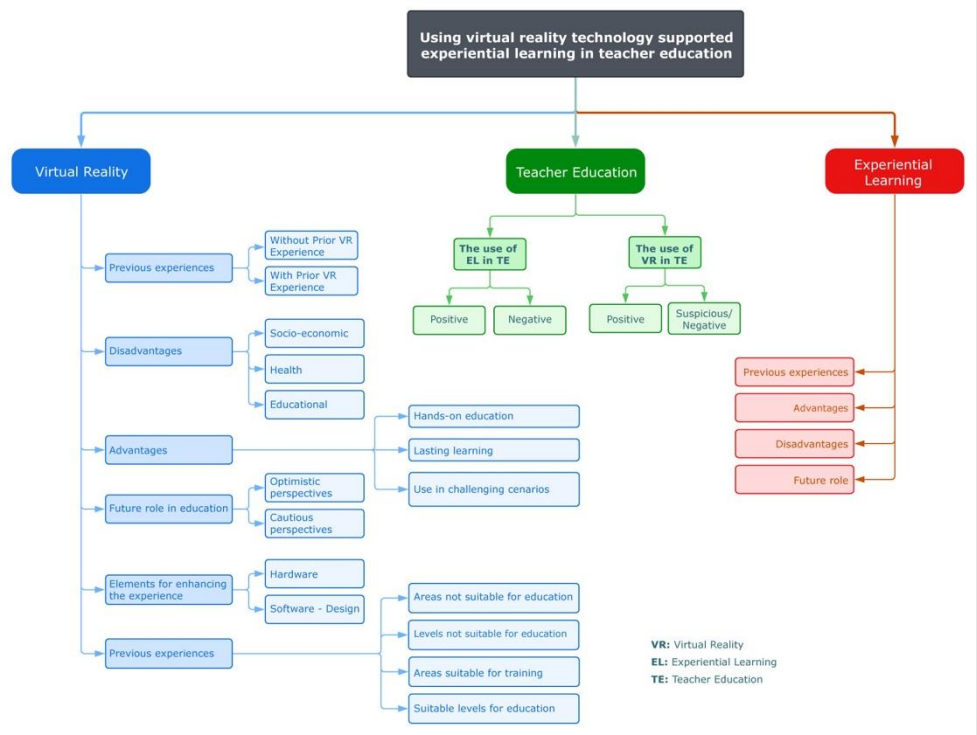

Figure 3. Themes and categories derived from content analysis.

Findings Related to the Virtual Reality Theme

Figure 3 identifies six main categories within the virtual reality theme: "previous experiences," "advantages," "disadvantages," "future role in education," "elements for enhancing the experience," and "application in education." The "previous experiences" category are divided into those with and without prior VR experience. The "advantages" category encompasses hands-on education, lasting learning, and use in challenging scenarios. "Disadvantages" cover socio-economic, health, and educational concerns. The "future role" category reflects both optimistic and cautious perspectives. "Elements for enhancing the experience" focus on hardware and software, while "application in education" outlines suitable and unsuitable areas and levels for VR's use.

When participants who tried virtual reality for the first time during the interview were asked why they had not experienced this technology before, nearly all indicated that they had not had the opportunity. For instance, P12, when asked if they had experienced virtual reality before, initially mentioned an experience in augmented reality. Upon being reminded by the researcher that the technology was different, they acknowledged that they had not experienced virtual reality before. When further asked why, the response was, "*…no opportunity, I never came across any chance.*" Participant coded P17, after stating they were experiencing virtual reality for the first time, attributed it to *"...let's say, I never encountered anything related to virtual reality, neither at*

work nor during my education. I never leaned in that direction. It's not about preference; actually, I didn't have the opportunity." P05, who also had no prior virtual reality experience, stated, *"…but I never had the chance to go and try it somewhere. But when I saw this (volunteer participant advertisement), I was frankly more intrigued, so I came because I was curious.*". Many participants' initial VR experiences were through gaming (P01, P02, P03, P08, P10, P11, P20, P22, P29), with P08 recalling the use of a VR headset for a box-cutting game, likely Beat Saber, described as a "*very realistic experience*." P29 cited playing a zombie game, noting it as more sensory and exciting, even affecting blood pressure due to its realism.

Participants with prior VR experience generally held positive views, except for P01, who experienced motion sickness. P01 stated, "*Because of the glasses... it causes some headache, so I prefer not to use it much*," attributing the discomfort to their prescription glasses and visual impairment. Nevertheless, the consensus on VR technology remained positive, emphasizing its benefits for practical education, lasting learning, and use in difficult scenarios. Below are abridged comments on its educational utility:

P03 discussed virtual reality's (VR) potential to lower the affective filter, enhancing learning: "*...the positives include experiential learning. You feel immersed...the affective filter decreases...if applied in elementary school, it could be combined with music and cartoons...*" P04 emphasized VR's ability to engage, motivate, and spark curiosity: "*...drawing in the student, motivating, and arousing curiosity… new things excite and intrigue them...*" P12 suggested VR could boost classroom participation: "*...it arouses curiosity...*" P11 spoke on learning's permanence of learning with VR, highlighting the value of personal experience: "*If conditions are met, it'd be wonderful...subjective experiences are unforgettable...I see no limitations or negatives."* P25 pointed out VR's accessibility and experiential benefits: "*...things you can't access or experience are possible in VR. We were just in a classroom setting, which I can't currently access*." This summary captures participants' views on VR's educational advantages, emphasizing immersive learning, engagement, and the unique experiences it offers.

While acknowledging VR technology's benefits, discussions also surfaced its socio-economic, health, and educational disadvantages. Key socio-economic worries included the risk of mechanization, with P01 noting, "*I momentarily thought... that it seems like we're moving towards robotization, slightly drifting away from teaching*." P02 highlighted the drawback of diminished physical interaction, stressing face-to-face education's value: "...*the negative part is the lack of eye contact, hand gestures, body language.*". P29 saw VR's promise but criticized its primitiveness and cost: "*It's a very new technology right now. It appears quite primitive... But it's related to the cost...*" Nonetheless, a cautious optimism persisted. Fourteen participants expressed both positive and cautious views about VR's use, access, and equity. P10 stressed the need for quick VR adoption: "*We're late in shifting to virtual...*" There was a notable interest in 6 Degrees of Freedom (6 DoF) for immersion. Five participants discussed enhanced movement and realism in VR, desiring larger spaces and accurate tracking.

Participants were asked about potential applications of virtual reality-supported experiential learning beyond teacher training, leading to four identified subcategories: Suitable and unsuitable areas for education, and suitable and unsuitable levels for education. Here are selected insights from these categories: "*I don't think there are many (areas where it shouldn't be used), it's like a prediction...*" (P02); "*Actually, none… even in art class, because it also relaxes the inner world. It provides a different observation area…*" (P12); "*Sir, I think it would work in all of them. That's what I believe...*" (P18). Most participants (P02, P03, P04, P06, P09, P10, P13, P20, P18,

P19, P24, P25, P28, P29) expressed the view that experiential learning integrated with virtual reality would be beneficial in medicine and related fields. "*It would be highly beneficial and successful in medicine.*" (P19), "*... especially if the student can participate with their own hand movements, especially in surgery…* " (P20). Some participants mentioned that it would not be suitable for use in certain areas. For example, P13, P15, and P24 said it could not be used in sports and/or arts education, while P05, P20, P22, P25, P26, and P29 stated it would not be suitable for linguistics and social sciences. "*I don't see it being used much in physical education*" (P24); "*I don't think it would be very useful in English*" (P26);"*Generally speaking, I don't think it will be necessary in verbal subjects…* " (P25).

Concerns were voiced about VR in early education by several participants (P03, P08, P09, P11, P12, P13, P14, P15, P20, P23, P26, P27). P23 specifically mentioned, "*I believe it shouldn't be used until adolescence...*"; P08 pointed out, "*preschool, I think (should not be used). Because preschool is a very different audience…*" Despite this, VR was seen positively for high school and higher education. A few (P07, P19, P24, P25, P28, P29) supported VR for younger students. P28 argued, "*... for preschool, elementary, and middle school, I think it would be much more successful...*"; P19 suggested, "*Definitely, it should start from elementary school*." This captures the varied perspectives on VR's appropriateness across educational levels, including direct quotes for clarity.

Participant insights demonstrated the broad potential of VR in enhancing experiential learning across various educational levels.

Findings Related to the Teacher Education Theme

Within this theme, two main categories were identified: the application of experiential learning in teacher education, and the integration of virtual reality (VR) technology within the same context. Participants largely held positive opinions about incorporating experiential learning into teacher education. For example, P03 highlighted its importance for inclusivity and individualized education, stating, "*Considering individual differences and being able to offer inclusive education to all students is necessary... experiential learning can be provided both theoretically and in practice during internships.*" This comment underlines the value of experiential learning in addressing individual needs within teacher education.

Participants indicated that experiential learning is not sufficiently integrated into education faculties, often limited to the final year. P08 argued for its increased use, emphasizing the importance of repetition and hands-on experience: "*It's used in our last year... It needs to be more active...*"; P09 shared that practical knowledge is applied in the fourth year during the Ministry of Education internship, highlighting the value of seeing theory in practice. P11 advocated for extending experiential learning beyond the final year, citing the lasting impact of practical experiences over theoretical ones: "*Let's not only do it in the last year; let's apply it always...*"; P06 suggested that more frequent use of experiential learning methods would enable teachers to recognize and address individual student needs, potentially making lessons more effective. These comments underscore a consensus on the need for broader and earlier implementation of experiential learning methods in teacher education.

The interviews indicate that teacher candidates hold a positive view of integrating of Virtual Reality (VR) technology into teacher education. Yet, there are reservations regarding its practicality under current educational conditions. P11 pointed out the challenges of implementing VR technology given the present school infrastructures but acknowledged its potential benefits

once these hurdles are overcome: "*It would probably be difficult, considering the conditions of our school"*. P15 emphasized the necessity of establishing clear guidelines and ensuring comprehensive training for both teachers and students to facilitate effective VR integration: "*If it can adhere to certain rules and if the training is properly shared with the students and teacher candidates beforehand…*". These insights reflect enthusiasm for VR's educational potential while acknowledging its challenges.

A majority of the participants expressed favorable attitudes towards incorporating Virtual Reality (VR) technology into teacher education. Specifically, eighteen participants explicitly endorsed its usage, whereas eleven advocated for its application with certain stipulations. Notably, participants such as P01, P02, P03, P04, P06, P09, P10, P11, P12, P13, P14, P16, P17, P18, P20, P21, P26, and P28, demonstrated unconditional support for integrating VR technology in this context: "*If it's done with virtual reality, the impact could be much greater. Students might gain more experience than they would in a traditional classroom setting*" (P16), "*Virtual reality has been popular for nearly a decade but remains underused in schools. It could significantly enhance learning. Practical training is crucial in teacher education, yet we focus mostly on theory. VR should be utilized to bridge this gap* (P06), "*... I think we should keep up with the updates and developments in education. It should be offered in faculties of education, at least as an elective course*" (P03), "*It should be used, as it feels like a real experience. Using it now would be beneficial, and it's likely to develop further. Once developed, it must be fully integrated into education faculties* (P13).

Some participants (P05, P07, P11, P15, P18, P19, P22, P23, P24, P27, P29) have expressed positive attitudes towards the implementation of virtual reality technology in teacher education but have also raised certain reservations. "*I think it's something that needs to be developed and used. I've thought before about how it would be if this were implemented. I believe it will be beneficial for education if it's developed and adjusted properly*" (P29). "*Of course, going to school and experiencing it firsthand is always much better. If we were to use this technology through glasses, we would need to recreate the same environment in the virtual space, which I don't think is necessary…"*. They acknowledge VR's potential to enrich learning while stressing the necessity for meticulous planning, early introduction, and judicious use to genuinely aid future teachers.

Findings Related to the Experiential Learning Theme

The theme of Experiential Learning revealed categories including previous experiences, advantages, disadvantages, and its future role. Most participants highlighted their lack of prior knowledge or experience with the theory of experiential learning often conflating it with related concepts like practical education and constructivist teaching. Notably, none of the participants remembered engaging with the experiential learning cycle in their courses. For instance, P05, when asked about experiential learning in their classes, stated, "*No, I don't remember anything. Generally, the emphasis was primarily on traditional methods*..." The COVID-19 pandemic also exacerbated this gap, as P05, P11, P12, P13 mentioned forgetting much of their online coursework. P16 admitted to likely forgetting due to inattention, while P26 noted, "*…But we never really saw it laid out in four stages like that…*" highlighting an indirect familiarity with related topics. P10 added, " *...now I understand experiential learning better."*

Responses to questions about the implementation of experiential learning in teacher education were varied and insightful. "*... Because, sometimes, even when people are not in their best mood, they can disengage from the class. Experiential learning increases the productivity in class*" (P10). Participant 19 stated that "*If classes were conducted this way (according to the*

experiential learning theory), it would be more engaging and ensure greater student participation..." Participant 26 said, " *I think it should be used because to be honest, the experiential learning is the real learning*" Participant 03 stated, "*considering individual differences and being able to offer inclusive education to all students is necessary…Therefore, experiential learning can be provided both theoretically and in practice during internships*." Similarly, some participants believe that the experiential learning theory in educational activities will become more widespread in the future. "*I believe experiential learning will increase. We are already moving towards experiential learning… w*e want this kind of learning, not rote memorization." (P04). "*I think it will increase…these could initially be like, not virtual reality but augmented reality, like experiments on cards…"* (P28). "… because the more you apply, the more you learn. It appeals to more senses..." (P28). These reflections highlight the pivotal importance of incorporating experiential learning into teacher education programs. It bridges the gap between theoretical knowledge and practical application, ensuring educators are well-equipped to accommodate diverse learning needs and fully prepare future teachers for the dynamic nature of classroom settings. The adoption of experiential learning strategies aim to boost student engagement and learning outcomes while fostering the development of adaptable, reflective, and skilled educators ready to meet the changing demands of modern education.

Metaphorical Insights from Participants' Experiences with VR

The metaphors created by participants, with the exception of P15, convey a positive outlook. These are summarized in Table 2.

Table 2. Metaphors created by the participants.

Code	Metaphor	Code	Metaphor
P 01	It is an extraordinary experience.	P 16	It is like a child taking their first steps.
P 02	It is discovery.	P 17	It is like hitting the jackpot (positive)
P 03	It is a second life.	P 18	It is learning by doing and experiencing.
P 04	It is riding a bicycle.	P 19	It is looking into the future.
P 05	It is isolation.	P 20	It is a video game
P 06	It is a parallel universe.	P 21	Unable to provide a metaphor.
P 07	It is being inside the canvas	P 22	It is living John Dewey.
P 08	It is being in a dream.	P 23	It's a dissimilar experience.
P 09	It is being in a dream.	P 24	It is an entrance to a different world.
P 10	It is space.	P 25	It is an experience itself
P 11	It is life itself.	P 26	It is being in a dream.
P 12	It is an application cloud.	P 27	It is being in a different dimension.
P 13	It is a different world.	P 28	It is being a character in a computer game
P 14	It is like you are inside it.	P 29	It is swimming with diving gear.
P 15	It is like a delusion (negative).		

The explanations for the metaphors provided by some participants in response to the "because" structure is quoted below:

Participants shared diverse metaphors to describe their experiences with virtual reality in education, reflecting a range of perceptions. P01 described the VR experience as "an extraordinary experience," noting the surreal aspect due to lack of personal experience but foreseeing its eventual necessity in daily life. P03 likened it to "a second life," drawing parallels with the game Second Life to emphasize the blend of practice and reflection inherent in experiential learning within a

virtual realm. P05's metaphor of "isolation" depicted a sense of detachment from reality, highlighting the immersive aspect of VR as transporting users to another world. P09 chose "a dream" to describe the experience, capturing the transient yet impactful nature of emotions and events felt within VR, similar to a dream's fleeting reality. P11 described it as "life itself," suggesting that VR experiences can mirror life's lessons, where missed or mistaken experiences shape our understanding and memories. P15 offered a negative view with "a delusion," expressing skepticism about the accessibility and practicality of VR technology in education and the extensive training required for teachers. P22 used "living John Dewey" to honor the educational reformer's philosophy of learning through doing and experiencing, embodied by VR's interactive environment. Lastly, P29 described their experience as "swimming with diving gear," emphasizing the safety and exploratory freedom VR provides, allowing users to transcend their usual limitations. These explanations illustrate the complex and nuanced attitudes toward VR in education, ranging from optimistic and immersive to critical and skeptical, each encapsulating unique insights into the potential and challenges of integrating virtual reality into educational contexts.

The varied perspectives and metaphors from participants highlight the range of experiences and expectations with experiential learning and virtual reality in education. Despite a generally positive outlook and anticipation of technological advancements and wider adoption, concerns about accessibility and the need for comprehensive teacher training highlight existing challenges. Integrating VR and experiential learning methods into educational practices is recognized as a complex yet potentially transformative process, requiring a balanced approach to leverage the benefits while addressing obstacles to successful implementation.

Notes from Researcher Observations

Researchers have observed that teacher candidates were eager and enthusiastic during the application process. However, despite participants having successfully completed the Teaching Principles and Methods course, it was noted that their knowledge and proficiency levels regarding experiential learning were considerably limited. While participants expressed positive views about the integration of virtual reality technology with experiential learning, researchers also observed a lack of optimism regarding the broad adoption of this practice. This pessimism is primarily attributed to economic constraints and the prevailing perception that, despite the adoption of a learner-centered educational philosophy, the educational system still largely relies on rote learning in practice. Participants reflected the viewpoint that the use of virtual reality technology in teacher education could enrich the teaching practice as an alternative. Yet, there is a strong belief that no technology can replace the importance of eye contact and direct communication with students. Considering the rapid advancements in artificial intelligence, it is not far-fetched to anticipate that virtual reality technology, enhanced with AI, could create interactive environments with virtual characters in teacher education in the future. However, it has also been observed that teacher candidates do not have a flexible mindset regarding this issue. Some participants struggled significantly with producing metaphors, which could be attributed to both a lack of technological literacy and insufficient creative thinking skills. While some tried to create metaphors related to their experiences, they ended up using statements that merely summarized their experiences. For example, P18 described the experience as "*like learning by doing and experiencing"* essentially providing a summary of their experience.

Discussion, Conclusion and Suggestions

In this research it was found that teacher candidates' view the integration of virtual reality technology with experiential learning in teacher education positively and beneficially. The metaphors generated by participants, which are almost entirely positive, corroborate the expressions shared during interviews. Researchers also observed that teacher candidates experienced the application of virtual reality integrated with experiential learning with excitement and high motivation. Pantelidis (2010) notes that the use of virtual reality technology in education enhances student motivation by supporting active participation in an interactive environment. The study reveals that even with a basic virtual reality application, teacher candidates generally experienced an immersive experience, were impacted by it, and believe that this experience should be expanded across different educational levels and fields. However, financial barriers to accessing this technology and challenges in content development processes have emerged as significant limitations. Literature review shows that the number of studies on virtual reality applications in teacher education is exceedingly insufficient. The findings of the few available studies align with those of the current research (Billingsley, G., Smith, S., Smith, S., & Meritt, 2019; Grossman, 2018; Clark, 2011; Serin, 2020).

McGarr (2020) notes that research on the application of virtual reality technology in teacher education has only emerged in the last decade, indicating its potential to guide the development of teacher education programs for training future teachers. McDonald, Kazemi & Kavanagh (2013) emphasize the importance of this technology in enriching teaching practices processes. In this study, virtual reality technology integrated with experiential learning was applied as a teaching practice, and teacher candidates were generally satisfied. However, they also stated that teaching requires real eye contact and communication, which virtual reality technology cannot replace. Therefore, it is thought that this technology could be effectively used not directly as a practice but as preparation for authentic teacher training internships. Indeed, Nissim and Weissblueth (2017) have highlighted that the use of virtual reality technology in teacher education positively affects teacher self-efficacy, creativity, and innovative thinking skills. Developing different VR scenarios could allow teacher candidates to experience some situations they may encounter in the future. Kim and Ko (2012) mention that virtual reality technology plays a significant role in providing equal opportunities in processes such as recognizing and experiencing different cultural characteristics. In this study, VR technology integrated with experiential learning was found beneficial by teacher candidates for applying theoretical knowledge. The literature also emphasizes significant developments in bridging the gap between theory and practice in teacher candidates' education through VR (Cohen, Wong, Krishnamachari & Berlin, 2020; Ke, Lee & Xu, 2020). Clark (2011) has stated the necessity of training teacher candidates with an awareness of the advantages and disadvantages of this technology. Moreover, the unique opportunities of virtual reality are closely aligned with the objectives of application-based teacher education (Grossman, 2018; Lamb & Etopio, 2020). Kosko and colleagues (2021) argue for an increase in conceptualization studies and applied research on the implementation of VR and extended reality in teacher education. Atal, Admiraal, and Saab (2023) also state that technological applications in teacher education should not be applied independently but supported by an instructional model. In this study, Kolb's Experiential Learning Cycle was experienced with VR technology accordingly. Researching how different learning models can be integrated with virtual reality technology and examining their effects will contribute to the knowledge base in this field.

This study revealed that VR technology's potential to revolutionize education with innovative methods. However, unequal access to technology could hinder these advancements, a challenge similar to that faced by earlier technologies like television and the internet, which eventually became widely accessible. The educational landscape anticipates a substantial surge in immersive applications, driven by advancements in VR, artificial intelligence, and wearable technology. Consequently, integrating VR into educational programs and teacher training is necessitates for its broad adoption. Such integration serves as a critical cornerstone for improving teaching methods and equipping future educators with the necessary skills to leverage VR effectively within the classroom. To this end education programs must provide practical VR integration training and address issues like privacy, data security, and fair representation in virtual environments. Through the exchange of ideas in scientific conferences and the pursuit of rigorous research initiatives, a more comprehensive understanding of VR's effectiveness in education can be cultivated, paving the way for the development of well-defined best practices within this field.

Based on the findings of this study, to gain a more comprehensive understanding of VR technology's impact on education, researchers should explore a wider range of research methodologies. Experimental studies could be valuable in confirming VR's contributions to teacher training and evaluating its measurable outcomes on student learning. Moreover, conducting descriptive and mixed-methods research with larger sample groups could shed light on the broader role and practical applications. This research could also illuminate the potential of VR in promoting inclusivity and accommodating individual differences in education. Therefore, researchers are encouraged to adopt these methodologies further investigate the potential benefits and multifaceted impacts of VR integration in educational contexts.

To equip future educators with the skills to leverage emerging technologies, teacher education programs require continuous revision and integration of innovative tools like virtual reality. This approach will ensure that teacher candidates graduate with the necessary skills to keep pace with technological advancements and adopt dynamic and flexible teaching approaches after graduation. Virtual Reality environments offer unique opportunities for structuring knowledge and promoting creative thinking, by immersing learners in realistic scenarios. These experiences change learners' knowledge, perceptions, attitudes, and emotions, offering meaningful and creative learning opportunities. These experiences not only change learners' knowledge, perceptions, attitudes, and emotions, but also culminate in the creation of a rich and transformative learning space. Virtual reality environments should be viewed not merely as technological tools but as transformative educational systems with the potential to revolutionize teacher education through their innovative integration.

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