

A FIBONACCI-BASED APPROACH TO ENHANCING VR TRAINING EFFICIENCY: EVIDENCE FROM ENGLISH FOR TECHNICAL FIELDS

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Abstract

This study explores the development of an efficient method for establishing virtual reality (VR) educational laboratories, with a specific focus on English for technical fields. Research indicates that VR-based instructional methods can boost comprehension rates to 75–90% and expedite knowledge acquisition by up to four times compared to traditional teaching. However, extended VR sessions often lead to adverse physical and cognitive effects such as dizziness, eye strain, and fatigue. To address these issues, we propose a Fibonacci-based approach to structuring VR laboratory sessions. By organizing learning intervals according to the Fibonacci sequence and integrating short, periodic breaks, this method enables smoother cognitive transitions, reduces physical discomfort, and optimizes students' adaptation to and from the virtual environment. A comparative experiment involving 24 students showed that participants who followed the Fibonacci-based method demonstrated statistically significant improvements in learning outcomes and overall well-being when compared to those in continuous VR sessions ($p < 0.05$).

Keywords: Virtual Reality, Fibonacci Sequence, Technical Education, VR Laboratories, Learning Efficiency, Cognitive Adaptation, Student Health

1. Introduction

Recent developments in educational technology underscore virtual reality (VR) as a powerful tool for enhancing student engagement and learning outcomes, particularly in technical fields. Studies show that VR-based laboratories can elevate comprehension rates to 75–90% and accelerate mastery by four times compared to

conventional methods. This surge in VR adoption is evident in the increasing number of universities implementing VR-based modules (see Figure 1).

Despite these advances, continuous VR sessions without systematic breaks can cause dizziness, nausea, and eye fatigue, particularly for students unaccustomed to extended immersion. Moreover, transitioning between virtual and real-world contexts can be cognitively demanding. Consequently, this paper introduces a Fibonacci-based scheduling approach to break VR sessions into intervals that align with natural cognitive and physiological rhythms.

2. Literature Review

2.1 VR in Training and Education

Caroline W. (2024) observed that VR training can outperform conventional pedagogies by offering immersive and interactive experiences that enhance retention. Aneesh K. (2024) highlighted VR's transformative role in corporate skills training, enabling realistic, hands-on simulations for accelerated learning. Similarly, Doug D. (2024) presented ten case studies affirming VR's capacity to offer impactful and memorable instruction.

2.2 Fibonacci Sequence in Nature and Learning

The Fibonacci sequence (1, 1, 2, 3, 5, 8, ...) frequently appears in natural and biological contexts. Elias D.F. (2024) discusses how Fibonacci numbers surface in human growth patterns. Sacco R.G. (2018) and Ravindra C. & Rengan V. (2022) elaborate on Fibonacci's role in synchronicity and human anatomical structures. Kaygin et al. (2011) further show that contextualizing mathematical concepts like the Fibonacci sequence can significantly improve comprehension and application in educational settings.

Collectively, these studies underscore VR's potential to revolutionize modern education and confirm the pedagogical promise of applying Fibonacci-based timing structures to optimize cognitive function and minimize fatigue.

3. Method

A comparative, experimental research design was employed to investigate whether a Fibonacci-based scheduling approach could address the known challenges of continuous VR sessions. Twenty-four students were randomly assigned into two groups:

- **Traditional VR Group (12 students):** Experienced continuous VR sessions without structured breaks.
- **Fibonacci VR Group (12 students):** Engaged in VR sessions structured according to Fibonacci time intervals, interspersed with 2–5 minute breaks.

3.1 Data Collection and Analysis

Quantitative data included task completion rates, adaptation measures (e.g., dizziness, eye strain, cognitive fatigue), and academic performance. An independent t-test was conducted to determine statistical significance between the two groups. The threshold was set at $p < 0.05$.

4. Development of Teaching Stages

Human developmental processes often follow the Fibonacci sequence in rhythms and cycles. Drawing on the Fibonacci Life Chart Method (FLCM), each Fibonacci number can represent distinct human and cognitive development stages. Structuring VR sessions based on these intervals may, therefore, capitalize on natural learning rhythms.

- **Segmenting VR Time:** Learning intervals are allocated according to Fibonacci numbers (e.g., 3, 5, 8, 13 minutes), incrementally extending immersion while providing short breaks.
- **Short Breaks:** Each interval is followed by 2–5 minute breaks. This prevents eye strain and mental fatigue, enabling cognitive and physical recalibration.
- **Task Complexity:** The learning content is divided into seven levels, escalating in difficulty. During an 80-minute practical session, students

gradually increase their VR exposure while targeting progressively complex tasks.

5. Structured Lesson Processes

To optimize cognitive load and reduce fatigue, the lesson sequence is meticulously organized (Table 1). Each step leverages short, strategically placed breaks to align with natural rhythms and maintain student well-being.

PROCESS OF LESSON	Break Time	Lesson Time
I. Starting class	–	3 min
II. Warm-up	–	5 min
III. Introduction of the class	–	2 min
Break – Watching result	1 min	–
IV. Adapting eyes for VR	–	3 min
Break – Watching result	1 min	–
V. Adapting body to the VR	–	5 min
Break – Watching result	2 min	–
VI. Starting VR with pre-task	–	8 min
Break – Watching result	3 min	–
VII. Main task activity	–	13 min
Break – Watching result	3 min	–
VI. Post-task	–	8 min
Break – Watching result	2 min	–
V. Conclusion	–	5 min
Break – Homework	2 min	–
III. Assessment part	–	3 min

This structured plan ensures students adapt incrementally to the VR environment, minimizing physical and cognitive stress. Brief intermissions also help students reflect on progress and retain new information more effectively.

6. Practical Section and Results

Twenty-four students were evaluated using both continuous VR sessions (Traditional Group) and Fibonacci-based sessions (Fibonacci Group). Both academic performance and physiological/cognitive comfort were measured. A t-test

(df = 22) yielded $p = 8.85 \times 10^{-10}$ – 108.85×10^{-10} , which is well below 0.05, indicating a highly significant difference favoring the Fibonacci-based method.

6.1 T-test Analysis

- **Null Hypothesis (H_0):** No difference exists between the traditional and Fibonacci-based VR methods.
- **Alternative Hypothesis (H_1):** There is a significant difference between these two methods.

Given that $p < 0.05$, H_0 is rejected, affirming that structuring VR sessions according to Fibonacci intervals meaningfully improves student performance and health outcomes.

7. Conclusion

This research demonstrates that applying a Fibonacci-based schedule in VR laboratories enhances student learning, minimizes cognitive and physical strain, and eases transitions between virtual and real environments. The results have immediate implications for instructional design in technical fields, including English for Specific Purposes (ESP) courses. Short, structured segments of VR immersion, interspersed with periodic breaks, provide students sufficient time to adapt cognitively and physically, thus maximizing retention and performance.

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