Review of: "Teaching the seasons of the year to kindergarten students using desktop virtual reality. A comparative study"

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Potential competing interests: No potential competing interests to declare.

Introduction Section :

The paper under review offers a thorough exploration of the potential benefits of integrating Virtual Reality (VR) technology into kindergarten education, primarily focusing on its application in teaching subjects related to the natural environment. While the authors present a compelling case for the transformative role of VR, some critical points warrant further consideration and discussion.

Firstly, the introduction effectively sets the stage by emphasizing the distinct learning characteristics of kindergarten students and the importance of addressing their innate curiosity. The authors rightly argue for the significance of introducing natural environment concepts early on. However, the section could benefit from a more concise articulation of the main argument, as the extensive detail might overwhelm readers with information that could be streamlined.

The connection between prior experiences and the proposed use of VR is well-established. Still, the review lacks a critical examination of potential drawbacks associated with traditional teaching methods, which would provide a more balanced perspective. A comparative analysis between conventional tools and VR technology could enhance the paper's academic rigor.

The methodology presented in the research is commendable for its attempt to investigate the impact of desktop Virtual Reality (dVR) on kindergarten students' learning, particularly in the context of understanding concepts related to the natural environment. However, several critical points merit consideration and discussion.

Methods Section:

Rationale and Hypotheses: The paper clearly articulates the rationale behind the study, justifying the need to investigate the impact of dVR on young students in comparison to conventional teaching materials. The hypotheses outlined are specific and align with the research objectives. However, the assertions about the impact of dVR on learning outcomes and satisfaction levels lack sufficient grounding in existing literature. A more extensive review of prior studies on dVR in kindergarten education could strengthen the foundation for these hypotheses.

Research Design: The choice of a within-subjects research design is justified, considering the advantages it offers in terms of smaller sample sizes and reduced confounding effects. However, the paper acknowledges potential downsides

such as the practice effect. While efforts are made to mitigate these effects through randomization and content variation, the potential influence on learning outcomes remains a significant concern. A comparative between-subjects design or a more detailed discussion of the limitations associated with the within-subjects design would enhance the methodological robustness.

Sample and Duration: The sample size determination using G*Power is well-explained, and precautions taken to counter the fatigue effect and carryover/context effects are reasonable. However, the unforeseen absences that resulted in a reduced final sample size could introduce bias. The paper does not elaborate on the impact of this reduction on the study's power and generalizability.

Materials: The selection of learning content related to the study of seasons is appropriate for kindergarten students, aligning with the curriculum. The development of the dVR application using OpenSimulator is a strength, providing an immersive virtual environment. However, the decision to choose different seasons for the dVR and conventional materials treatments raises questions about the comparability of content. The efforts to align with Mayer's multimedia design principles are commendable, but the impact of these design choices on learning outcomes is not discussed.

Instruments: The evaluation tests and structured interviews for data collection are suitable for the target age group, incorporating visuals and emoticons to enhance comprehension. However, the paper lacks details on the reliability and validity of these instruments, which are crucial for ensuring the integrity of the collected data. A more thorough discussion of the development and validation process of these instruments is necessary.

Procedure: The implementation procedure aligns with a proposed learning framework for 3D virtual environments, providing a structured approach. The initial familiarization session and the group activities in the dVR condition are well-planned. However, the paper does not discuss potential biases introduced by the teacher's guidance during the dVR sessions, which may impact the students' interactions and experiences.

Ethical Considerations: The paper mentions ethical approval and parental consent, which is essential when involving minor participants. However, the ethical considerations associated with exposing young children to immersive technologies like dVR, including potential psychological impacts, are not discussed. A more robust discussion of ethical safeguards and considerations is necessary.

Results, Discussion, and Conclusion Section:

While the study makes a commendable contribution to the field of early childhood education, several critical points warrant attention.

Firstly, the research design is robust, incorporating a range of assessments and statistical analyses. The use of Analysis of Covariance (ANCOVA) and Analysis of Variance (ANOVA) adds depth to the evaluation of learning outcomes and factors influencing student experiences. The inclusion of both quantitative and qualitative data enriches the findings, providing a holistic understanding of the impact of dVR applications.

The internal consistency of the questionnaires, assessed through Cronbach's α, meets acceptable standards, ensuring

the reliability of the study's measurements. The detailed presentation of statistical analyses, including effect sizes, enhances transparency and allows readers to gauge the practical significance of the results.

The study successfully confirms its first hypothesis, demonstrating that the dVR application yields superior learning outcomes compared to conventional materials. This aligns with existing literature on the transformative potential of VR in education. The exploration of various factors such as immersion, enjoyment, ease of use, and motivation contributes valuable insights into the nuanced aspects of dVR applications in early childhood education.

However, certain aspects merit critical consideration. The gender-based analyses, while interesting, lack deeper exploration and contextualization. The study merely mentions that gender did not significantly impact various factors, leaving room for a more nuanced discussion on potential gender-related influences on learning experiences.

Moreover, the unexpected result regarding the lack of correlation between motivation and learning outcomes raises questions about the specific attributes of the dVR application or the study's context that may have contributed to this deviation from established findings. Further research is essential to delve into the intricacies of motivation within the given technological context.

The study could benefit from an expanded sample size and increased session duration, addressing potential limitations. Additionally, the focus on a specific topic (seasons of the year) may limit the generalizability of the findings to a broader range of subjects. A more diverse curriculum could provide a more comprehensive understanding of dVR applications' effectiveness across various educational domains.

In conclusion, this research significantly contributes to the discourse on dVR applications in early childhood education. Despite its limitations, the study offers valuable insights into the multifaceted impacts of immersive technologies on learning outcomes and student experiences. Future research should build upon these foundations, exploring diverse topics, incorporating larger samples, and delving into the complexities of motivation in the context of VR-enhanced education.