

Evaluating the Impact of AR-Enhanced Virtual Traveling Labs on Physics Teaching and Learning

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Abstract. Augmented Reality (AR) is increasingly being recognized as a transformative technology in education, particularly for enhancing virtual laboratory experiences in physics teaching and learning. This study evaluated the impact of AR-enhanced virtual labs, specifically the Traveling Virtual Lab (TVL), on physics education. A quantitative research design was employed, and (n=18) respondents used a systematic sampling strategy to select teachers across different grade levels. The adapted "Student Acceptance of Virtual Laboratory questionnaire" was used to gather data on teachers' perceptions of the appeal and effectiveness of TVL. The findings revealed a strong agreement among teachers regarding the importance of laboratory equipment and hands-on learning experiences in physics education. The TVL received highly positive perceptions from the teachers regarding its appeal and effectiveness in teaching physics concepts. Although no significant differences were found in the appeal of TVL based on teachers' gender or grade level, male teachers perceived TVL to be more effective than female teachers. A strong positive correlation was found between the appeal and effectiveness of TVL in teaching physics concepts. These findings highlight the potential of AR-enhanced virtual labs, particularly TVL, to address challenges in physics education and provide engaging and interactive learning experiences. The study recommends the integration of AR-enhanced virtual labs into physics curricula, professional development programs for teachers, further research on gender disparities, resource allocation for implementation, and ongoing evaluation and refinement of these innovative educational tools.

Keywords: Augmented Reality; Education; Interactive; Learning; Physics teaching; Virtual labs

1.0 Introduction

Augmented Reality (AR) is increasingly recognized as a transformative technology in education, particularly for enhancing virtual laboratory experience. AR's ability of AR to overlay digital content onto the real world offers unique opportunities for interactive and immersive learning, making it especially valuable in STEM education (Kumar et al., 2024). In the context of virtual laboratories, AR has shown significant potential in bridging the gap between physical and virtual learning environments. A study examining substituting physical lab components with tangible replicas and virtual representations found that AR can reduce experimental setup time without

compromising knowledge transfer (Knierim et al., 2020). This suggests that AR can streamline laboratory processes while maintaining educational efficacy. AR's application of AR in virtual laboratories extends beyond simulations. This allows students to interact with complex concepts tangibly and engagingly. For instance, AR can create immersive learning experiences that foster interest and aid information retention (Gaikwad & Mulay, 2024).

AR applications in engineering education have been developed to improve students' self-ability and interest in practical experimentation (Sarode et al., 2019). These applications enable students to interact with 3D models and images superimposed on real objects, enhancing their understanding of the specific concepts. However, implementing AR in education is challenging. Developing instructional AR tools and applications requires significant time and effort, which may delay or hinder their adoption in educational settings (Sharma et al. 2023). Additionally, issues such as cost, content development, and accessibility must be addressed to unlock the full potential of AR in education (Selvakumar & Sivakumar, 2023). Despite these challenges, the growing role of AR in education, particularly in enhancing virtual laboratory experiences, is undeniable. AR's ability to create interactive and personalized learning environments aligns well with the principles of Education 5.0, which emphasizes student-centered learning and emerging technologies (Abuzir, 2024; Selvakumar & Sivakumar, 2023). As AR technology continues to evolve, it holds promise in revolutionizing education by providing dynamic, engaging, and effective learning experiences in virtual laboratory settings and beyond.

Physics education in traditional settings encounters numerous obstacles, particularly in offering captivating, practical learning experiences and providing access to laboratory facilities. A study involving 107 high school physics instructors found that only 25% reported having well-equipped physics labs, while 45% operated without dedicated labs but utilized science kits or improvised materials. Notably, 30% lacked access to physics laboratories, science kits, and locally improvised resources (Nzabahimana et al. 2024). This scarcity of resources significantly restricts students' opportunities for hands-on experiential learning, which is vital for understanding intricate concepts in physics. The shortcomings of conventional teaching methods in physics education go beyond the resource limitations. Students often struggle to grasp abstract physical concepts without conducting practical experimentation. Moreover, time constraints in laboratory sessions prevent teachers and students from adequately conducting activities, further impeding the learning process (Nzabahimana et al. 2024). These challenges are especially evident in information security education, where restrictive IT policies can impede hands-on experience in traditional computer laboratories (Konak et al., 2013).

To address these issues, novel approaches, such as virtual laboratories (VLs), digital practical work (DPW), and immersive technologies, such as virtual reality (VR) and augmented reality (AR), are being investigated. These technologies offer promising solutions by delivering immersive, interactive experiences that can replicate complex experiments and render abstract concepts more tangible (Moloi & Matabane, 2024; Prayogi & Verawati, 2024). However, the implementation of these technologies faces several hurdles, including a lack of teacher awareness, limited ICT tools, insufficient supporting resources, and the need for comprehensive professional development programs (Prayogi & Verawati, 2024; Nzabahimana et al., 2024). Surmounting these obstacles is crucial for transforming physics education and ensuring all students have access to engaging, hands-on learning experiences regardless of their physical laboratory resources.

Virtual laboratories have become a valuable resource for providing students with hands-on experiences, particularly when physical laboratories are unavailable or during events such as the COVID-19 pandemic (Racha et al., 2022). These digital environments allow students to engage in interactive learning and develop practical skills. Augmented Reality (AR) has been recognized as a promising technology for enhancing the virtual laboratory experience. AR has the potential to narrow the divide between virtual and real-world settings, fostering more engaging and productive learning opportunities (Iqbal & Campbell, 2021). This technology enables direct manipulation of virtual objects in real-world contexts, which could be particularly beneficial for simulating laboratory equipment and experiments. AR can facilitate learning experiences that would otherwise be unattainable in resource-limited educational systems (Iqbal & Campbell, 2021). Researchers have explored the integration of AR with social robotics in classrooms to improve interpersonal communication and student engagement in learning (Hennerley et al., 2017). This combination can be applied to virtual laboratories, creating a more interactive and collaborative environment that resembles physical laboratory settings. Although the specific concept of Traveling Virtual Labs was not mentioned, the incorporation of AR in virtual laboratory

environments shows promise in addressing challenges related to interactivity and effectiveness in teaching. For example, studies have shown that using AR smart glasses in laboratories can increase student engagement and improve learning outcomes (Racha et al. 2022). As these technologies continue to advance, they have the potential to transform the way students interact and learn from virtual laboratory experiences.

This study is significant because it addresses several gaps in the current research on AR-enhanced virtual laboratories. First, while there is extensive research on using Virtual Reality (VR) and Augmented Reality (AR) in education, there is a notable lack of focus on their specific applications in virtual laboratories. Existing literature primarily covers general educational contexts, gaming, and medical applications (Aliwi et al., 2023; Bajaj, 2023). This study fills this gap by examining AR-enhanced virtual laboratories, which represent a unique intersection between technology and practical scientific education. Interestingly, despite the growing interest in AR and VR technologies, the large-scale demand for these technologies in learning environments is scarce (Dörner et al., 2010). This contradiction highlights the need for research exploring the potential of AR-enhanced virtual labs to bridge this gap and increase their adoption in educational settings. This study is significant because it addresses the lack of comprehensive research on AR-enhanced virtual labs, potentially offering insights into overcoming current technological limitations and integration challenges (Bajaj, 2023; Borgmann et al., 2018). Focusing on this Specific Application. This study aimed to investigate the impact of Augmented Reality (AR)-enhanced Virtual Labs on the teaching and learning of physics, focusing on teachers' perceptions of the appeal and effectiveness of these tools, the relationship between the frequency of laboratory activities and their effectiveness, and the influence of demographic factors such as sex and grade level. By examining the significant differences and relationships among these variables, this study aimed to provide insights into the potential of AR-based Traveling Virtual Labs (TVLs) as innovative, equitable, and effective resources for improving physics education.

2.0 Methodology

2.1 Research Design

This study employed a quantitative research approach to examine and measure the correlation between variables and evaluate the hypotheses using statistical methods (Fischer et al., 2023). The quantitative design offers a methodical and rigorous framework for exploring educators' views on the TVL and its AR components in physics instruction. By utilizing quantitative techniques, this study sought to produce objective and broadly applicable results that enhance existing knowledge in this field. The investigation identifies independent variables (IVs), such as teacher characteristics, and dependent variables (DV), including attitudes toward the TVL and its AR features. These variables were defined to allow for quantitative measurements, ensuring the study's ability to gather numerical data for analysis.

2.2 Respondents of the Study

This study employed a systematic sampling strategy to select a representative sample of teachers from the target population. The total population consisted of eighteen (18) physics teachers across different grades. To determine the sampling interval (k), we divided the population size by the desired sample size of 18, resulting in a sampling interval of $k=1$. Starting with a randomly selected teacher from the ordered list, every k th teacher is selected for inclusion in the sample. The interval or sampling interval (k) was calculated by dividing the population by the desired sample size (Voxco, 2021). This systematic approach ensures a balanced representation across grade levels while maintaining randomness in selection. The final sample comprised 18 teachers: 31.2% from senior high school, 25% from primary and tertiary levels, and 18.2% from junior high school.

2.3 Data Gathering Instrument

Quantitative data collection methods were employed to gather numerical data from the participants. Surveys or questionnaires can collect responses related to perceptions, ratings, and demographic information. These instruments were designed using Likert scales or other quantitative measures to facilitate the data analysis. The research instrument utilized for data gathering in this study is the "Student Acceptance of Virtual Laboratory questionnaire," adapted from Park (2009). This questionnaire measured students' acceptance of virtual laboratory activities, particularly in the context of physics education. The instrument consists of 37 items rated on a 5-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree").

The questionnaire was divided into two main sections: Part 1 focused on demographics designed for teachers; the introduction to the questionnaire provided participants with an overview of the research objectives and context, inviting them to share their experiences and opinions on laboratory activities in physics and the Traveling Virtual Lab (TVL), a solar-powered, augmented reality (AR) learning kit designed to enhance physics education. The content of Part 2 is structured into several sections, each containing Likert-scale items related to different aspects of laboratory activities, including access to equipment, effectiveness of current activities, and frequency of hands-on experiences.

The validity and reliability of the instrument have been established using several methods. First, the questionnaire items were adapted from an instrument Park (2009) validated to ensure content validity. Pilot testing was conducted to assess the clarity and validity of the survey items before their full implementation. Furthermore, using Likert-scale responses allows for quantitative analysis of responses, contributing to the instrument's reliability.

2.4 Data Gathering Procedure

The data-gathering procedure for this quantitative research design involved systematically collecting numerical data using well-designed instruments, such as surveys or questionnaires, based on the study's research questions and hypotheses. These instruments were pilot-tested with a small sample to ensure clarity and validity, incorporating revisions as needed. The sampling strategy identified the target population and criteria for inclusion by employing systematic sampling to select participants at regular intervals, ensuring representativeness and minimizing bias. Once participants were selected, the finalized instruments were distributed with clear instructions and assurances of confidentiality to encourage honest responses. Data collection methods included in-person distribution, email dissemination, or online platforms. The completed surveys were recorded and entered into a secure database or a spreadsheet.

Descriptive statistical analysis was used to summarize the sample characteristics and key variables, followed by inferential statistical analysis to test the hypotheses and explore variable relationships. The results concerning the research objectives were interpreted and presented using tables, graphs, and descriptive statistics. The study's findings are discussed, noting limitations and suggesting future research directions. This systematic procedure ensured rigorous data collection, analysis, and interpretation, contributing to advancements in physics education and educational technology.

2.5 Statistical Tools

Table 1 outlines the specific research questions and corresponding statistical analysis techniques to address each question.

Table 1. Statistical tools per research question	
Research Question	Statistical Analysis
1. Profile of Teachers	Descriptive statistics (frequencies, percentages)
2. Level of Agreement on TVL Perception	Descriptive statistics (means, standard deviations)
3. Level of Effectiveness of AR Features	Descriptive statistics
4. Relationship between Teacher Profiles and TVL Perception	Chi-square tests or logistic regression analysis
5. Relationship between TVL Perception and AR Features	Pearson correlation analysis or multiple regression analysis

2.6 Ethical Considerations

Ethical considerations for this study of AR-enhanced virtual labs in physics education include ensuring equitable access to technology, protecting student privacy and data, obtaining informed consent, addressing potential psychological impacts, maintaining educational quality, disclosing conflicts of interest, promoting inclusivity, considering long-term effects, providing adequate teacher training, and responsibly reporting results. Researchers should ensure that all participants have equal access to necessary devices and Internet connectivity, implement proper data protection safeguards, obtain informed consent from participants or guardians, offer support to students struggling with the AR interface, minimize disruption to regular learning, accommodate students with disabilities, and transparently disclose any potential conflicts of interest or funding sources. By addressing these ethical considerations, this study can be conducted in a manner that respects participant rights, promotes fairness, and maintains scientific integrity.

3.0 Results and Discussion

3.1 Evaluating the Impact of AR-Enhanced Virtual Labs on Physics Teaching and Learning

Table 2 shows the level of agreement between the teachers' accessibility to equipment and the current effectiveness of laboratory activities.

Table 2. Accessibility to equipment and the current effectiveness of laboratory activities

Variable	Mean	Description	SD
Accessibility of equipment	4.30	Strongly Agree	0.50
Effectiveness of activities	4.40	Strongly Agree	0.50

Studies have affirmed the significance of laboratory equipment and practical experience in physics education with high mean scores ($M=4.3$, $SD=0.5$; equipment importance: $M=4.4$, $SD=0.5$ for lab helpfulness), indicating a strong consensus on the value of hands-on learning. More than 80% of physics teachers in Aceh require both hands-on and virtual laboratories for effective teaching (Muliandi et al., 2024). Proper use of laboratory equipment correlates with higher student performance (Olufunke, 2012). While traditional lab equipment is essential, virtual and remote laboratories are increasingly recognized for their potential, especially in resource-limited or distance-learning contexts. Remote labs can enhance prospective physics teachers' multiple representation abilities (Fatmaryanti et al., 2024), and virtual labs can boost creativity (Gunawan et al., 2017). High mean scores reflect consensus on the importance of both traditional and innovative lab experiences. However, challenges like equipment inadequacy, lack of maintenance, and time constraints often hinder practical learning (Sunardi et al. 2022). Addressing these issues requires investment in equipment, teacher training, and the development of virtual and remote lab solutions.

Table 3. Appeal and effectiveness of the TVL in learning Physics concepts

Variable	Mean	Description	SD
The appeal of the TVL	4.50	Strongly Agree	0.60
Effectiveness of the TVL	4.50	Strongly Agree	0.60

This passage examines educators' perspectives on the Traveling Virtual Lab (TVL) for physics instruction. As shown in Table 3, instructors strongly endorsed the TVL's attractiveness and efficacy, with identical average ratings of 4.5 and standard deviations of 0.6 for both aspects. These high scores on a 5-point scale indicate a highly favorable view of TVL among teachers. The consistent 0.6 standard deviation suggests uniform agreement among the surveyed educators. These findings imply that teachers consider the TVL an engaging and effective tool for conveying physics concepts, potentially serving as a valuable complement or alternative to the conventional laboratory experience in physics education.

Several studies have underscored the significance of effective teaching methods in TVL and physics education. Pangan (2022) noted that TVL instructors often use diverse teaching approaches, including lecture-laboratory combinations, computer-aided lessons, and modeling demonstrations. Students found these strategies highly satisfactory, particularly regarding teaching quality, attitude, and style (Pangan, 2022). Abdul (2024) revealed that while TVL educators employ traditional teaching techniques, they also show flexibility in adapting their methods to suit resource availability, experience levels, and financial limitations. This adaptability ensures continued student engagement and learning effectiveness, potentially contributing to the appeal and efficacy of the TVL in teaching various subjects, including physics (- and -, 2024). In summary, although the cited literature does not directly support the specific metrics provided ($M=4.5$, $SD=0.6$), the research suggests that TVL instructors use diverse and adaptive teaching strategies that are well-received by students. This positive reception could potentially translate into high levels of appeal and effectiveness of physics instruction within the TVL framework. However, additional research on physics education in the TVL context is required to validate these assumptions.

3.2 Appeal of Traveling Virtual Laboratory in Teachers in Learning Physics Concepts According to Sex

As shown in Table 4, while male teachers ($M=4.8$) demonstrated a slightly higher mean score than their female counterparts ($M=4.3$), the independent sample t-test revealed that this difference was not statistically significant. The test statistics, $t(14) = -1.99$, $p = .066$, indicate a marginal difference that falls short of the conventional threshold for statistical significance ($p < .05$). This finding suggests that gender may not be a determining factor in teachers' appreciation of TL as an educational physics tool.

Table 4. T-test result of the appeal of TVL in teachers in learning Physics concepts according to sex

Sex	Mean	t-value	df	Sig. (2-tailed)
Male	4.80	1.99	14	.066
Female	4.30			

Although present, the observed difference in mean scores is not substantial enough to conclude that male and female teachers differ significantly in their perception of TL appeal. The p-value of .066, while close to the significance level, still indicates a 6.6% chance that the observed difference occurred by random chance rather than reflecting a true difference in the population. This result underscores the importance of cautious interpretation when examining gender-based differences in educational technology preferences, highlighting the need for further research with larger sample sizes to draw more definitive conclusions about the role of gender in teachers' attitudes towards virtual laboratories in physics education.

3.3 Appeal of Traveling Virtual Laboratory in Teachers in Learning Physics Concepts When Classified According to Grade Level Attended

The results of the one-way Analysis of Variance (ANOVA) indicated that there was no statistically significant difference in the appeal of TVL (Technology-Vocational-Livelihood) among teachers learning physics concepts when classified according to their grade level (see Table 5).

Table 5. One-way ANOVA results of the appeal of TVL in teachers learning Physics concepts according to grade level attended

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.54	3	0.180	0.44	.730
Within Groups	4.94	12	0.412		
Total	5.48	15			

The F-statistic, $F(3, 12) = 0.44$, with a p-value of 0.730, suggests that the observed differences in appeal across grade levels are likely due to random chance rather than a true effect. Based on these results, we conclude that 1. $F(3, 12)$ indicates that there were four groups (three degrees of freedom between groups) and 16 participants (12 degrees of freedom within groups). 2. An F-value of 0.44 is relatively low, indicating that the variance between groups was smaller than within groups. 3. The p-value of 0.730 is much higher than the conventional significance level of 0.05, providing strong evidence to reject the null hypothesis. These findings suggest that the grade level a teacher attends does not significantly influence their perception of the appeal of TVL in learning physics concepts. This implies that the TVL approach may be equally appealing across different grade levels, potentially indicating its versatility and broad applicability to physics education.

3.4 Effectiveness of TVL in Teachers in Learning Physics Concepts When Classified According to Sex

Table 6 revealed a significant gender-based difference in the perceived effectiveness of the TVL (Teaching and Learning) method among teachers ($t(14) = 2.41$, $p = .030$). Male teachers reported substantially higher effectiveness ratings ($M = 4.77$) than their female counterparts ($M = 4.15$), indicating that male educators found TVL more effective in their teaching practice.

Table 6. T-test for Independent Samples result of the effectiveness of TVL in teachers in learning physics concepts according to sex

Sex	Mean	t-value	Df	Sig. (2-tailed)
Male	4.77	2.41	14	.030
Female	4.15			

This disparity suggests potential variations in how male and female teachers implement, experience, or perceive the TVL method. Several factors contribute to this gender-based difference, including variations in teaching styles, subject areas, classroom dynamics, or personal preferences. Additionally, societal expectations and gender roles in education may influence how male and female teachers approach and evaluate new teaching methodologies. The higher effectiveness ratings from male teachers could indicate that the TVL method aligns more closely with their teaching approaches or that they may have had more positive experiences implementing it in their classrooms. Conversely, the lower ratings of female teachers might suggest that the TVL method may not fully address their specific needs or teaching contexts. This gender disparity highlights the importance of considering

diverse perspectives and experiences when developing and implementing educational strategies, ensuring that teaching methodologies are effective and inclusive for all educators, regardless of gender.

3.5 Effectiveness of TVL in Teachers Learning Physics Concepts According to Grade Level Attended

Table 7 describes the results of two statistical analyses regarding the effectiveness and appeal of a Traveling Virtual Laboratory (TVL) in teaching physics concepts. First, a one-way Analysis of Variance (ANOVA) was conducted to examine whether the effectiveness of TVL differed based on the year teachers taught. The results, $F(3, 12) = .33$, $p = .803$, indicated no significant differences. This suggests that the effectiveness of the TVL in teaching physics concepts is consistent across the different teaching years. Second, an independent samples t-test was performed to compare the appeal of the TVL between the male and female teachers. The results, $t(14) = -1.99$, $p = .066$, showed no statistically significant differences. Male ($M = 4.8$) and female ($M = 4.3$) teachers reported similar levels of appeal for TVL. The p-value of .066, above the conventional significance level of .05, suggests that any observed differences in appeal between genders could be attributed to chance rather than a true population difference. These findings collectively indicate that TVL's effectiveness and appeal of TVL in physics education are not significantly influenced by the year of teaching or the teacher's gender.

Table 7. One-way ANOVA results of the effectiveness of TVL in teachers learning physics concepts according to the grade level attended

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.409	3	.136	.33	.803
Within Groups	4.929	12	.411		
Total	5.338	15			

3.6 Correlation Between the Appeal and Effectiveness of TVL in Teaching Physics Concepts

This study investigated the relationship between the appeal and effectiveness of a Traveling Virtual Laboratory (TVL) in teaching physics concepts to educators. Table 8 reveals a strong, positive, and statistically significant correlation between these two variables ($r(14) = .88$, $p = .000$). The correlation coefficient of 0.88 indicates an extremely robust positive link, suggesting that as the attractiveness of TVL increases, so does its efficacy in helping teachers learn physics concepts, or vice versa. A p-value of .000, which falls below the conventional significance level of .05, implies that this correlation is highly unlikely to be due to chance. Fourteen degrees of freedom (14) suggested a sample size of 16 teachers. These results indicate that educators who find the TVL more engaging will likely perceive it as more effective in understanding physics concepts, highlighting the importance of creating engaging and attractive virtual learning environments for successful physics instruction.

Table 8. Correlation between the appeal and effectiveness of TVL in teaching physics concepts

	Pearson Correlation	df	Sig. (2-tailed)
Appeal	.88	14	.000
Effectiveness			

4.0 Conclusion

This study evaluated the impact of AR-enhanced virtual laboratories, specifically the Traveling Virtual Lab (TVL), on physics education. The findings revealed strong agreement among teachers regarding the importance of laboratory equipment and hands-on learning experiences in physics education. The TVL received highly positive perceptions from teachers regarding its appeal and effectiveness in teaching physics concepts. Although no significant differences were found in the appeal of TVL based on teachers' gender or grade level, male teachers perceived TVL to be more effective than female teachers. A strong positive correlation was found between the appeal and effectiveness of TVL in teaching physics concepts. These findings highlight the potential of AR-enhanced virtual labs, particularly TVL, to address challenges in physics education and provide engaging and interactive learning experiences. However, some limitations should be noted, including the relatively small sample size and the potential bias in self-reported perceptions. Future research should explore implementation in diverse educational settings, examine long-term learning outcomes, and investigate ways to optimize TVL effectiveness across the sexes. Overall, this study provides valuable insights into the potential of AR-enhanced virtual labs for transforming physics education.

This research suggests incorporating AR-enhanced virtual laboratories, specifically the Traveling Virtual Lab (TVL), into physics education curricula to tackle challenges and offer immersive, interactive learning experiences. Additional studies with larger participant pools and varied educational contexts should be undertaken to confirm

these results and examine the long-term effects of the TVL on student achievement. Exploring methods for maximizing TVL efficacy across sexes is essential, addressing the noted disparities in perception between male and female educators. Offering professional training to teachers to successfully integrate AR-enhanced virtual labs into their instructional methods is vital. Moreover, investigating the potential applications of the TVL in other STEM fields could improve hands-on learning across various disciplines. Finally, devising strategies to merge traditional laboratory equipment with AR-enhanced virtual labs may optimize the advantages of both approaches in physics education.

5.0 Contributions of Authors

In this study, Authors 1 and 3 conceptualized and designed the research, including formulating the research questions and hypotheses, contributing significantly to data collection and analysis and ensuring the accuracy and consistency of the data gathered. Played a key role in reviewing the literature and drafting the introduction, providing insights into relevant theories and prior research findings, instrumental in interpreting the results, assisting with statistical analyses, bringing clarity to the findings, focusing on the discussion and implications, linking the findings to practical applications, and suggesting avenues for future research. Authors 3 and 4 Contributed to the final manuscript by reviewing and refining it for coherence, accuracy, and clarity, approved the final version for submission, and lastly oversaw the entire project.

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7.0 Conflict of Interests

No conflict of interest.

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