

INTISARI

Pembelajaran dalam pendidikan kedokteran gigi menuntut integrasi antara pemahaman anatomi dan keterampilan prosedural yang presisi. Metode konvensional, termasuk penggunaan cadaver dan *dental phantom*, masih memiliki keterbatasan dalam hal visualisasi, ketersediaan, serta kurangnya umpan balik *real-time*. Perkembangan teknologi *Augmented Reality* (AR) menawarkan solusi melalui visualisasi tiga dimensi yang interaktif dan kontekstual. Oleh karena itu, penelitian ini bertujuan untuk: (1) menganalisis faktor-faktor yang diperlukan dalam perancangan model pembelajaran berbasis AR, (2) mengukur pengaruh model tersebut terhadap efektivitas pembelajaran, dan (3) menganalisis pengaruhnya terhadap efisiensi pembelajaran mahasiswa kedokteran gigi.

Penelitian ini menggunakan pendekatan eksperimen dengan desain *within-subject*, di mana sebanyak 16 responden menjalani tiga kondisi pembelajaran, yaitu metode konvensional, AR visual, dan AR visual-audio. Variabel yang diukur meliputi efektivitas (Y1) yang dinilai melalui hasil kuis, efisiensi (Y2) yang diukur melalui waktu penyelesaian tugas (*cycle time*), serta penerimaan pengguna (Y3) yang dianalisis menggunakan *System Usability Scale* (SUS) dan NASA-TLX. Pengujian statistik dilakukan melalui uji normalitas *Shapiro-Wilk*, dilanjutkan dengan uji nonparametrik *Friedman* untuk melihat perbedaan antar kondisi, serta uji *post hoc Conover* untuk analisis lanjutan pada variabel yang signifikan.

Hasil penelitian menunjukkan bahwa tidak terdapat perbedaan signifikan pada efektivitas pembelajaran antar metode dengan hasil ($p = .614$), karena data ($p > .05$) meskipun secara deskriptif nilai rata-rata metode AR visual audio (79.87) mendekati metode konvensional (80.41) dan lebih tinggi dibandingkan AR visual (70.66). Sebaliknya, dari aspek efisiensi, terdapat perbedaan signifikan antar metode ($p = .006$) karena ($p < .05$), di mana metode AR visual (168.27 detik) dan AR visual audio (175.83 detik) lebih cepat dibandingkan metode konvensional (216.91 detik). Hasil *post hoc* menunjukkan bahwa perbedaan signifikan terjadi antara metode konvensional dengan AR visual ($p = .020$) dan AR visual-audio ($p = .011$), sementara tidak terdapat perbedaan signifikan antara kedua metode AR ($p = 1.000$). Dengan demikian, penelitian ini memberikan kontribusi dalam pengembangan model pembelajaran berbasis AR yang terbukti mampu meningkatkan efisiensi pembelajaran tanpa menurunkan efektivitas, serta menawarkan pendekatan evaluasi yang terintegrasi antara aspek kognitif, prosedural, dan pengalaman pengguna dalam pendidikan kedokteran gigi.

Kata Kunci: *Augmented Reality*, Pembelajaran Kedokteran Gigi, Efektivitas, Efisiensi, dan Usabilitas.

ABSTRACT

Learning in dental education requires the integration of anatomical understanding and precise procedural skills. Conventional methods, including the use of cadavers and dental phantoms, still have limitations in terms of visualization, availability, and the lack of real-time feedback. Advances in Augmented Reality (AR) technology offer a solution through interactive and contextual three-dimensional visualization. Therefore, this study aims to: (1) analyze the factors required in the design of an AR-based learning model, (2) measure the model's impact on learning effectiveness, and (3) analyze its impact on the learning efficiency of dental students.

This study employs an experimental approach with a within-subject design, in which 16 participants underwent three learning conditions: the conventional method, visual AR, and visual-audio AR. The measured variables include effectiveness (Y1), assessed through quiz results; efficiency (Y2), measured through task completion time (cycle time); and user acceptance (Y3), analyzed using the System Usability Scale (SUS) and NASA-TLX. Statistical testing was conducted using the Shapiro-Wilk normality test, followed by the nonparametric Friedman test to examine differences between conditions, and the Conover post hoc test for further analysis of significant variables.

The results indicate no significant difference in learning effectiveness among the methods ($p = .614$), as the data showed ($p > .05$), although descriptively, the mean score for the visual-audio AR method (79.87) was close to that of the conventional method (80.41) and higher than that of the visual AR method (70.66). Conversely, in terms of efficiency, there was a significant difference between the methods ($p = .006$) because ($p < .05$), where the visual AR method (168.27 seconds) and the visual-audio AR method (175.83 seconds) were faster than the conventional method (216.91 seconds). Post hoc results indicate that significant differences exist between the conventional method and visual AR ($p = .020$) and visual-audio AR ($p = .011$), while no significant difference was found between the two AR methods ($p = 1.000$). Thus, this study contributes to the development of AR-based learning models that have been proven to improve learning efficiency without reducing effectiveness, and offers an integrated evaluation approach that combines cognitive, procedural, and user experience aspects in dental education.

Keywords: *Augmented Reality, Dental Education, Effectiveness, Efficiency, and Usability.*