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Visualization Of The Crescent Moon's Position Using The Sky Guide Application In Determining The Beginning Of The Lunar Month

Nurul Fitriah
Alauddin State Islamic University Makassar
Email: nfitriah788@gmail.com

Fatmawati
Alauddin State Islamic University Makassar
Email: fatmawati@uin-alauddin.ac.id

Jasdar Agus
Alauddin State Islamic University Makassar
Email: jasdarphysis@gmail.com

Abstract

This study examines the use of the Sky Guide application as a modern approach to determining the beginning of the Qamariah lunar months in the digital era. The research focuses on: (1) the hilal simulation procedure using Sky Guide based on augmented reality technology; (2) the comparison of the simulation results' accuracy with traditional hisab calculations using ephemeris data; and (3) the evaluation of Sky Guide as an educational tool along with its limitations for official lunar-month determinations. This study employs a descriptive-comparative library research method. Data were gathered from classical and modern falak literature, scientific articles, and field simulations conducted in Makassar on 27 February 2025 (29 Sha'ban 1446 H) and 29 March 2025 (29 Ramadan 1446 H). The analysis involves astronomical parameter comparisons between Sky Guide, Stellarium, and Accurate Times.The findings indicate that Sky Guide provides real-time hilal visualizations but lacks numerical data such as crescent altitude and elongation. Minor discrepancies were observed when compared to conventional hisab methods. Therefore, Sky Guide is more suitable as an educational medium for falak literacy rather than as a basis for official Qamariah month.

Keywords:
Sky Guide, Hilal, Digital Islamic Astronomy, Hisab-Rukyat, Qamariah Months.

Abstrak

Pokok masalah ini membahas penggunaan aplikasi *Sky Guide* sebagai pendekatan modern dalam penentuan awal bulan *Qamariah* di era digital. Fokus penelitian meliputi: (1) prosedur simulasi hilal menggunakan *Sky Guide* berbasis teknologi *augmented reality*; (2) perbandingan akurasi hasil simulasi dengan metode hisab falak konvensional menggunakan data *ephemeris*; dan (3) analisis fungsi *Sky Guide*

sebagai media edukasi falak beserta keterbatasannya dalam penetapan resmi awal bulan Hijriah. Jenis penelitian ini adalah *library research* dengan pendekatan deskriptif-komparatif. Data diperoleh melalui literatur falak klasik dan modern, jurnal ilmiah, serta simulasi lapangan di Makassar pada 27 Februari 2025 (29 Sya'ban 1446 H) dan 29 Maret 2025 (29 Ramadhan 1446 H). Analisis dilakukan melalui perbandingan parameter astronomis antara *Sky Guide*, Stellarium, dan Accurate Times. Hasil penelitian menunjukkan bahwa *Sky Guide* mampu menampilkan visualisasi hilal secara real-time, namun tidak memberikan data numerik seperti tinggi dan elongasi hilal. Perbandingan menunjukkan adanya selisih kecil dengan metode hisab konvensional. Dengan demikian, *Sky Guide* lebih tepat digunakan sebagai media edukasi dan literasi falak, bukan sebagai dasar keputusan penetapan awal bulan Hijriah oleh otoritas resmi.

Kata Kunci:
Sky Guide, Hilal, Ilmu Falak Digital, Hisab-Rukyat, Awal Bulan *Qamariah.*

A. Introduction

The disparity in determining the beginning of the lunar month is a central issue in the discipline of astronomy, which has direct implications for the practice of Islamic worship, particularly the determination of the beginning of Ramadan, Shawwal, and Dhu al-Hijjah. Since classical times, the method used to determine the beginning of the Hijri month was rukyatul hilal, which is the direct observation of the appearance of the young crescent moon on the western horizon after sunset.[1] In its historical development, rukyat was then combined with the hisab method based on astronomical calculations to ensure whether the crescent moon theoretically exists.

This research aims to analyze the representation of the crescent moon thru the simulation of the Sky Guide application and to evaluate the level of conformity of that visualization with contemporary astronomical calculation data. In both classical and modern astronomical traditions, the determination of the beginning of the lunar month is always associated with two main approaches, namely rukyat (observation) and hisab (calculation). The development of technology in the digital era has introduced application-based astronomical devices capable of providing real-time visualization of celestial

[1]Slamet Hambali, *Ilmu Falak*, Bandung: Refika Aditama, 2015, h. 92.

object positions.[2] In the contemporary era, technological advancements have also given rise to various popular astronomical applications that can display celestial object positions in real-time, including the Sky Guide application, which has become one of the visual devices.

The use of these popular astronomy applications raises methodological issues in the study of Islamic astronomy. This is due to the fact that most of these visual applications do not provide astronomical numerical parameters, such as the altitude of the crescent moon, the elongation of the moon-sun, the age of the moon, and the lag time. These parameters are the main scientific indicators used by astronomers to determine the visibility of the crescent moon. Modern astronomical literature emphasizes that visualization cannot replace ephemeris, because the criteria for crescent visibility are determined by mathematical measurements that can be scientifically verified.[3]

This research focuses on the analysis of hilal simulation using the Sky Guide application with an observation point in the city of Makassar. This city was chosen because it is one of the strategic locations for the official moon sighting by the Ministry of Religious Affairs of the Republic of Indonesia. Geographically, Makassar has a relatively open western horizon, making it very ideal for observation activities.[4]

The development of modern science and astronomy technology in the 21st century has led to the emergence of new approaches in the practice of hisab-rukyat. One of them is the use of digital sky simulation applications such as Sky Guide, Stellarium, and Accurate Times. These applications are designed to display the positions of celestial objects in real-time based on GPS and ephemeris data, making it easier for users to obtain a visual representation of

[2]Susiknan Azhari, *Ensiklopedi Hisab Rukyat* (Yogyakarta: Pustaka Pelajar, 2008), h. 11–14.

[3]Slamet Hambali, *Modernisasi Hisab Rukyat di Era Digital* (Jakarta: Prenadamedia Group, 2021), h. 42–48.

[4]Ahmad Fauzi, "Perbandingan Akurasi Stellarium dan Accurate Times," *Jurnal Falakiyah* 8, no. 2 (2020), h.110–115.

the position of the crescent moon, the direction of the sun, and the horizon.[5]

The emergence of this technology opens up opportunities for the integration of classical astronomy with digital devices as part of the modernization of the hisab-rukyat method. Nevertheless, there is still a disparity between technological advancement and methodological acceptance in the context of determining the beginning of the month. Countries like Indonesia continue to refer to the MABIMS rukyat imkan criteria, which require a minimum crescent height of 3° and a minimum elongation of 6.4° as the official standard.[6] Digital simulations like Sky Guide are considered not yet legally valid because they do not provide detailed numerical data such as the height of the crescent moon, elongation, moon age, and lag time. This shows a gap between the educational aspect of digital applications and the need for astronomical accuracy in determining the beginning of the Qamariah month.

On the other hand, literature reviews show that the integration of technology, particularly augmented reality-based astronomy applications, can enhance the astronomical literacy of the community and students, as the visualization of the crescent moon makes astronomical concepts easier to understand.[7] Several studies also show an increase in interest in learning astronomy thru digital media, but there has not been much research specifically assessing the accuracy of Sky Guide in simulating the crescent moon when compared to standard astronomical calculations.[8] Based on this condition, this research aims to fill the gap by testing the simulation of the crescent moon's position using Sky Guide, and then comparing it with astronomical calculation data from Stellarium and Accurate Times on two

[5]Pilendia D., "Stellarium sebagai Media Pembelajaran Fenomena Astronomi," *Jurnal Ilmiah Wahana Pendidikan* 8, no.1 (2022).

[6]Uzlifah & Firdiniah, "Kalender Zonal sebagai Upaya Unifikasi Awal Bulan Kamariah," *Elfalaky* 8, no.1 (2024).

[7]Rahman & Ahmed, "Solusi Digital untuk Pencatatan Waktu Islam," *International Journal of Islamic Applications in Computer Science and Technology* 6.1 (2018).

[8]Ahmad Fauzi, "Perbandingan Akurasi Stellarium dan Accurate Times dalam Penentuan Hilal," *Jurnal Falakiyah* 8, no.2 (2020), h.112.

important moments, namely February 27, 2025 (29 Sha'ban 1446 H) and March 29, 2025 (29 Ramadan 1446 H). This study examines the procedure for simulating the crescent moon, the accuracy level of the application, as well as its role and limitations in the context of determining the beginning of the lunar month.[9]

Furthermore, this research is motivated by the increasing use of digital technology in daily life, including in scientific and religious activities. Thus, there is a need for scientific mapping regarding the extent to which applications like Sky Guide can contribute to the development of modern astronomy, both in the context of education, research, and as practical observation aids. Ultimately, this research is expected to strengthen the literature on digital astronomy and provide a comprehensive understanding of the integration of modern astronomical simulations with traditional hisab-rukyat principles.

B. Methods

This research uses a descriptive-comparative approach, which is a method that describes the working process of the Sky Guide application in simulating the new moon while simultaneously comparing the results with numerical astronomical calculations from Stellarium and Accurate Times.[10] This approach aligns with modern astronomical research standards that emphasize the analysis of astronomical data thru cross-method comparisons. The type of research is library research supported by digital simulations, where primary data is obtained from screenshots and visual observations on the Sky Guide application, while secondary data is obtained from calculations by Stellarium, Accurate Times, as well as classical and modern astronomical literature.[11]

Observations were conducted at the main research location in Makassar City, which is one of the official sighting points of the Indonesian Ministry of

[9]Susiknan Azhari, *Ensiklopedi Hisab Rukyat*, Yogyakarta: Pustaka Pelajar, 2008, h.233.

[10]Pilendia D., "Stellarium sebagai Media Pembelajaran Fenomena Astronomi," *Jurnal Ilmiah Wahana Pendidikan* 8, no.1 (2022).

[11]Ahmad Fauzi, "Perbandingan Akurasi Stellarium dan Accurate Times dalam Penentuan Hilal," *Jurnal Falakiyah* 8, no.2 (2020).

Religious Affairs and has a relatively open western horizon, making it ideal for crescent moon observations.[12] Simulations were conducted on critical dates for determining the beginning of the lunar month, including February 27, 2025 (29 Sha'ban 1446 AH) and March 29, 2025 (29 Ramadan 1446 AH). The analyzed astronomical parameters include the altitude of the crescent moon (altitude), elongation, moon age, and lag time, and are verified using conventional calculations based on ephemeris data referring to the MABIMS Imkan Rukyat standards (altitude 3°, elongation 6.4°, minimum moon age 8 hours).[13]

Data collection techniques were carried out thru digital documentation, namely recording the results of the Sky Guide simulation, numerical data from Stellarium and Accurate Times, as well as classifying data based on the time and location of observation. All the data were then analyzed using data reduction, classification, and comparison methods, as commonly used in modern Islamic astronomy research.[14] The analysis shows that Sky Guide is capable of providing a good visual representation of the crescent moon, but it does not provide detailed numerical data as required by astronomical calculations, thus still necessitating cross-verification with more precise instruments.

C. Results and Discussion

1. Procedure for Simulating the New Moon Using the Sky Guide Application

The simulation of the crescent moon conducted thru the Sky Guide application is a fundamental step in understanding the representation of the crescent moon's position based on modern astronomical technology approaches. The use of this application in the research was conducted at an observation location in the city of Makassar, which is astronomically situated at coordinates approximately 5° S and 119° E, and is one of the official observation points for the Ministry of Religious Affairs of the Republic of

[12]Uzlifah & Firdiniah, "Kalender Zonal sebagai Upaya Unifikasi Awal Bulan Kamariah," *Elfalaky* 8, no.1 (2024).

[13]MABIMS, *Kriteria Baru Imkan Rukyat*, 2021.

[14]Susiknan Azhari, *Ensiklopedi Hisab Rukyat*, Yogyakarta: Pustaka Pelajar, 2008.

Indonesia. The selection of this location considers the relatively open western horizon to minimize visual obstructions during the observation time.[15]

The simulation was conducted on two important dates, namely February 27, 2025 (29 Sha'ban 1446 AH) and March 29, 2025 (29 Ramadan 1446 AH). The selection of these dates refers to the astronomical principle that the sighting of the new moon is conducted on the 29th of the Hijri month after sunset, at a time when the new moon is potentially visible if conjunction has occurred beforehand.[16] Therefore, the simulation was conducted within the time frame of 18:10–18:20 WITA, which is after sunset when the twilight begins to weaken but the western horizon is still bright enough to detect the crescent moon.[17] The Sky Guide application was operated by activating augmented reality (AR) mode and pointing the device toward the western horizon.

The application projects the position of the crescent moon in the form of a thin crescent icon that moves according to the moon's daily motion based on the device's internal sensors such as GPS, digital compass, and gyroscope.[18] In the simulation process, it was found that the application is capable of providing a stable orientative visualization, making it easier for users to understand the crescent moon's movement pattern. However, this application does not display astronomical numerical data, such as the altitude of the crescent moon, elongation, moon age, and lag time.

This parameter is a basic scientific requirement in the assessment of the visibility of the crescent moon according to modern astronomical literature.[6] Contemporary astronomical literature emphasizes that visualization cannot replace quantitative and verifiable ephemeris calculation data.[19] Therefore, the results of the Sky Guide simulation cannot be used as the basis for determining

[15]Ahmad Izzuddin, *Ilmu Falak Praktis*, (Semarang: Walisongo Press, 2012), h. 12.

[16]Slamet Hambali, *Ilmu Falak Praktis*, (Semarang: Pustaka Rizki Putra, 2012), h. 56.

[17]MABIMS, *Kriteria Baru Imkan Rukyat 2021*, (Jakarta: Dirjen Bimas Islam Kemenag RI, 2021), h. 15.

[18]Moedji Raharto, "Astronomi Posisi dan Perhitungan Data Benda Langit," *Buletin Observatorium Bosscha* 3, no. 1 (2020), h. 14.

[19]Susiknan Azhari, *Ensiklopedi Hisab Rukyat*, (Yogyakarta: Pustaka Pelajar, 2008), h. 233.

the beginning of the month, but rather as a visual representation. On those two observation dates, Sky Guide still displayed the crescent moon even tho, according to astronomical calculations, the crescent moon parameters did not meet the MABIMS 2021 visibility criteria, namely a minimum altitude of 3°, elongation of 6.4°, and an age of the moon ≥ 8 hours. This happened because Sky Guide shows the geometric position of the moon above the horizon, not its optical-atmospheric visibility level.[20] Thus, the Sky Guide simulation provides educational benefits in introducing the direction and position of the crescent moon, but it cannot replace the astronomical calculation method in determining the beginning of the lunar month.

2. Comparison of Sky Guide Simulation Results with Astronomical Calculation Data

The comparison was made by comparing the visualization results of Sky Guide with two modern astronomical calculation tools, namely Stellarium and Accurate Times, both of which are known for their high precision due to being based on scientific ephemeris. Stellarium and Accurate Times provide numerical outputs in the form of the altitude of the crescent moon (altitude), elongation, moon age, and lag time, which are the main parameters for assessing the visibility of the crescent moon.[21] On the 29th of Ramadan 1446 AH (March 29, 2025), Sky Guide displayed the crescent moon icon above the horizon.

However, according to Stellarium's numerical calculations, the height of the crescent moon is only about 1° and the elongation is about 6°, values that are below the minimum limit of Imkan Rukyat. This condition astronomically indicates that the crescent moon is almost impossible to see with the naked eye, yet it is still visualized by Sky Guide because this application does not take

[20]Kementerian Agama RI, *Almanak Hisab Rukyat 2023*, (Jakarta: Kemenag RI, 2023), h. 45.

[21]Ahmad Fauzi, "Perbandingan Akurasi Stellarium dan Accurate Times dalam Penentuan Hilal," *Jurnal Falakiyah* 8, no. 2 (2020), h. 112.

into account the aspect of optical visibility.[22] Other research also supports this conclusion. Fauzi found that AR-based visual astronomy applications cannot be used as a source for calculations because they do not provide verified ephemeris parameters. On the other hand, Stellarium and Accurate Times show high accuracy because they are based on DE430/DE440 data from NASA, which is used in international astronomical research.[23]

This result is consistent with previous research stating that visual simulation applications like Sky Guide cannot be used as a reference for determining the new moon, as they do not provide ephemeris data, which is a requirement for scientific verification. On the other hand, Stellarium and Accurate Times have proven to be accurate and stable in calculating the parameters of the crescent moon, as also demonstrated in contemporary astronomical research.[24] MABIMS emphasizes that the determination of the beginning of the Qamariah month should be based on numerical astronomical parameters, not solely on non-quantitative visual observations. Therefore, the visualization of the Sky Guide only serves as a support for education and pre-sighting, not as an official validation instrument for the beginning of the month.

3. Evaluation of the Accuracy and Limitations of Sky Guide in Determining the Beginning of the Lunar Month

The evaluation is conducted by reviewing both the benefits and limitations of its application. Sky Guide makes an important contribution to astronomy education, especially for beginners who want to learn about the direction of the moon's movement, the orientation of the sun, and the dynamics of the sky.[25] Real-time AR-based visualization is an added value that is hard to find in numerical calculation devices.

[22]Dede Firdaus, "Dinamika Penentuan Awal Bulan Kamariah di Indonesia," *Jurnal Falakiyah* 8, no. 2 (2020), h. 110.

[23]D. Pilendia, "Stellarium sebagai Media Pembelajaran Fenomena Astronomi," *Wahana Pendidikan* 8, no.1 (2022): 4–7.

[24]Slamet Hambali, *Ilmu Falak*, (Bandung: Refika Aditama, 2015), h. 92.

[25]Abdullah Hidayat, *Simulasi Posisi Benda Langit Menggunakan Aplikasi Sky Map*, (Tesis UIN Sunan Kalijaga, 2021), h. 34–38.

However, from a scientific perspective, this application has several limitations:

a. Not having astronomical numerical data, whereas parameters such as altitude, elongation, and the age of the moon are the core of assessing the visibility of the crescent moon. Modern astronomical literature emphasizes that the determination of the new moon must be based on precise ephemeris calculations.[26]
b. The limitations of device sensors, such as GPS and digital compasses, can potentially result in a directional deviation of 1–2°. In the context of the crescent moon, which is often only a few degrees above the horizon, such a small deviation is very critical.[27]
c. Not taking atmospheric factors into account, even tho air turbulence, clouds, and light pollution greatly determine the visibility of the crescent moon.
d. Does not have a visibility verification module, so the crescent moon still appears visually even tho it is scientifically impossible to see.

Thus, Sky Guide can only be used as a medium for learning and pre-observation. For the determination of the new month, numerical astronomical calculation tools such as Stellarium, Accurate Times, and WinHisab remain the primary references.

4. Perbandingan Hasil Hisab Astronomis Dengan Visualisasi Aplikasi *Sky Guide*

The comparison between the results of astronomical calculations and the visualization of Sky Guide is the main focus of this research because the two methods have different characteristics and objectives. Astronomical calculations work based on mathematical-observational calculations that produce numerical data such as the altitude of the crescent moon, elongation

[26]Slamet Hambali, *Modernisasi Hisab dan Rukyat di Era Digital*, (Jakarta: Prenadamedia Group, 2021), h. 85.

[27]Moedji Raharto, "Astronomi Posisi dan Perhitungan Sudut Benda Langit," *Buletin Observatorium Bosscha* 3, no. 1 (2020), h. 17.

angle, moon age, and the lag time between sunset and moonset.[28] All of these parameters are scientific standards in determining the visibility of the crescent moon and have been widely used in both classical and modern astronomical literature.[29] Meanwhile, Sky Guide only displays a visual image in the form of a crescent moon icon projected toward the sky thru an augmented reality (AR) interface. The visualization follows the geometric position of celestial bodies based on the device's sensors, but does not include numerical data, so the evaluation of the crescent moon's visibility cannot be conducted scientifically thru this application.[30]

In this study, the astronomical calculations for the dates of February 27, 2025 (29 Sha'ban 1446 AH) and March 29, 2025 (29 Ramadan 1446 AH) indicate that the crescent moon is in a very low position. On the first date, the height of the hilal was less than two degrees and the elongation was below the MABIMS visibility limit. On the second date, the height of the hilal was only about one degree, while the elongation was around six degrees, which does not meet the ideal visibility parameters.[31] With such conditions, astronomical calculations clearly indicate that the crescent moon is almost impossible to sight directly. This situation creates the impression that the crescent moon has been "seen" in the application, whereas astronomically it has not yet met the visibility thresholds. This phenomenon is important because many lay users mistakenly interpret that the visualization in the application is equivalent to the actual sighting (rukyat hakiki). In fact, rukyat requires clear sky conditions, appropriate light contrast, and a certain altitude value for the crescent moon's light to pass thru atmospheric scattering.[32]

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[28]Moh. Ilyas, *A Modern Guide to Astronomical Calculations of Islamic Calendar, Times & Qibla*, (Kuala Lumpur: Berita Publishing, 1984), h. 72.

[29]Muhyiddin Khazin, *Ilmu Falak dalam Teori dan Praktik*, (Yogyakarta: Buana Pustaka, 2004), h. 54–55

[30]Thomas Djamaluddin, "Penentuan Awal Bulan Hijriah Berdasarkan Astronomi Modern", *Jurnal Sains Antariksa*, 2018, h. 12–13.

[31]MABIMS, *Kriteria Imkan Rukyat Baru 2021*, Kementerian Agama RI, h. 3–4.

[32]Slamet Hambali, *Ilmu Falak: Arah Kiblat, Waktu Salat, dan Awal Bulan*, (Bandung:

Additionally, comparisons with numerical calculations using Stellarium and Accurate Times show much higher accuracy. Both applications provide complete parameters that allow for a thorough evaluation of the visibility of the crescent moon and have been used in professional astronomical studies. The results of both are consistent and support the calculation data in this thesis, thus it can be confirmed that Sky Guide cannot be used as an astronomical instrument, but only as a visual mapping.[33] Therefore, the difference between astronomical calculations and the visualization of Sky Guide is not merely technical, but fundamental. Hisab provides objective and testable data, whereas Sky Guide offers an illustrative view that cannot be used as a basis for religious or scientific decisions. This comparison serves as evidence that visual applications cannot replace the hisab-rukyat method based on precise data.

5. The Position of Sky Guide in Modern Astronomy Studies: An Educational Medium, Not a New Moon Instrument

The research results show that Sky Guide has high functional value in the context of astronomical education, but it does not have scientific authority in determining the beginning of the Qamariah month. The generated visualizations are very helpful for students and the community to understand the orientation of the crescent moon, the direction of the sunset, and the relative position of the Moon to the horizon, allowing the movement of celestial bodies to be studied intuitively.[34]

In the modern world of astronomy, the use of digital applications as a learning medium has become an important part of the educational process. Sky Guide is able to fill this space quite well because its interface is simple and easy for beginners to understand. Students, santri, and the general public can

Refika Aditama, 2015), h. 112.

[33]Muh. Fauzi, "Konsistensi Perhitungan Stellarium dan Accurate Times dalam Observasi Hilal", *Jurnal Falakiyah*, Vol. 7 No. 1 (2020), h. 55–58..

[34]Ahmad Izzuddin, *Hisab Rukyat: Teori dan Implementasi*, (Jakarta: Kencana, 2020), h. 97.

recognize constellations, the direction of the Moon's setting, and the timings of other astronomical phenomena thru visual simulations. Therefore, this application is suitable for use in basic astronomy practical activities or sky orientation classes.[35]

However, when placed in the context of moon sighting, Sky Guide cannot be considered a scientific instrument. The first reason is that this application does not provide astronomical numerical parameters. Without altitude, elongation, moon age, and lag time figures, the interpretation of the visibility of the hilal becomes impossible. In fact, these parameters are standard requirements in the criteria for the possibility of sighting the moon (imkan rukyat) according to MABIMS 2021 and international astronomical literature.[36] Sky Guide was not built as a professional observation device. This application is intended for the general public, not for astronomers or official moon sighting institutions. Therefore, this application is more appropriately classified as an educational astronomy aid, rather than an astronomical observation instrument.[37]

Thus, the position of Sky Guide in modern astronomy studies can be formulated as follows: Sky Guide is an educational tool, helping beginners understand the dynamics of the sky. Sky Guide is not a tool for crescent moon verification, as it does not provide scientific parameters. Sky Guide cannot be the basis for istbat, as it does not meet the standards of hisab-rukyat, and Sky Guide remains valuable, but only in the context of learning and sky orientation.[38] The placement of this position is important to prevent the misuse of digital applications in the process of determining the beginning of the lunar

[35]Muhammad Odeh, "New Criterion for Lunar Crescent Visibility", *Icarus*, Vol. 56 (2006), h. 43–45.

[36] Yallop, B.D., "A Method for Predicting Crescent Visibility", *HM Nautical Almanac Office*, (1997), hlm. 1–3.

[37]Pilendia Dias, "Pemanfaatan Aplikasi Astronomi dalam Edukasi Falak", *Wahana Pendidikan*, Vol. 9 (2022), h. 102.

[38]South African Astronomical Observatory (SAAO), "Atmospheric Extinction and Crescent Visibility", 2019.

month. Modern astronomical studies emphasize that only professional astronomical instruments and field observations can serve as the basis for religious decisions, while visual applications like Sky Guide are merely supplementary to learning.[39]

From the perspective of research analysis, the presence of Sky Guide in modern astronomy studies cannot be positioned merely as a passive digital application, but as a bridge of understanding between the realm of astronomical theory and observational practice. Although it does not meet the criteria of a scientific instrument for determining the beginning of the month, Sky Guide instead becomes an effective transitional medium in building basic astronomical literacy for users. When students are able to read directions, understand the phases of the Moon, and recognize the dynamics of the sky thru Sky Guide, the process of mastering further astronomical calculations becomes easier and more directed.

This shows that the educational function of Sky Guide is strategic. This application is not a substitute for telescopes and professional calculation devices, but it can serve as an initial stage for someone before entering the more complex world of observation. With its simple visualization capabilities, Sky Guide can spark an interest in learning astronomy and encourage users to move on to more scientific observation methods. Thus, the value of Sky Guide lies in its ability to strengthen the cognitive foundation of users, rather than in determining the legal rulings of rukyat according to Islamic law.

D. Conclusion

The implementation of the crescent moon simulation procedure using the Sky Guide application shows that this application is capable of providing a visual representation of the crescent moon's position in real-time thru augmented reality technology. The simulation was conducted in Makassar with

[39]Azhari, *Ensiklopedi Hisab Rukyat*, (Yogyakarta: Pustaka Ilmu, 2008), h. 125.

the timing set according to the last phase of the lunar month, and the results indicate that Sky Guide can display the crescent moon's orientation stably and follow the moon's daily movement pattern. However, this application does not provide astronomical numerical data such as altitude, elongation, moon age, or lag time, so its position is only as a medium for visualization and education, not as an instrument for astronomical or religious verification.

The comparison between the results of the Sky Guide simulation and numerical calculation tools such as Stellarium and Accurate Times confirms that Sky Guide cannot replace ephemeris-based calculation tools. Although Sky Guide displays the crescent moon above the horizon on the 29th of Sha'ban and the 29th of Ramadan 1446 AH, the calculations from Stellarium and Accurate Times show that the crescent moon parameters on those dates do not yet meet the MABIMS 2021 visibility criteria. This means that the visual display of Sky Guide cannot be used as the basis for determining the beginning of the month, because the application does not take into account optical visibility or atmospheric conditions. Thus, Sky Guide is illustrative, while numerical calculations are verifiable and scientific.

Evaluation of the accuracy and limitations of the Sky Guide application shows that although this application has strong educational value for learning about astronomy, it is not yet suitable for use as an instrument for determining the beginning of the lunar month. Some of the contributing factors are: the absence of astronomical numerical parameters, reliance on device sensor accuracy, the neglect of atmospheric factors, and the lack of a visibility verification module. Therefore, the determination of the beginning of the month must still refer to the hisab and rukyat methods based on numerical data and standard observations, while Sky Guide can only be used for educational needs, orientation of celestial directions, and as a companion for basic astronomy learning. Overall, this research affirms that the Sky Guide has high pedagogical value in helping the public understand the crescent moon, but

it cannot be an official tool in determining the beginning of the Hijri month. The integration of visual media and accurate astronomical calculations remains the most comprehensive approach in contemporary astronomical studies.

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