# Analysis of the Use of Artificial Intelligence-Based Applications in Arabic Text Automatic Diacritization

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**Abstract**

Education has been transformed by the development of artificial intelligence (AI) technology that can assist humans with tasks. Nowadays, learning is made easier by a variety of AI-based apps as well as teachers and books. An artificial intelligence-based tool for learning the Arabic language is *Tashkeel*, which is particularly suitable for diacriticizing Arabic texts to make them easier to understand. The accuracy of the *Tashkeel* application in applying Harakat to Arabic texts remains to be tested, although it is widely trusted. The purpose of this study is to evaluate the accuracy of the Tashkeel application in applying Harakat to Arabic texts and to find out what students think about it. This study uses a sequential explanatory model in a mixed research design. The instruments used in the study were questionnaires and records detailing the results of applying *Harakat* to Arabic words, sentences, and texts using the *Tashkeel* program. Following data collection, quantitative analysis was conducted using basic descriptive statistics. The results showed *Tashkeel*'s high accuracy in applying *Harakat* to Arabic texts. However, users still must criticize the results when applying *Harakat* to longer texts. According to the results of the study, most students have used this application and believe that its availability has been helpful.

**Keywords**: Arabic; artificial intelligence; diacritization; text.

## Introduction

The development of technology has made human work easier. Jobs that were once done by humans can now be made by the products of the latest technology. Artificial Intelligence (AI) is the result of technological advances that are currently being discussed. AI is currently emerging as one of the human masterpieces because it can replace the role of humans. The AI itself refers to the ability of computers and machines to mimic human cognition and action (Wartman & Donald Combs, 2018). In line with this understanding, Sharma et al. (2019) state that AI is the ability to approximate human reasoning. Chassignol et al. (2018) defined AI theoretically as controlling the development and use of computer systems with human capabilities, particularly intelligence and the ability to perform tasks requiring human intelligence, including visual perception, speech recognition, decision making, and translation between languages. In general, according to these definitions and descriptions, artificial intelligence involves the development of machines that have a certain level of intelligence and can perform human-like functions, including cognitive functions, learning, decision-making, and adaptation to the environment.

AI has now entered the realm of education. Even according to Holmes et al. (2023) in the last three decades ago, AI has been considered a powerful tool to facilitate new paradigms for instructional design, technology development, and educational research that are impossible to


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develop in traditional education modes. The emergence of AI-based learning support applications such as Grammarly, Open.ia, and alqalam.ia further accelerated the process of AI integration in education. As with the use of other technologies in education, the use of AI in education also presents its own opportunities and challenges. The presence of AI-based learning applications opens opportunities for new innovations in learning, especially personalised learning (Ouyang & Jiao, 2021). Furthermore, education is supported by AI in at least two ways: (1) the educational process—supporting and modifying the pedagogy and routine functions of the educator; and (2) the scope and content of education—what type of education is required.

The use of AI in education not only offers opportunities but also presents challenges for both teachers and students. For lecturers, the existence of AI must be approached with the ability and awareness that they are now not the only source of learning but a facilitator of learning. Given the rapid technological progress that has characterised the last few decades, artificial intelligence systems can transform the role of teachers. There will always be a role for teachers in education, but this role and its changes may change due to new technology in the form of intelligent computer systems. Artificial intelligence systems can take on tasks like classification, help students improve their learning, and potentially even replace one-on-one instruction in the real world (Zeide, 2019). Meanwhile, the use of AI challenges students to continue to think critically. It is not uncommon for the ease that AI provides in completing a task to result in students being hesitant to re-correct the results of the work the AI has done. In fact, AI is a machine product that may still need improvement.

*Tashkeel* is one of the AI-based platforms that can be used for Arabic syntax learning. This application is a text processing technology that uses an automatic diacritization engine to provide accurate diacritization for Arabic text. The process of self-accenting in Arabic text is a difficult activity as it involves knowledge of Arabic syntax, which is quite complicated. The presence of applications that can provide lines in Arabic texts, such as *Tashkeel*, is welcomed enthusiastically by Arabic language education students. The presence of the application is considered to have partially resolved the difficulties faced in learning Arabic. Research on the use of Tashkeel in Arabic language learning has been previously conducted by Almaliki et al. The results of the study concluded that the *Tashkeel* application can be used by students to improve their ability to read Arabic texts, although the accuracy of providing Harakat is still unknown. Therefore, an analysis is required to determine the location of the Harakat errors provided by this application. Given this background, this study aims to analyze the accuracy of using the *Tashkeel* application in giving harakat in Arabic texts as well as students' perceptions of using the application. Research on the use of *Tashkeel* in Arabic language learning has been previously conducted by Fahraini & Almaliki (2023). The results of the study concluded that the *Tashkeel* application can be used by students to improve their ability to read Arabic texts, although the accuracy of providing *Harakat* is still unknown. Therefore, an analysis is required to determine the location of the *Harakat* errors provided by this application. Given this background, this study aims to analyze the accuracy of using the *Tashkeel* application in giving harakat in Arabic texts as well as students' perceptions of using the application.

## Method

The purpose of the study is to find out how accurate the automatic diacritization of Arabic texts by Tashkeel applications is and what students think about these applications. This uses the most basic type of mixed-methods research design. This approach is intended to facilitate the interpretation of qualitative data when using quantitative data and insights. While qualitative

research allows researchers to delve deeper into a small number of participants, quantitative research helps collect data from a large number of participants and generalize the results. Whatever the reasoning may be, make sure you include it in the introduction to the study, for example (Creswell, 2012). This study uses a sequential explanatory strategy. Explanatory sequential mixed methods involve first conducting quantitative research, analyzing the results, and then further developing the results to provide a more thorough explanation using qualitative research (Asenahabi, 2019). The research group consists of students in the seventh semester of the Arabic Education Program at Jakarta State University. The sample includes 38 students. In this study, fifteen phrases, six sentences, and one text are used as data sources. Simple descriptive statistics were used to analyse the data from the questionnaire results, and the results were then presented as tabular and graphical data.

## Result And Discussion

### A. Result of Paraphrasing Phrases

In the first phase of the Harakat assignment test, the research attempted to test the consistency of Tashkeel's Harakat assignment to Arabic phrases. In this phase, a phrase was tested three times. In addition to checking consistency, testers also checked the accuracy of Harakat matching by testing various similar phrases. In Arabic itself, there are at least five types of phrases: *Murakkab idhafi* (subordinate noun phrase), *Murakkab wasfi* (subordinative adjective phrase), *Murakkab badali* (appositive phrase), *Murakkab athfi* (coordinative noun phrase), and *Murakkab syibhul jumlah* (prepositional phrase) (Mubarak et al., 2020).

1. *Murakkab idhafi* (subordinate noun phrase)

   The first phrase to compare the results of Harakat is *murakkab idhafi* (subordinate noun phrases). The test results for this set are shown in Table 1.

*Table 1. Test result diacritization on subordinate noun phrases*

| Example Word | *Tashkeel* Test Result | | | Manual Result |
|---|---|---|---|---|
| | 1st trial | 2nd trial | 3rd trial | |
| قصص الأنبياء | قِصَصُ الْأَنْبِيَاءِ | قِصَصُ الْأَنْبِيَاءِ | قِصَصُ الْأَنْبِيَاءِ | قِصَصُ الْأَنْبِيَاءِ |
| صلاة العصر | صَلَاةُ الْعَصْرِ | صَلَاةُ الْعَصْرِ | صَلَاةُ الْعَصْرِ | صَلَاةُ الْعَصْرِ |
| صفّ الرّجال | صَفُّ الرِّجَالِ | صَفُّ الرِّجَالِ | صَفُّ الرِّجَالِ | صَفُّ الرِّجَالِ |

Based on Table 1, Tashkeel gives consistent *Harakat* to *Murakkab Idhafi* in terms of consistency, despite being repeated three times and tested with three different subordinate noun phrases. From the point of view of accuracy, the assignment of Harakat for this type of phrase is very accurate because *Murakkab Idhafi* will get a *Dhammah Hara*kat on the first noun *(Mudhaf*) and a *Haraka*t mark on the second noun (*Mudhaf ilaih*) (Wightwick & Gaafar, 2005).

2. *Murakkab wasfi* (subordinative adjective phrase)

   The second phrase to compare the results of Harakat is Murakkab wasfi (a subordinative adjective phrase). The test results for this set are shown in Table 2.

*Table 2. Test result diacritization on subordintate adjective phrases*

| Example Word | *Tashkeel* Test Result | | | Manual Result |
|---|---|---|---|---|
| | 1st trial | 2nd trial | 3rd trial | |
| القرآن الكريم | الْقُرْآنُ الْكَرِيمُ | الْقُرْآنُ الْكَرِيمُ | الْقُرْآنُ الْكَرِيمُ | الْقُرْآنُ الْكَرِيمُ |

| | | | | |
|---|---|---|---|---|
| شوق كبيرة<br>الدّكان الجميل | شَوْقٌ كَبِيرَةٌ<br>الدُّكَّانُ الْجَمِيلُ | شَوْقٌ كَبِيرَةٌ<br>الدُّكَّانُ الْجَمِيلُ | شَوْقٌ كَبِيرَةٌ<br>الدُّكَّانُ الْجَمِيلُ | شَوْقٌ كَبِيرَةٌ<br>الدُّكَّانُ الْجَمِيلُ |

Based on table 2, in terms of consistency, Tashkeel consistently gives harakat to murakkab wahfi even though it was repeated three times and tested using three different subordinate noun phrases. From the aspect of accuracy, the harakat for this type of phrase is very accurate because murakkab washfi will be given the same harakat between the object being described (*maushuf*) and the adjective (*shifat*) (Beresford, 2023).

3. *Murakkab badali* (appositive phrase)

The third phrase for which the results of the Harakat task were compared was *Murakkab badali* (appositive phrase). The test results for this set are shown in Table 3.

*Table 3. Test result diacritization on appositive phrases*

| Example Word | *Tashkeel* Test Result | | | Manual Result |
|---|---|---|---|---|
| | 1st trial | 2nd trial | 3rd trial | |
| الرياض عاصمة المملكة | الرِّيَاضُ عَاصِمَةُ | الرِّيَاضُ عَاصِمَةُ | الرِّيَاضُ عَاصِمَةُ | الرِّيَاضُ عَاصِمَةُ الْمَمْلَكَةِ |
| السعودية | الْمَمْلَكَةِ السُّعُودِيَّةِ | الْمَمْلَكَةِ السُّعُودِيَّةِ | الْمَمْلَكَةِ السُّعُودِيَّةِ | السُّعُودِيَّةِ |
| محمد ابن عبد الله | مُحَمَّدُ ابْنُ عَبْدِ الله | مُحَمَّدُ ابْنُ عَبْدِ الله | مُحَمَّدُ ابْنُ عَبْدِ الله | مُحَمَّدُ ابْنُ عَبْدِ الله |
| وزير الدينية محمد هاشم | وَزِيرُ الدِّينِيَّةِ مُحَمَّدُ هَاشِمٍ | وَزِيرُ الدِّينِيَّةِ مُحَمَّدُ هَاشِمٍ | وَزِيرُ الدِّينِيَّةِ مُحَمَّدُ هَاشِمٍ | وَزِيرُ الدِّينِيَّةِ مُحَمَّدُ هَاشِمٍ |

From Table 3, Tashkeel consistently gives Harakat to *Murakkab Badali* in terms of consistency, although it was repeated three times and tested with three different appositive phrases. From the point of view of accuracy, the assignment of H*arakat* for this type of phrase is very accurate because *Murakkab Badali* is given the same Harakat between Subtitute-for (*Mubdal Minhu*) and the Subtitute (*Mubdal*) is given the same *Haraka*t (Al-Ghulayain, 2014).

4. *Murakkab athfi* (coordinative noun phrase)

The fourth phrase for which the results of the harakat assignment were compared was Murakkab athfi (coordinative noun phrase). The test results for this phrase are shown in table 4.

*Table 4. Test result diacritization on coordinative phrases*

| Example Word | *Tashkeel* Test Result | | | Manual Result |
|---|---|---|---|---|
| | 1st trial | 2nd trial | 3rd trial | |
| اللغة والثقافة | اللّغَةُ وَالثَّقَافَةُ | اللّغَةُ وَالثَّقَافَةُ | اللّغَةُ وَالثَّقَافَةُ | اللّغَةُ وَالثَّقَافَةُ |
| الوضوء والصلاة | الْوُضُوءِ وَالصَّلَاةِ | الْوُضُوءِ وَالصَّلَاةِ | الْوُضُوءِ وَالصَّلَاةِ | الْوُضُوءِ وَالصَّلَاةِ |
| الكفار والمشركون | الْكَفَّارُ وَالْمُشْرِكُونَ | الْكَفَّارُ وَالْمُشْرِكُونَ | الْكَفَّارُ وَالْمُشْرِكُونَ | الْكَفَّارُ وَالْمُشْرِكُونَ |

Based on Table 4, we know that in terms of consistency, Tashkeel consistently maps Harakat to Murakkab Athfi (coordinative noun phrase), despite being repeated three times and tested with three different coordinative phrases. In terms of accuracy, the harakat for this type of phrase is very accurate, as the same harakat is given to *Murakkab Badali* between the first word and the second word (Mahmoud, 2012).

5. *Murakkab syibhul jumlah* (prepositional phrase)

The final phrase to compare the results of the Harakat task is *Murakkab syibhul jumlah* (prepositional phrase). The test results for this set are shown in Table 5.

*Table 5. Test result diacritization on prepositional phrases*

| Example Word | *Tashkeel* Test Result | | | Manual Result |
|---|---|---|---|---|
| | 1st trial | 2nd trial | 3rd trial | |
| في الليل | فِي اللَّيْلِ | فِي اللَّيْلِ | فِي اللَّيْلِ | فِي اللَّيْلِ |
| إلى المدرسة | إِلَى الْمَدْرَسَةِ | إِلَى الْمَدْرَسَةِ | إِلَى الْمَدْرَسَةِ | إِلَى الْمَدْرَسَةِ |
| في هذا الوقت | فِي هَذَا الْوَقْتِ | فِي هَذَا الْوَقْتِ | فِي هَذَا الْوَقْتِ | فِي هَذَا الْوَقْتِ |

Based on Table 5, we know that Tashkeel gives consistent Harakat to Murakkab Syibhul Jumlah (prepositional phrase) in terms of consistency, despite being repeated three times and tested with three different prepositional phrases. In terms of accuracy, the Harakat for this type of phrase is very precise, as murakkab syibhul jumlah usually has a preposition + noun pattern. The noun that comes after the preposition receives a Kasrah Harakat (Mubarak et al., 2022).

Based on the *Harakat* tests of the above five types of phrases, it can be concluded that the *Tashkeel* application language reliably provides *Harakat* for Arabic phrases with very high accuracy.

## B. Result of Giving Harakat to The Sentences

In the second phase of the Harakat mapping test, the research tested the consistency of Tashkeel's mapping of Harakat to Arabic phrases. In this phase, a phrase was tested three times. In addition to testing consistency, testers also tested the accuracy of Harakat matching by testing three different similar sentences. In Arabic itself, there are several sentence patterns, but in general, Arabic sentences are divided into two types: noun sentences (*jumlah ismiyah*) and verb sentences (*jumlah fi'liyah*).

1. Jumlah ismiyah (noun sentence)

The first sentence pattern tested when giving harakat using the Tashkeel application is a noun sentence (jumlah ismiyah). The comparison of Harakat between the results of giving Harakat with Tashkeel and giving it manually is shown in Table 6.

*Table 6. Test result diacritization on noun sentences*

| Example Sentences | *Tashkeel* Test Result | | | Manual Result |
|---|---|---|---|---|
| | 1st trial | 2nd trial | 3rd trial | |
| اليوم يوم العطلة | الْيَوْمُ يَوْمُ الْعُطْلَةِ | الْيَوْمُ يَوْمُ الْعُطْلَةِ | الْيَوْمُ يَوْمُ الْعُطْلَةِ | الْيَوْمُ يَوْمُ الْعُطْلَةِ |
| إن النول ثلاث روبيات | إِنَّ النَّوْلَ ثَلَاثُ رُوبِيَّاتٍ | إِنَّ النَّوْلَ ثَلَاثُ رُوبِيَّاتٍ | إِنَّ النَّوْلَ ثَلَاثُ رُوبِيَّاتٍ | إِنَّ النَّوْلَ ثَلَاثُ رُوبِيَّاتٍ |
| كان قطارنا متأخرا | كَانَ قِطَارُنَا مُتَأَخِّرًا | كَانَ قِطَارُنَا مُتَأَخِّرًا | كَانَ قِطَارُنَا مُتَأَخِّرًا | كَانَ قِطَارُنَا مُتَأَخِّرًا |

The results in Table 6 show that Tashkeel is consistent and accurate in assigning *harakat* to noun phrases. This can be seen in the consistency with which noun clauses are given the same *harakat*. although it was tested three times and with three different noun sets. The accuracy of the given *Harakat* is also reliable, as the results of giving *Harakat* with T*ashkeel* are the same as those of giving Harakat manually. In principle, the results of assigning three sets of nouns, according to Tashkeel, are correct. In the first noun sentence, the sentence pattern used is

*mubtada*+*khabar*/subject+predicate. The Mubtada is originally given a *Dhammah hara*kat, and the *Khabar* follows the *Mubtada* (Ali al-Jarim, 1956).

In the second noun clause, the preposition *Inna*+*mubtada*+*khabar*/Inna+subject+predicate is used as a sentence pattern. Regarding the rules for specifying *Harakat* in the noun sentence, This is appropriate because the subject preceded by the preposition *inna* must be *nashab* (fathah), and the predicate must be *rafa'* (*dhammah*) (Beresford, 2023).

However, the sentence pattern preposition kaana + subject + predicate is employed in the third noun sentence. Regarding the guidelines for assigning harakat to noun phrases, this is also accurate because the predicate, *nashab (fathah)*, and subject, *rafa' (dhammah)*, must be read before the preposition *Kaana* (Mahmoud, 2012).

2. Jumlah ismiyah (Verb Sentence)

The first sentence pattern tested when giving harakat using the Tashkeel application is a noun sentence (jumlah ismiyah). The comparison of Harakat between the results of giving Harakat with Tashkeel and giving it manually is shown in Table 6.

*Table 7. Test result diacritization on verb sentences*

| Example Sentences | *Tashkeel* Test Result | | | Manual Result |
|---|---|---|---|---|
| | 1st trial | 2nd trial | 3rd trial | |
| أنام مبكرا في الليل | أَنَامُ مُبَكِّرًا فِي اللَّيْلِ | أَنَامُ مُبَكِّرًا فِي اللَّيْلِ | أَنَامُ مُبَكِّرًا فِي اللَّيْلِ | أَنَامُ مُبَكِّرًا فِي اللَّيْلِ |
| أسمع الدروس بنشاط | أَسْمَعُ الدُّرُوسَ بِنَشَاطٍ | أَسْمَعُ الدُّرُوسَ بِنَشَاطٍ | أَسْمَعُ الدُّرُوسَ بِنَشَاطٍ | أَسْمَعُ الدُّرُوسَ بِنَشَاطٍ |
| جاء إليّ داود صباحا | جَاءَ إِلَيَّ دَاوُدَ صَبَاحًا | جَاءَ إِلَيَّ دَاوُدَ صَبَاحًا | جَاءَ إِلَيَّ دَاوُدَ صَبَاحًا | جَاءَ إِلَيَّ دَاوُدُ صَبَاحًا |

The results in Table 7 show that *Tashkeel* is consistent but not entirely accurate in assigning the Harakat to verb clauses. This can be seen in the consistency of the same Harakat across verb phrases despite being tested three times and with three different verb phrases. The accuracy of the given harakat is also reliable, although there is a slight difference in the third sentence. In the first verb sentence, all the harakat given were correct. The word أنا م receives the *Harakat Rafa'* (*Dhamah*) because it is a *Mudhari-Fi'il* (present tense). The word مبكرا receives the *Harakat Nashab* (*Fathah*) because it is a complement or adverb of time. The word في الليل receives a kasrah harakat because it is preceded by the letter jar. In the second verb sentence, all the specified harakat are correct. The word أسمع receives the Harakat Rafa' (Dhamah) because it is a Mudhari fi'il. The word الدروس receives the Harakat Nashab (Fathah) because it is an object of work. The word بنشاط is given a kasrah harakat because it is preceded by the letter jar (MAHMOUD, 2012).

In the third verb sentence, there is an inaccuracy in giving the *harakat*. The result of giving harakat using Tashkeel's word دَا ودَ is given a fathah harakat (nashab), while the manual harakat is given a *dhammah harakat*. دَا ود The difference in harakat will affect the understanding of the text because the word دَا ودَ with *fathah harakat* places the word as an object, while with *dhammah harakat* places the word as a subject (Beresford, 2023).

Based on the *Harakat* test for the above two sentence types, it can be concluded that the *Tashkeel* application language can be trusted to indicate *Harakat* in noun sentences, but there are still errors in indicating *Harakat* in verb sentences.

## C. Results of Giving Harakat to Text

*Tashkeel* application is used to test the assignment of *Harakat* in the third stage. *Researchers examined* how well Tashkeel classified a text as *Harakat*. After applying the Harakat,

the results are compared with the original text, which already contains the *Harak*at. Table 8 shows a comparative analysis between the two.

*Table 8. Test result diacritization on Arabic text*

| Original Text | Tashkeel App Result |
|---|---|
| كيْفَ أقضي يَوْمِي | كيْفَ أقضي يَوْمِي |
| أَنَامُ مُبَشِّراً فِي اللَّيْلِ وَأَقُومُ مُبَشِّرًا فِي الصَّبَاحِ، أَسْتَيْقِظُ عَلَى اسْمِ اللَّهِ وَذِكْرِه، أَسْتَعِدُّ لِلصَّلَاةِ ثُمَّ أَذْهَبُ مَعَ وَالِدِي إِلَى الْمَسْجِدِ، وَالْمَسْجِدُ قَرِيبٌ مِنْ بَيْتِي، فَأَتَوَضَّأُ وَأُصَلِّي مَعَ الْجَمَاعَةِ ، وَأَرْجِعُ إِلَى الْبَيْتِ وَأَتْلُو شَيْئًا مِنَ الْقُرْآنِ الْكَرِيمِ، ثُمَّ أَخْرُجُ إِلَى الْبُسْتَانِ وَأَجْرِي، ثُمَّ أَرْجِعُ إِلَى الْبَيْتِ فَأَشْرَبُ اللَّبَنَ وَأَسْتَعِدُّ لِلذَّهَابِ إِلَى المِدْرَسَةِ ، وَأُفْطِرُ إِذَا كَانَتْ أَيَّامُ الصَّيْفِ، وَأَتَغَدَّى إِذَا كَانَتْ أَيَّامُ الشِّتَاءِ ، وَأَصِلُ إِلَى الْمَدْرَسَةِ فِي الْمِيعَادِ. | أَنَامُ مُبَشِّرًا فِي اللَّيْلِ وَأَقُومُ مُبَشِّرًا فِي الصَّبَاحِ، أَسْتَيْقِظُ عَلَى اِسْمِ اَللَّهِ وَذِكْرِه، أَسْتَعِدُّ لِلصَّلَاةِ ثُمَّ أَذْهَبُ مَعَ وَالَّذِي إِلَى الْمَسْجِدِ، وَالْمَسْجِدُ قَرِيبٌ مِنْ بَيْتِي، فَأَتَوَضَّأُ وَأُصَلِّي مَعَ الْجَمَاعَةِ، وَأَرْجِعُ إِلَى الْبَيْتِ وَأَتْلُو شَيْئًا مِنْ الْقُرْآنِ الْكَرِيمِ، ثُمَّ أَخْرُجُ إِلَى الْبُسْتَانِ وَأَجْرِيَ، ثُمَّ أَرْجِعُ إِلَى الْبَيْتِ فَأَشْرَبُ اللَّبَنَ وَأَسْتَعِدُّ لِلذَّهَابِ إِلَى الْمَدْرَسَةِ، وَأَفْطَرَ إِذَا كَانَتْ أَيَّامُ الصَّيْفِ، وَأَتَغَدَّى إِذَا كَانَتْ أَيَّامُ الشِّتَاءِ، وَأَصْلُ إِلَى الْمَدْرَسَةِ فِي الْمِيعَادِ. |
| وَأَمْكُثُ فِي الْمَدْرَسَةِ سِتَّ سَاعَاتٍ، وَأَسْمَعُ الدُّرُوسَ بِنَشَاطٍ وَرَغْبَةٍ، وَأَجْلِسُ بِأَدَبٍ وَسَكِينَةٍ، حَتَّىٰ إِذَا انْتَهَى الْوَقْتُ وَضُرِبَ الْجَرَسُ خَرَجْتُ مِنَ الْمَدْرَسَةِ وَرَجَعْتُ إِلَى الْبَيْتِ. | وَأَمْكُثُ فِي الْمَدْرَسَةِ سِتَّ سَاعَاتٍ، وَأَسْمَعُ الدُّرُوسَ بِنَشَاطٍ وَرَغْبَةٍ، وَأَجْلِسُ بِأَدَبٍ وَسَكِينَةٍ، حَتَّى إِذَا انْتَهَى الْوَقْتُ وَضَرَبَ الْجَرَسُ خَرَجْتُ مِنْ الْمَدْرَسَةِ وَرَجَعْتُ إِلَى الْبَيْتِ. |
| وَلَا أَقْرَأُ بَعْدَ صَلَاةِ الْعَصْرِ إِلَى الْمَغْرِبِ، وَفِي بَعْضِ الْأَيَّامِ أَمْكُثُ فِي الْبَيْتِ، وَفِي بَعْضِ الْأَيَّامِ أَذْهَبُ إِلَى السُّوقِ وَأَشْتَرِي حَوَائِجَ الْبَيْتِ، وَفِي بَعْضِ الْأَيَّامِ أَخْرُجُ مَعَ أَبِي أَوْ أَخِي إِلَى بَعْضِ الأَقَارِبِ، أَوْ أَلْعَبُ مَعَ إِخْوَتِي وَأَصْدِقَائِي. | وَلَا أَقْرَأُ بَعْدَ صَلَاةِ الْعَصْرِ إِلَى الْمَغْرِبِ، وَفِي بَعْضِ الْأَيَّامِ أَمْكُثُ فِي الْبَيْتِ، وَفِي بَعْضِ الْأَيَّامِ أَذْهَبُ إِلَى السُّوقِ وَأَشْتَرِي حَوَائِجَ الْبَيْتِ، وَفِي بَعْضِ الْأَيَّامِ أَخْرُجُ مَعَ أَبِي أَوْ أَخِي إِلَى بَعْضِ الْأَقَارِبِ، أَوْ أَلْعَبُ مَعَ إِخْوَتِي وَأَصْدِقَائِي. |
| وَأَتَعَشَّى مَعَ وَالِدِي وَإِخْوَتِيْ وَأَحْفَظُ دُرُوسِي، وَأُطَالِعُ لِلْغَدِ وَأَسْتَعِدُّ لِلدَّرْسِ، وَأَكْتُبُ مَا يَأْمُرُ بِهِ الْمُعَلِّمُ، وَأُصَلِّي الْعِشَاءَ وَأَقْرَأُ قَلِيْلًا، ثُمَّ أَنَامُ عَلَى اسْمِ اللَّهِ وَذِكْرِه. | وَأَتَعَشَّى مَعَ وَالِدِي وَإِخْوَتِي وَأَحْفَظُ دُرُوسِي، وَأُطَالِعُ لِلْغَدِ وَأَسْتَعِدُّ لِلدَّرْسِ، وَأَكْتُبُ مَا يَأْمُرُ بِهِ الْمُعَلِّمُ، وَأُصَلِّي الْعِشَاءَ وَأَقْرَأُ قَلِيلًا، ثُمَّ أَنَامُ عَلَى اسْمِ اللَّهِ وَذِكْرِه. |

| | |
|---|---|
| تِلْكَ عَادَتِي كُلَّ يَوْمٍ لَا أُخَالِفُهَا، وَأَقُومُ مُبَشِّراً يَوْمَ الْعُطْلَةِ أَيْضَاً، وَأُصَلِّي مَعَ الْجَمَاعَةِ وَأَتْلُو الْقُرْآنَ، وَأَقْضِي الْيَوْمَ فِي مُطَالَعَةِ كِتَابٍ وَمُحَادَثَةٍ مَعَ أَبِي وَأُمِّي وَإِخْوَتِي، وَفِي زِيَارَةِ قَرِيبٍ وَأَمْكُثُ أَحْيَانَا فِي البَيْتِ، وَأَخْرُجُ أَحْيَانَا إِلَى عِيَادَةِ مَرِيضٍ، الْخَارِجِ. | تِلْكَ عَادَتِي كُلَّ يَوْمٍ لَا أُخَالِفُهَا، وَأَقُومُ مُبَشِّرًا يَوْمَ الْعُطْلَةِ أَيْضًا، وَأُصَلِّي مَعَ الْجَمَاعَةِ وَأَتْلُو الْقُرْآنَ، وَأَقْضِي الْيَوْمَ فِي مُطَالَعَةِ كِتَابٍ وَمُحَادَثَةٍ مَعَ أَبِي وَأُمِّي وَإِخْوَتِي، وَفِي زِيَارَةِ قَرِيبٍ وَأَمْكُثُ أَحْيَانًا فِي الْبَيْتِ، وَأَخْرُجُ أَحْيَانًا إِلَى عِيَادَةِ مَرِيضٍ، الْخَارِجِ. |

From the data in Table 8, it can be seen that the difference in Harakat between the results of using the *Tashkeel* application and manual use can only be found in three words, namely the words أجري، أفطر، and ضرب. The three words that have differences in Harakat are verbs (f*i'il*). In the first word, Tashkeel has the word أجري with أَجْرِيَ, while the harakat in the original text is أَجْرِي.

In *Tashkeel*, the verb is a past tense verb (*Madhi*), which is why it is assigned a *Fathah harakat*, whereas in the original text it is a present tense verb (*Mudhari*) from the word جَرَى. The verb will indeed be difficult for a computer program to read because it is a hollow verb, or *fill mu'tal*, which has an *ilat* letter at the end (Nuruddin et al., 2018). The *ilat* letter can be a trap for beginners, as it is written but sometimes not read.

In the second verb أفطر, *Tashkeel* gives the *harakat fahtah* at the end, while in the original text, the final *harakat* of the verb is *dhamah*. This is almost the same case with the first verb, where *Tashkeel* assumes that the word أفطر is a past tense verb (*fi'il madhi*) with a *fathah harakat*, whereas in the original text, the word أفطر is a present tense verb (*fi'il mudhari*) with a *dhamah* final *harakat*.

For the third verb ضرب, Tashkeel gives the harakat ضَرَبَ, while the original text gives the harakat ضُرِبَ. Tashkeel seems to have simply recognized that the word is a verb without considering whether the verb is an active or passive verb. Tashkeel records the verb as a basic active ضَرَبَ, while in the context of the sentence it is a passive verb ضُرِبَ. This difference in the harakat of the verb ضرب affects the harakat of the following word, الجرس. Therefore, the Harakat on the word الجرس is different from the original text due to Tashkeel. However, in this case, the researcher can tolerate this due to the different Harakat impact of the word ضرب. Machine errors in understanding these aspects of Arabic morphology are inevitable. Arabic morphology poses challenges for computer-aided language processing systems. The extraordinary degree of ambiguity in the writing system, the rich morphology, and the highly complex word formation process of word roots and patterns contribute to making computational approaches to Arabic very demanding (Soudi et al., 2007).

**Students' Perception of Tashkeel Application**

To find out students' experiences and opinions, researchers distributed questionnaires to 38 students in the Arabic language education program at the Faculty of Language and Arts at Jakarta State University. The questionnaire consisted of 12 questions and was distributed via the

WhatsApp group. The results of respondents' answers to the given questionnaire are shown in Table 9.

*Table 9. The results of questionnaire*

| No. | The Questions/Statements | Yes | | No | |
|---|---|---|---|---|---|
| | | Number | Percentage | Number | Percentage |
| 1 | I have known about the Tashkeel app before. | 37 | 97,4 | 1 | 2,6 |
| 2 | I have used the Tashkeel app before. | 37 | 97,4 | 1 | 2,6 |
| 3 | The Tashkeel app is easy to use. | 37 | 97,4 | 1 | 2,6 |
| 4 | Tashkeel app helps give harakat to Arabic texts. | 37 | 97,4 | 1 | 2,6 |
| 5 | The results of Harakat assignment by Tashkeel app are correct. | 28 | 73,7 | 10 | 26,3 |
| 6 | Tasykil app helps me understand Arabic texts. | 37 | 97,4 | 1 | 2,6 |
| 7 | Tashkeel app helps me understand the position of words in an Arabic text structure. | 25 | 65,8 | 13 | 34,2 |
| 8 | Tashkeel app is reliable in overcoming difficulties in reading Arabic texts. | 38 | 100 | 0 | 0 |
| 9 | I am interested in using the Tashkeel application for understanding Arabic texts. | 38 | 100 | 0 | 0 |
| 10 | I think the Tashkeel l app still has weaknesses. | 38 | 100 | 0 | 0 |
| 11 | Accuracy of Harakat assignment by Tashkeel app | 10%-25% | 25%-50% | 50%-75% | 75%-100% |
| | | 0 (0) | 0 (0) | 31 (81,6) | 7 (18,4) |
| 12 | The weakness of the Tashkeel application is in my opinion | Accuracy | Display | accessibility | Features |
| | | 2 (5,3) | 8 (21) | 0 (0) | 28 (73,7) |

From the data in Table 9, we can see that most students used the Tashkeel application to better understand Arabic texts. From the data, we also know that most students who have used the Tashkeel application demonstrate a high level of accuracy in matching Harakat to Arabic texts. The results of these data confirm previous research on the use of the Tashkeel application and that this application can improve students' ability to read Arabic texts (Fahraini & Almaliki, 2023). Although this Tashkeel application is already good, students hope that Tashkeel can be improved in terms of appearance and completeness of functions.

**Conclusion**

Tashkeel, as an artificial intelligence-based application, can help students in Arabic classes improve their ability to read Arabic texts. This is inextricably linked to the high accuracy with which Tashkeel indicates the harakat in Arabic texts. Experience has shown that there are already many students who feel supported by the existence of Tashkeel in reading and understanding

Arabic texts. All that is required is a critical attitude to accept the results of the process of giving haraka in a sufficiently long text, especially regarding the word aspect of the verb.

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