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# Islamic contextualized HOTS problems in linear algebra

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**Abstract**
This study aims to develop higher order thinking skills (HOTS) problem on linear algebra with an Islamic context. This study was conducted because undergraduate students are unable to solve HOTS questions, so they need practice and questions for training. The question development process uses the Tessmer development model, which consists of preliminary, self-evaluation, prototyping (expert review, one-to-one, and small group), and field test stages. However, the field test stage was not implemented due to time constraints that prevented the researcher from conducting a comprehensive field test. The research subjects were undergraduate mathematics education students divided into three groups based on high, medium, and low ability levels. The validity of the questions was measured using CVR and CVI. The analysis results showed that the 12 developed questions had a CVI score of 1.00, categorized as highly valid. These questions not only measure undergraduate students' higher-order thinking skills but also provide stimulation in the form of Islamic values. Further research is expected to proceed to the field test stage

**Keywords**: HOTS, Islamic context, linear algebra

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## INTRODUCTION

Learning in the 21st century includes six main aspects known as the 6C, namely critical thinking, collaboration, creativity, citizenship, character, and communication skills (Mutalib et al., 2023). Critical thinking is needed for a person to answer and face global challenges (Fahrurrozi, 2021). The critical thinking aspect is one part of higher order thinking skills (Acesta, 2020).

Higher order thinking skills (HOTS) include several cognitive processes, including: analyzing, providing arguments, applying concepts to different situations, composing, and creating (Hadi & Ramadhana, 2022). These abilities are the three highest cognitive levels of Bloom's revised taxonomy, namely analyzing (C4), evaluating (C5), and creating (C6) (Anderson & Krathwohl, 2001). Therefore, improving higher order thinking skills is very important to more easily formulate solutions to problems.

Based on the PISA 2022 results, Indonesian students' math skills ranked 70th out of 81 participating countries, with a score of 366 which is below the OECD average of 472 (OECD, 2023a). This shows that Indonesian students still have difficulty in solving math problems that refer to the PISA standard. The math questions in PISA have characteristics that belong to the HOTS category. PISA questions not only focus on mathematical procedures, but also demand the ability to analyze, evaluate, and solve complex problems in real-life contexts

(OECD, 2023b). Thus, the low ability of Indonesian students in solving PISA questions reflects the low level of thinking skills.

Students in Indonesia are not accustomed to working on questions designed to measure higher order thinking skills. This condition has an impact on the next level of education, which affects the quality of their abilities when pursuing higher education in university. This is in line with research findings by Astuti and Sabon (2020), which showed that only 7 out of 16 undergraduate students were able to solve math problems at level 5 in PISA. In addition, research by Rahayuningsih and Jayani (2019) states that only 6 out of 40 undergraduate mathematics students have high order thingking skills.

Undergraduate students need to be given HOTS-based problems as a means of introduction as well as habituation in developing and applying higher order thinking skills. Especially for undergraduate students of education study programs who will one day act as teachers. Mathematics teachers need to master higher order thinking skills as a provision in teaching, guiding, and designing HOTS questions used in the learning process (Zamsir et al., 2020). Therefore, the low PISA results are also influenced by the limited ability of teachers to develop questions that measure higher order thinking skills (HOTS).

One of the main focuses of Society 5.0 is to realize human welfare and happiness. Life in the Era of Society 5.0 has a significant impact on the world of education (Putri & Ferianto, 2023). This statement is in line with the values in Islamic teachings that emphasize the importance of balance between the rational aspect (reason) and the spiritual aspect (heart) (Idris, 2022). Education does not only focus on mastering science, but also emphasizes the importance of developing morals, morals, and sincerity of heart as an integral part in achieving happiness and welfare in life. The integration of religious values in the learning process also encourages a deeper understanding of Islamic teachings (Musyafak & Subhi, 2023).

Research conducted by Imamuddin and Isnaniah (2023) regarding the integration of Islamic values in mathematics learning concluded that this approach plays a role in increasing learning motivation, religiosity level, mathematics ability, and has a positive impact on students' mathematics learning outcomes. Aviola et al., (2023) and Faizah et al., (2023) also conducted research related to mathematics learning that integrates Islamic values and character This shows that the learning implemented is able to form positive characters in students. One form of implementation that can be done is to design problems with an Islamic context.

Furthermore, it is necessary to determine the material as a reference for developing questions. Algebra is one of the basic elements that is very important in the field of mathematics (Arigawati & Kusnandi, 2023). Algebraic material is studied, one of which is in the college of mathematics education study program with the title of the linear algebra course. Good mastery of linear algebra material can be a foundation that makes it easier for undergraduate students to understand and master other mathematics courses (Yusup, 2022). In addition, the implementation of linear algebra can be used in everyday life (Yuliany et al., 2021), such as in the fields of architecture, weather prediction, industry, and finance. Therefore, the material in linear algebra courses is very important and can be used as a basis for developing HOTS-based questions with an Islamic context.

Despite its importance, studies that specifically develop HOTS questions with Islamic contexts in linear algebra courses at the university level are still very limited. Therefore, the researcher intends to develop Higher Order Thinking

Skills-based questions with an Islamic context using the Tessmer model in linear algebra courses. This research contributes to providing HOTS questions that not only sharpen undergraduate students' cognitive abilities, but also shape character and religious values through the integration of Islamic contexts.

## RESEARCH METHOD

This research uses the formative research type development model from Tessmer (1993) to develop HOTS questions with Islamic contexts in Linear Algebra courses, which consists of several stages, namely the preliminary stage, the self evaluation stage, the formative evaluation or prototyping stage involving expert reviews, one-to-one, and small group, and the field test stage. However, the field test stage in this study has not been implemented. This is due to the limited time of research implementation which does not allow researchers to reach the field test stage thoroughly. In addition, the main focus of this research is on the validity, clarity, and performance of questions in the early stages of development, so the evaluation process is focused on the expert review, one-to-one, and small group stages as a strong foundation before the field test is conducted.

The test subjects of the product development of HOTS questions with Islamic context were undergraduate students of the mathematics education study program who were categorized into high, low, and medium ability student groups. The data collected consisted of validity data obtained from expert review, one-to-one, and small group. The instruments used were validation sheets and test instruments.

Analysis of the content validity of the questions was carried out to determine the suitability of the questions with the material used as a basis for making questions. The content validity test used is the Content Validity Ratio (CVR). According to Lawshe, CVR is a content validity analysis approach to measure the degree of agreement of experts regarding the suitability of question items with material (Hendryadi, 2017). To calculate CVR, the formula (Bashooir & Supahar, 2018) is used as follows:

$$\text{CVR} = \frac{2\text{ne}}{\text{N}} - 1$$

Description:
$ne$ = Number of expert reviews that state valid
$N$ = Number of expert reviews who conducted the assessment

From the CVR results, it can be determined which questions are accepted in the development of Islamic-context HOTS questions with the Tessmer model in linear algebra courses. Where the question is declared valid if it has CVR ≥ 0.99. After the CVR calculation, the overall validity value of the question can be determined using the CVI (Content Validity Index) with the formula (Bashooir & Supahar, 2018)) as follows:

$$\text{CVI} = \frac{\sum \text{CVR}}{\text{jumlah soal}}$$

The category of CVI calculation results is in the form of numbers 0-1 which can be categorized (Kristiani et al., 2017) as follows:

**Table 1.** Categories of CVI calculation results

| Assesment | Criteria |
|---|---|
| 0 – 0.33 | Not suitable |
| 0.34 – 0.67 | Suitable |
| 0.68 – 1 | Very Suitable |

## RESULTS AND DISCUSSION

The process of developing questions based on higher order thinking skills with Islamic context in linear algebra courses is to use the formative research development model (Tessmer). The following are the stages of the development process:

### Preliminary stage

This stage is the initial stage carried out by researchers to collect several references related to this research, namely about the development model to be used, the taxonomy of higher order thinking skills, the Islamic context, and linear algebra course materials, places and test subjects, and research objectives.

Some of the references obtained about the development model used are using the Tessmer development model, which is a development model commonly applied in question development research. The advantage of the Tessmer development model is that it has several stages that will produce good questions, namely up to *prototype* III. Then, HOTS-based questions measure Bloom's cognitive levels, namely analyzing (C4), evaluating (C5), and creating (C6) (Anderson & Krathwohl, 2001).

Furthermore, the Islamic context contained in the questions is in the form of Islamic stories from the Qur'an and hadith, muamalah, Islamic morals, and Islamic terminology. Then, based on the RPS of the linear algebra course in the mathematics education program at one of university in Makassar, the material consists of 6 chapters which include matrices, determinants, systems of linear equations, vectors in two-dimensional space and three-dimensional space, vector spaces, and linear transformations.

Based on the references obtained, then determining the place of research and test subjects. In this study, the researcher conducted a trial in the mathematics education class at one of university in Makassar. The reason for choosing the place and the test subjects is because based on the results of the researcher's initial observations with students in the mathematics education department at one of university in Makassar, information was obtained that the questions used in the linear algebra course were partly HOTS-based, but not yet integrated with Islam. Therefore, the researcher aims to develop HOTS-based questions with Islamic contests with the Tessmer model in linear algebra courses.

### Self-evaluation stage

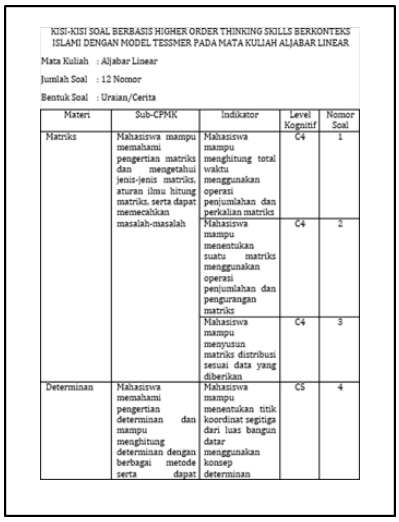
The self-evaluation stage is the second stage of the Tessmer development model which consists of 2 stages, namely the analysis stage and the design stage.

*Analysis stage*

At this stage consists of 3 activities namely curriculum analysis, student analysis, and material analysis. Curriculum analysis is carried out to find out the basic problems in the form of how the learning plan as a reference in the process of developing HOTS-based questions with Islamic context. Then, the

undergraduate student analysis stage focused on undergraduate students of the mathematics education study program at one of university in Makassar who were used as test subjects. These undergraduate students have different abilities. There are those with high, medium, and low abilities. Furthermore, researchers detailed the Linear Algebra material that students had learned and used in developing questions. Based on the results of the material analysis, it was found that the questions to be developed were questions that were in accordance with the learning materials formulated from the CPMK of linear algebra mathematics education study program at one of university of Makassar. The material includes matrices, determinants, SPL, vectors in two-dimensional space and three- dimensional space, vector spaces, and linear transformations.

Furthermore, researchers identified sub-CPMK from the 6 chapters of linear algebra material above. The identification of the sub-CPMK becomes a reference in creating indicators of HOTS-based questions with Islamic context.



KISI-KISI SOAL BERBASIS HIGHER ORDER THINKING SKILLS BERKONTEKS ISLAMI DENGAN MODEL TESSMER PADA MATA KULIAH ALJABAR LINEAR

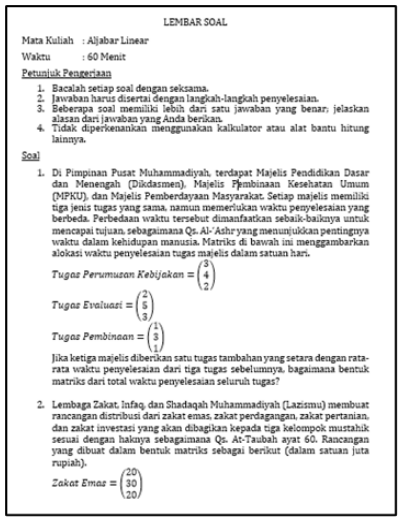
Mata Kuliah : Aljabar Linear

Jumlah Soal : 12 Nomor

Bentuk Soal : Uraian/Cerita

| Materi | Sub-CPMK | Indikator | Level Kognitif | Nomor Soal |
|---|---|---|---|---|
| Matriks | Mahasiswa mampu memahami pengertian matriks dan mengetahui jenis-jenis matriks, aturan ilmu hitung matriks, serta dapat mencelikan masalah-masalah | Mahasiswa mampu menghitung total waktu menggunakan operasi penjumlahan dan perkalian matriks | C4 | 1 |
| | | Mahasiswa mampu menentukan suatu matriks menggunakan operasi penjumlahan dan pengurangan matriks | C4 | 2 |
| | | Mahasiswa mampu menyusun matriks distribusi sesuai data yang diberikan | C4 | 3 |
| Determinan | Mahasiswa memahami pengertian determinan dan mampu menghitung determinan dengan berbagai metode serta dapat | Mahasiswa mampu menentukan titik koordinat segitiga dari luas bangun datar menggunakan konsep determinan | C5 | 4 |

**Figure 1.** Grid design.



LEMBAR SOAL

Mata Kuliah : Aljabar Linear

Waktu : 60 Menit

Petunjuk Pengerjaan

1. Bacalah setiap soal dengan seksama.
2. Jawaban harus disertai dengan langkah-langkah penyelesaian.
3. Beberapa soal memiliki lebih dari satu jawaban yang benar; jelaskan alasan dari jawaban yang Anda berikan.
4. Tidak diperkenankan menggunakan kalkulator atau alat bantu hitung lainnya.

Soal

1. Di Pimpinan Pusat Muhammadiyah, terdapat Majelis Pendidikan Dasar dan Menengah (Dikdasmen), Majelis Pembinaan Kesehatan Umum (MPKU), dan Majelis Pemberdayaan Masyarakat. Setiap majelis memiliki tiga jenis tugas yang sama, namun memerlukan waktu penyelesaian yang berbeda. Perbedaan waktu tersebut dimanfaatkan sebaik-baiknya untuk mencapai tujuan, sebagaimana Qs. Al-'Ashr yang menunjukkan pentingnya waktu dalam kehidupan manusia. Matriks di bawah ini menggambarkan alokasi waktu penyelesaian tugas majelis dalam satuan hari.

   *Tugas Perumusan Kebijakan* $= \begin{pmatrix} 3 \\ 4 \\ 2 \end{pmatrix}$

   *Tugas Evaluasi* $= \begin{pmatrix} 2 \\ 5 \\ 3 \end{pmatrix}$

   *Tugas Pembinaan* $= \begin{pmatrix} 1 \\ 3 \\ 1 \end{pmatrix}$

   Jika ketiga majelis diberikan satu tugas tambahan yang setara dengan rata-rata waktu penyelesaian dari tiga tugas sebelumnya, bagaimana bentuk matriks dari total waktu penyelesaian seluruh tugas?

2. Lembaga Zakat, Infaq, dan Shadaqah Muhammadiyah (Lazismu) membuat rancangan distribusi dari zakat emas, zakat perdagangan, zakat pertanian, dan zakat investasi yang akan dibagikan kepada tiga kelompok mustahik sesuai dengan haknya sebagaimana Qs. At-Taubah ayat 60. Rancangan yang dibuat dalam bentuk matriks sebagai berikut (dalam satuan juta rupiah).

   *Zakat Emas* $= \begin{pmatrix} 20 \\ 30 \\ 20 \end{pmatrix}$

**Figure 2.** Problem sheet design.

*Design stage*

After the researchers went through the analysis stage, the next stage was the design stage. At this stage, researchers design and design questions consisting of grids, question sheets, scoring guidelines, and prototype questions that contain indicators, question narratives, HOTS, Islamic contexts, and answer keys. The initial design of the grid is presented in Figure 1.

After making a lattice that contains the subject matter, sub-CPMK, question indicators, cognitive levels, and question numbers, the researchers then designed the questions based on the lattice that had been made. Researchers designed HOTS-based story problems with Islamic context (See Figure 2).

Furthermore, the researchers compiled scoring guidelines using Polya's (1973) assessment indicators as follows (See Figure 3).

PEDOMAN PENSKORAN SOAL BERBASIS HIGHER ORDER THINKING SKILLS BERKONTEKS ISLAMI DENGAN MODEL TESSNER PADA MATA KULIAH ALJABAR LINEAR

Mata Kuliah : Aljabar Linear

Jumlah Soal : 12 Nomor

Bentuk Soal : Uraian/Cerita

| Indikator Penilaian (Polya, 1973) | Aktivitas Mahasiswa | Skor |
|---|---|---|
| Memahami masalah | Mahasiswa tidak menuliskan hal-hal yang diketahui | 0 |
| | Mahasiswa keliru dalam menuliskan hal-hal yang diketahui | 1 |
| | Mahasiswa menuliskan hal-hal yang diketahui tapi tidak lengkap | 2 |
| | Mahasiswa menuliskan hal-hal yang diketahui dengan lengkap dan benar | 3 |
| Merencanakan penyelesaian | Mahasiswa tidak membuat rencana penyelesaian | 0 |
| | Mahasiswa membuat rencana penyelesaian tetapi mengarah pada jawaban yang keliru | 1 |
| | Mahasiswa membuat rencana penyelesaian yang mengarah pada jawaban benar tapi tidak lengkap | 5 |
| | Mahasiswa membuat rencana penyelesaian yang mengarah pada jawaban benar dengan lengkap | 7 |
| Menggunakan dan mengembangkan strategi pemecahan masalah | Mahasiswa tidak menuliskan prosedur penyelesaian | 0 |
| | Mahasiswa menuliskan prosedur penyelesaian tapi tidak jelas | 1 |
| | Mahasiswa menuliskan prosedur penyelesaian yang mengarah pada jawaban benar tapi tidak lengkap | 5 |
| | Mahasiswa menuliskan prosedur penyelesaian yang mengarah pada jawaban benar dengan lengkap | 7 |
| Melakukan pengecekan kembali | Mahasiswa tidak menuliskan kesimpulan jawaban | 0 |
| | Mahasiswa menuliskan kesimpulan jawaban tapi keliru | 1 |

**Figure 3.** Scoring guidelines design.

**Prototyping stage**

At this stage, all questions that have been designed by researchers will be evaluated. Questions that have been made based on self-evaluation in prototype I are given to expert review, one to one, and small group to be tested and the results are used as revision material.

*Expert review*

The validator assesses the instrument from 5 aspects related to the questions that have been developed, where each aspect has a value of 1 for the statement "Yes" and 0 for the statement "No". A value of 1 means that the expert considers the question to be in accordance with the material or aspects measured, while 0 means that the expert considers the question not in accordance with the aspects measured and needs improvement. In addition, validators provide opinions in the form of questions can be used without revision, questions can be used with minor revisions, questions can be used with major revisions, or all components must be revised. Suggestions from validators were used as input to improve prototype I.

*One-to-one*

As the research instruments were validated by experts, the questions were also tested one by one on three undergraduate mathematics education students who had passed the linear algebra course. One undergraduate student with high

ability, one with medium ability, and one with low ability. After being tested on these undergraduate students, the undergraduate students then answered questions about the HOTS-based questions with Islamic context. Undergraduate students commented that the directions and instructions in the question narrative were clear. The revised results of the expert review and one to one undergraduate student comments are called prototype II.

*Small group*

Prototype II was tested on six undergraduate mathematics education students simultaneously, namely two high ability, two medium ability, and two low ability. The trial was conducted for 60 minutes. From the small group results, it can be seen that as many as six undergraduate students can work on item number 1, five undergarduate students can work on items number 2 and 4, four undergraduate students can work on items number 3, 5, 6, and 7, three undergraduate students work on item number 8, two undergraduate students work on items number 9 and 10, and only one undergraduate student works on items number 11 and 12. Therefore, only item number 1 can be done by all undergraduate students.

Furthermore, the six undergraduate students gave comments on the HOTS-based questions with Islamic context. The undergraduate students commented that the question instructions were clear, the instructions in the question narrative were clear and complete, the questions were too difficult because the processing time was too short, there were no typos in the question narrative, and the questions could not be completed within 60 minutes. Thus, the processing time was changed to 120 minutes. The six undergraduate students' reviews were used as a reference to revise prototype II, resulting in prototype III.

**Content validity analysis**

Content validation of higher order thinking skills-based questions with Islamic context with the Tessmer Model in linear algebra courses aims to determine the validity of the questions carried out by several expert reviews (validators). The content validity test used is the Content Validity Ratio (CVR). According to Lawshe, CVR is a content validity analysis approach to measure the degree of agreement of experts regarding the suitability of question items with material (Hendryadi, 2017). After the CVR calculation, the overall validity value of the question can be determined using the CVI (Content Validity Index). The validation of the test instrument was carried out using a validation sheet filled in with a check mark (checklist) in the "Yes" and "No" statement columns.

Based on the results of the first validation analysis, it was found that of the 12 items developed, there were 5 items that had to be revised even though the CVI value reached 0.50, but the CVR value had not reached the minimum CVR of 0.99. After the items were revised and rearranged, the results of the content validation calculation.

The results of validation after revision show that 12 items were reviewed by two experts on the content validity of the questions. Then, from the CVR results, the CVI value is 1. This means that the questions based on higher order thinking skills with Islamic context with the Tessmer Model in linear algebra courses are very suitable (valid) with the material or aspects measured.

## CONCLUSION

The process of developing questions based on higher order thinking skills with Islamic context with the Tessmer Model in linear algebra courses goes through three stages to produce prototype III, namely the preliminary stage, self evaluation, and formative evaluation (expert review, one-to-one, and small group). The results of content validation show that all items developed have a high level of validity (CVI = 1), so they are suitable for measuring students' higher order thinking skills in an Islamic context. The final product is 12 items of Linear Algebra HOTS questions with Islamic context that have gone through a gradual validation and revision process. This research shows that HOTS questions with Islamic contexts are able to encourage the development of higher-order thinking skills while strengthening students' religious values. Thus, it is recommended that further research continue to the field test stage to test the questions more broadly. In addition, the development of similar questions in other courses needs to be done so that scientific integration and Islamic values can be applied more thoroughly.

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## Appendix

**GRID**

Course : Linear Algebra
Total Questions : 12
Type of Questions : Essay

| Material | Sub-CPMK | Indicator | Cognitive Level | Question Number |
|---|---|---|---|---|
| Matrices | Undergraduate students are able to understand the definition of matrices and identify types, rules, and solve problems | Undergraduate students are able to analyze data in matrix form and develop strategies to redistribute matrix elements using matrix operations | C4 | 1 |
| | | Undergraduate students are able to determine data suitability in matrix form against ideal needs using matrix operations | C5 | 2 |
| | | Undergraduate students are able to calculate total supply needs and determine supply priorities using matrix operations | C5 | 3 |
| Determinant | Undergraduate student are able to understand determinant and can compute them using various methods and solve problems | Undergraduate students are able to determine the coordinates of triangle based on the area using the concept of determinants | C4 | 4 |
| | | Undergraduate are able to determine coordinates using matrix determinants | C4 | 5 |
| Systems of linear equations | Undergraduate students are able to understand systems of linear equations and can solve them using various methods and solve problems | Undergraduate students are able to solve systems of linear equations to determine whether the requirements are fulfilled | C4 | 6 & 7 |

| Material | Sub-CPMK | Indicator | Cognitive Level | Question Number |
|---|---|---|---|---|
| | | Undergraduate students are able to determine a combination of material usage based on available inventory using systems of linear equations | C4 | 8 |
| Vectors in two-dimensional space and three-dimensional space | Undergraduate students are able to understand vectors in two-dimensional space and three-dimensional space and solve problems | Undergraduate students are able to determine vectors and parallel positions based on two points | C4 | 9 |
| Vector spaces | Undergraduate students are able to understand vector spaces and solve problems | Undergraduate students are able to determine wheter vectors form a 2D or 3D plane using linear combination of vectors | C4 | 10 |
| Linear transformation | Undergraduate students are able to understand linear transformations and apply them to solve problems | Undergraduate students are able to determine coordinate changes due to rotation by linear transformation | C4 | 11 |
| | | Undergraduate students are able to compare rotated coordinates | C5 | 12 |

**QUESTION SHEET**

Course : Linear Algebra
Time : 120 Minutes
Instructions :

1. Read each question carefully.
2. Provide complete steps in your answers.
3. Some questions may have more than one correct answer; answer the reasoning behind your answer.
4. Use of calculators or any calculating tool is not allowed.

Question :

1. The following matrix columns represent the allocation of time (in days) used by the Council of Primary and Secondary Education (Dikdasmen), the Council for the Development of Public Health (MPKU), and the Council for Community Empowerment at the Muhammadiyah Central Board to carry out tasks related to policy formulation, evaluation, and guidance.

$$M = \begin{bmatrix} 3 & 2 & 4 \\ 4 & 6 & 3 \\ 2 & 3 & 3 \end{bmatrix}$$

   The three councils utilize time as efficiently as possible to maximize their work, as stated in Surah Al-'Asr which emphasizes the importance of time in human life. If the Muhammadiyah Central Board desires to balance the workload among the three councils, what redistribution steps can be taken?

2. Lazismu (Muhammadiyah's Zakat, Infaq, and Shadaqah Institution) received zakat distribution reports (in million rupiahs) over the past three years in Makassar, Gowa, and Takalar regions. The data is presented in the matrix below, where each column represents the years 2022, 2023, and 2024:

$$Z = \begin{bmatrix} 25 & 30 & 28 \\ 20 & 22 & 24 \\ 15 & 18 & 20 \end{bmatrix}$$

   Lazismu evaluates the reports to design the zakat distribution for the upcoming year so that it aligns with the rights of each region, as stated in Surah At-Tawbah verse 60. The evaluation shows that over the three years, Makassar required 35% of the total zakat, Gowa 40%, and Takalar 25%. Has the zakat distribution over the past three years matched the needs of each region?

3. The military forces in South Sulawesi require supplies of food, weapons, and medicine (in units), as stated in Surah Al-Anfal verse 60 regarding the importance of thorough military preparation. The supply needs per soldier are represented in the matrix below, where each row represents infantry (al-Musyat), cavalry (al-Fursan), and archers (ar-Rumat):

$$S = \begin{bmatrix} 4 & 1 & 2 \\ 2 & 3 & 2 \\ 1 & 2 & 4 \end{bmatrix}$$

   The number of troops at the military base is shown in the following matrix:

$$P = [120 \quad 80 \quad 60]$$

   If a supply truck can only carry 1,000 units, how many of each supply type (food, weapons, medicine) can be loaded into the truck to maximize military preparedness?

4. The Amrullah Aisyiyah Orphanage in Limbung received a donation of 18 m² of ceramic tiles to be installed in a triangular learning garden. This donation supports the development of the orphanage, in line with Surah Al-Baqarah verse 220, which emphasizes the importance of caring for orphans. The garden has three corner points: A(2,5) at the right corner of the mosque's back wall, B(6,9) near the orphanage entrance gate, and C in the corridor corner

of the Islamic boarding school located in quadrant I. If the total ceramic tile area exactly covers the floor of the learning garden, what are the possible coordinates for point C?

5. Mr. Ahmad, his wife, and their two children were traveling to their hometown. Along the way, they stopped at a prayer room to combine their Dhuhr and Asr prayers, in accordance with Surah An-Nisa verse 101, which explains the permissibility of combined prayers during travel. If the prayer rows (saf) are formed into two 2×2 matrices with determinant = 0, determine the saf coordinates for each family member.

6. Mr. Ahmad owns two textile factories in Central Java producing gamis (Islamic dresses) to be distributed to two umrah travel organizers: Arrahmah Tour and SM Tour & Travel. Factory 1 distributes 160 pieces in a 4:1 ratio, while Factory 2 distributes 240 pieces in a 1:2 ratio. Mr. Ahmad wants to ensure that the minimum needs of both travel agencies are met, in line with Surah Al-Mu'minun verse 8, which describes successful people as those who fulfill their trusts and promises. If Arrahmah Tour needs at least 200 pieces and SM Tour & Travel 120 pieces, can the production from Mr. Ahmad's factories meet their minimum needs?

7. PT Aditex Bangun Cipta will produce two types of ihram cloth for an umrah travel agency ordering 80 pieces. The company aims to fulfill the order responsibly, as stated in Surah Al-Muddaththir verse 38 about accountability. PT Aditex has two machines: the first takes 3 hours to produce cotton ihram and 2 hours for microfiber, while the second takes 2 hours for cotton and 4 hours for microfiber. The weekly time capacity is 240 hours for Machine 1 and 200 hours for Machine 2. Can PT Aditex fulfill the ihram cloth order within a week?

8. Muhammadiyah's Philanthropic Movement plans to distribute food for iftar (breaking the fast), in accordance with the hadiths of At-Tirmidhi and Ibn Majah which mention the rewards of feeding fasting individuals. The food comes in three packages: rice box, rice bowl, and bento, each requiring different amounts of rice, side dish, and vegetables. Total available ingredients are 50 kg of rice, 30 kg of side dishes, and 40 kg of vegetables. What are the possible distributions of ingredients for each package, and how many total packages can be made?

9. In the initial design of Masjid Nurul Ishlah's construction, two main pillars were to be placed inside the mosque. Pillar A is at (0,0) and pillar B is at (4,3). The project architect reviewed the design based on the hadith of Thabrani about excellence in work. Is it possible for the architect to add a third pillar that is aligned with the line between the first two pillars by calculating the existing vector?

10. A team from the Ministry of Religious Affairs wants to determine the qibla direction on land where a mosque will be built, as facing the qibla is a prayer requirement. The team uses three 3D vectors representing the mosque wall directions: $u = (2, -1, 3)$ $v = (-1, 4, 2)$ $w = (3, 2, -5)$. Do these three vectors sufficiently determine the qibla direction accurately in terms of linear vector combinations?

11. A ceramic craftsman modifies tile patterns to beautify the mosque floor, in line with Surah At-Tawbah verse 18 about prospering the mosque. The craftsman applies rotation around the origin (0, 0). The original tile positions are (2, 3) and (-1, 4), and the new positions are (3, -2) and (4, 1). What is the angle of rotation?

12. The position of a mosque's mihrab (prayer niche) is at vector (1,0). During renovation, the mihrab is rotated 45° counterclockwise, as instructed in Surah Al-Baqarah verse 144 commanding Muslims to face the qibla during prayer. If the qibla direction lies at coordinates (cos(45°), sin(45°)), does the new position of the mihrab align with the qibla direction?

**SCORING GUIDELINES**

Course : Aljabar Linear
Total Questions : 12
Type of Questions : Essay

| Assessment Indicators (Based on Polya, 1973) | Undergraduate Student Performance | Score |
|---|---|---|
| Understanding the problem | Undergraduate student does not mention known elements | 0 |
| | Undergraduate student writes incorrect known elements | 1 |
| | Undergraduate student writes incomplete known elements | 2 |
| | Undergraduate student writes complete and correct known elements | 3 |
| Planing the solution | Undergraduate student does not make a plan | 0 |
| | Undergraduate student makes a plan but leads to incorrect answer | 1 |
| | Undergraduate student makes a partially corrcet plan | 5 |
| | Undergraduate student makes a complete and correct plan | 7 |
| Using or developing problem solving strategy | Undergraduate student does not write solution procedure | 0 |
| | Undergraduate student writes unclear solution procedure | 1 |
| | Undergraduate student writes partially correct procedure | 5 |
| | Undergraduate student writes a complete and correct procedure | 7 |
| Checking the result | Undergraduate student does not write a conclusion | 0 |
| | Undergraduate student writes incorrect conclusion | 1 |
| | Undergraduate student writes nearly complete conclusion | 2 |
| | Undergraduate student writes complete and correct conclusion | 3 |
| | Maximum score per question | 20 |

Total maximum score for 12 questions = 20 x 12 = 240
Undergraduate student's final score = $\frac{Total\ score\ obtained}{240} \times 100$