# Using a grey-based decision-making approach to comparison between online video conferencing tools Approach– A case study in Libya

Ali M Abdulshahed[1], Mohamed Abugharsa[2]
[1]Faculty of Engineering, Misurata University, Misurata, Libya
[2]Faculty of Information Technology, Misurata University, Misurata, Libya
Email: a.abdulshahed@eng.misuratau.edu.ly, m.abugharsa@it.misuratau.edu.ly

**Abstract**

This work aims to revolutionize the selection process of online conferencing and video-sharing applications within Libyan universities by introducing an innovative framework. This framework utilizes the methodologies of Prompt Engineering and the Grey-based approach to provide a systematic decision-making technique. It carefully considers the unique needs of Libyan universities and the prevailing conditions in Libya, thereby enabling decision-makers to make well-informed choices and optimize their technological infrastructure. By harnessing the cutting-edge methodology of Prompt Engineering and leveraging the power of the Grey-based approach, we introduce a systematic decision-making technique that takes into account the distinct requirements of Libyan universities and the prevailing conditions in Libya. To date, no literature has been discovered that combines Prompt Engineering and the Grey-based approach. However, we have developed a novel framework that integrates both methodologies, offering a systematic and flexible evaluation approach for the selection of appropriate platforms within Libyan universities. This framework also effectively addresses the uncertainties present in real-world situations while considering the specific needs of Libyan universities.

**Keywords**

**Online conferencing video**
**Libyan universities**
**Prompt Engineering**
**Grey-based approach**
**Decision making**
**Higher education excellence.**

## استخدام منهج اتخاذ القرار بناءً على النظرية الرمادية في أختيار أدوات مؤتمرات الفيديو عبر الإنترنت– دراسة حالة في ليبيا

علي محمد عبد الشاهد[1] ، محمد بشير أبوغرسة[2]

**الملخص**

هذا العمل يهدف إلى تقديم طريقة علمية في عملية اختيار تطبيقات المؤتمرات عبر الإنترنت ومشاركة الفيديو في الجامعات الليبية من خلال تقديم إطار مبتكر. يستخدم هذا الإطار منهجيات هندسة الأوامر والنهج المبني على النظرية الرمادية لتوفير تقنية اتخاذ قرار منهجية. يأخذ بعين الاعتبار احتياجات الجامعات الليبية الفريدة والظروف السائدة في ليبيا بعناية، مما يتيح لاتخاذ القرارات اتخاذ خيارات مستنيرة وتحسين بنية تكنولوجيا المعلومات والاتصالات. من خلال استغلال منهجية هندسة الأوامر الحديثة والاستفادة من قوة النهج المبني على النظرية الرمادية، نقدم تقنية اتخاذ قرار منهجية تأخذ في اعتبارها متطلبات الجامعات الليبية المتميزة والظروف السائدة في ليبيا. ومع ذلك، قمنا بتطوير إطار جديد يدمج كلا النهجين، مما يقدم نهجًا منهجيًا ومرنًا لتقييم البنى المناسبة داخل الجامعات الليبية. يتناول هذا الإطار أيضًا بفعالية التحديات المتواجدة في التعليم عن بعد مع مراعاة احتياجات الجامعات الليبية الخاصة.

*الكلمات المفتاحية*

*تطبيقات مشاركة الفيديو*
*الجامعات الليبية*
*هندسة الأوامر*
*النهج المبني على النظرية الرمادية*
*اتخاذ القرار*
*التميز في التعليم العالي.*

## 1 Introduction

In the realm of decision-making, where uncertainty is prevalent and choices are abundant, the pursuit of a comprehensive and effective approach has been ongoing (Du, Liu, Liu, Tao, & Negotiation, 2023; Du, Xie, Liu, & Goh, 2023). Among the numerous methods available, one particular approach shines as a beacon of clarity and practicality: the Grey Theory. By skilfully manoeuvring through uncertain circumstances, the Grey Theory has proven to be a valuable tool in decision-making across various fields (Du, Liu, et al., 2023; Du, Xie, et al., 2023; L. Liu, Liu, Fang, Jiang, & Shang, 2023). By leveraging imprecise information and balancing multiple factors, it sheds light on the path towards informed judgments and successful outcomes. In this study, we will explore the benefits offered by the combination of Grey Theory and prompt engineering, examining how this distinctive framework empowers decision-makers to navigate complexity, optimize resources, and foster innovation.

Prompt engineering is a skill set that is becoming increasingly important in effectively conversing with large language models (LLMs) like ChatGPT. By providing instructions to an LLM through prompts, users can enforce rules, automate processes, and ensure specific qualities and quantities of generated output. Prompts essentially act as a form of programming that allows customization of the outputs and interactions with LLMs (White et al., 2023). With et al. (White et al., 2023) introduces a catalog of prompt engineering techniques in the form of patterns, which have been applied to address common problems encountered when interacting with LLMs. These prompt patterns serve as reusable solutions analogous to software patterns, offering structured and adaptable approaches to address output generation and interaction challenges with LLMs. Several key insights were gained from this work on prompt patterns. Firstly, prompt patterns greatly enhance the capabilities that can be achieved with conversational LLMs. For instance, in healthcare sector (Wang et al., 2023), and education sector (Hutson & Cotroneo, 2023).

Analytical Hierarchy Process (AHP) is a widely used method for multi-criteria decision-making (MCDM) that was developed by Saaty (Saaty, 2013). Its purpose is to offer a flexible and easily comprehensible approach for analysing complex problems. According to (Pant, Kumar, Ram, Klochkov, & Sharma, 2022), AHP is the most frequently utilized MCDM method. However, the AHP methodology primarily focuses on determining the relative importance of criteria while neglecting their interdependencies. It involves breaking down a complex problem into hierarchical levels and comparing possible pairs in a matrix to assign weights to each factor, along with assessing the consistency ratio.

In the study by Chan and Chan (F. T. Chan & Chan, 2004), utilized the Analytic Hierarchy Process (AHP) to assess and choose suppliers. The AHP framework consisted of six evaluation criteria and 20 sub-factors, and the relative significance of these factors was determined by analysing customer requirements. Another research conducted by Chan et al. (F. Chan, Chan, Ip, & Lau, 2007) employed the Analytical Hierarchy Process

(AHP) to tackle the issue of supplier selection. They evaluated potential suppliers using a set of fourteen criteria. To assess the sensitivity of different alternatives, they conducted a thorough analysis using "Expert Choice" software, which allowed them to observe how the alternatives reacted to changes in the relative importance ratings of each criterion.

Although AHP is widely employed for solving multi-criteria decision-making problems in real-life applications, it falls short in explaining uncertain conditions, particularly during the pairwise comparison stage. Most human judgments cannot be represented as precise numbers. Since some evaluation criteria are subjective and qualitative, decision-makers find it challenging to express preferences using exact numerical values and provide precise pairwise comparisons. To address these issues, AHP has been integrated with other methods, fuzzy set theory (James, Asjad, & Panchal, 2023), grey relational analysis (Delcea & Cotfas, 2023a), and combinations of different methods (Delcea & Cotfas, 2023b).

The work in (Yurtyapan & Aydemir, 2022) focuses on the selection of Enterprise Resource Planning (ERP) software using the intuitionistic fuzzy and interval grey number-based MACBETH method. The study emphasizes the significance of choosing suitable ERP software for businesses to enhance decision-making and competitiveness. The authors propose a new approach that incorporates interval grey numbers and intuitionistic fuzzy set theory to address uncertainties and quantify expert opinions. The findings demonstrate the effectiveness of the proposed method in handling uncertain conditions during ERP software selection and highlight the importance of considering criteria uncertainties in the decision-making process. The study contributes to the literature by optimizing the ERP software selection process using the MACBETH method and validating the importance of expert opinions in this context.

The aforementioned MCDM methods possess individual merits, strengths, and limitations tailored to specific applications. Nonetheless, this work does not centre around appraising these methods. Generally speaking, the task of choosing the optimal supplier remains a formidable challenge, as it predominantly hinges on uncertain information that is intricate to represent and frequently relies on the proficiency of specialists.

In the early 1980s, Deng introduced the Grey systems theory (Deng, 1982), which is a methodology designed to address problems involving incomplete information. This technique deals with systems that have partially known information by extracting useful knowledge from available data. According to the Grey theory, even though a system may appear complex, it possesses internal laws that govern its existence and operation, and these can be revealed with a small amount of data (Prakash et al., 2023).

A grey number is a type of figure where we only have knowledge about the range of values, without an exact value (S. Liu, Fang, Yang, & Forrest, 2012). This number can represent the degree of uncertainty in information, either as an interval or a general number set. The application of Grey systems theory in the decision-making process is highly beneficial in overcoming the limitations of the Analytic Hierarchy Process (AHP).

Yang and Chen (Yang & Chen, 2006) made an effort to merge AHP (Analytic Hierarchy Process) with grey relational analysis (GRA) in order to assess the viability of their combined method for supplier selection. They employed AHP to determine the relative significance weights of qualitative criteria. Subsequently, these weights were employed as coefficients within the GRA model, which amalgamated tangible and intangible factors to produce grey relational grade values. The supplier attaining the highest value was regarded as the optimal option for an outsourcing manufacturing organization.

These successful applications serve as inspiration for us to delve into the characteristics of Grey systems and apply them systematically to address the suitability of video calling programs for Libyan universities.

In recent years, the rapid advancement of technology has brought about a profound transformation in various aspects of our lives, and education is no exception. One notable development is the emergence of video calling applications, which has had a significant impact on teaching and learning methods. These applications have opened up new avenues for communication and collaboration, enabling educators and students to connect regardless of geographical constraints. In this paper, we will explore the utilization of such programs in Libyan universities, examining the potential advantages they offer in the field of education.

The following are some widely used video calling applications (Singh & Awasthi, 2020):

- Zoom: Zoom has gained immense popularity as a global video calling program. It provides high-quality services and offers free personal meetings for a limited number of participants. Paid plans are also available, offering additional features and capabilities.
- Microsoft Teams: Microsoft Teams provides a comprehensive suite of communication and collaboration tools, including audio and video calls, instant messaging, file sharing, and document collaboration.
- Skype: Skype is a well-known communication program that facilitates voice and video calls, as well as text chats. It can be used on computers, smartphones, and tablets.
- Google Meet: Google Meet is an online meeting service provided by Google. It offers high-quality video calls, ease of use, and supports screen sharing and document collaboration.
- WhatsApp: WhatsApp is a popular messaging app that allows both individual and group communication. It enables users to make video and voice calls with other WhatsApp users.

- FaceTime: FaceTime is an exclusive app for Apple devices, enabling users to easily make voice and video calls.
- Telegram: Telegram is an instant messaging app that also offers voice and video calling capabilities. It features robust message encryption, fast media downloads, and supports large group communication.

In this work, we present an innovative framework aimed at revolutionizing the selection process of online conferencing and video-sharing applications specifically tailored to the unique needs of Libyan universities. By leveraging the cutting-edge methodology of Prompt Engineering and harnessing the power of a Grey-based approach, we introduce a systematic decision-making technique that takes into account the distinct requirements of Libyan universities as well as the prevailing conditions in Libya. The incorporation of prompt engineering significantly augments the comparison process, rendering the adaptable Grey model applicable across a myriad of domains. Through our comprehensive study, our primary objective is to empower decision makers within Libyan universities, equipping them with the necessary tools and knowledge to make informed choices and optimize their technology infrastructure, thereby ushering in a new era of higher education excellence.

# 2 Method

## 2.1 Preliminaries

The Grey System Theory, developed by Deng in (1982), is a methodology that addresses problems characterized by incomplete information or small sample sizes. It offers a means to analyze uncertain systems with limited knowledge by extracting valuable information from available data. By doing so, the theory enables an accurate description of system behaviours and the underlying laws of evolution. In this context, a Black-Grey-White colour scheme is employed to represent complex systems (S. Liu, Forrest, & Yingjie, 2011). The concepts of the grey system can be visualized in Figure 1. Specifically, a grey number is a type of value where only the range is known, while the exact value remains uncertain. Such a number can be presented as an interval or a general number set, indicating the degree of information uncertainty. This section provides an overview of Grey Systems Theory and Grey Numbers, aiming to facilitate a comprehensive understanding of the model.

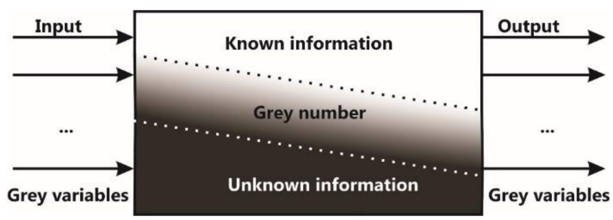


Figure 1: The concept of Grey System.

### 2.1.1 Definition of grey number

In the vast expanse of knowledge, where possibilities abound and uncertainties thrive, let us embark on a journey into the realm of grey sets. Picture a universal set, encompassing all that is known and unknown. Within this boundless domain, we encounter a captivating concept: the grey set, denoted as G. Its essence lies in two unique mappings: $\overline{\mu}_G(X)$ and $\underline{\mu}_G(X)$: $\overline{\mu}_G(X) : X \longrightarrow [0,1]$ and $\underline{\mu}_G(X)$: $X \longrightarrow [0,1]$ such that $\overline{\mu}_G(X) \geq \underline{\mu}_G(X)$, $\times \in X$. both guiding us through the shades of uncertainty. Since the lower limit $\otimes G = [\underline{G},\infty)$ and upper limit $\otimes G = (-\infty,\overline{G}]$ can be assessed, G is well-defined as an interval $\otimes G = [\underline{G},\overline{G}]$ where $\underline{G} > \overline{G}$. Let s be the evidence, $\overline{G}$ the upper, $\underline{G}$ the lower limit then $\underline{G} \leq s \leq \overline{G}$ if $\underline{G} = \overline{G}$ then $\otimes G$ is a white grey number with a real value which shows the presence of the information. Conversely, a black grey number is a type of grey number that remains veiled in mystery, withholding any knowledge or understanding about its nature. (S. Liu et al., 2012). Intriguingly, the grey set reveals its boundaries—boundaries that may be estimated but not fully ascertained.

### 2.1.2 Basic operations on Grey numbers

The arithmetic principles governing grey numbers bear resemblance to interval values, and the operational rules applied to general grey numbers can be defined in alignment with the rules governing real numbers (L. Li & X. Li, 2023; X. Li & L. Li, 2023).

Addition: $\otimes G_1 + \otimes G_2 = [\underline{G_1} + \underline{G_2}, \overline{G}_1 + \overline{G}_2]$

Subtraction: $\otimes G_1 - \otimes G_2 = [\underline{G_1} - \overline{G}_2, \overline{G}_1 - \underline{G_2}]$

Multiplication: $\otimes G_1 \times \otimes G_2 = [min(\underline{G_1}\underline{G_2}, \underline{G_1}\overline{G}_2, \overline{G}_1\underline{G_2}, \overline{G}_1\,\overline{G}_2), max(\underline{G_1}\underline{G_2}, \underline{G_1}\overline{G}_2, \overline{G}_1\underline{G_2}, \overline{G}_1\,\overline{G}_2)]$

Division: $\otimes G_1 \div \otimes G_2 = [\underline{G_1}, \overline{G}_1] \times \left[\frac{1}{\overline{G}_2}, \frac{1}{\underline{G_2}}\right]$

Length of grey number: $L(\otimes G) = [\overline{G} - \underline{G}]$

When comparing grey numbers, the degree of possibility between two grey numbers is expressed as follows: $P\{\otimes G_1 \leq \otimes G_2\} = \frac{max(0, L^* - max(0, \overline{G}_1 - \underline{G_2}))}{L^*}$

Where $L^* = L(\otimes G_1) + L(\otimes G_2)$

Based on this comparison of two grey numbers, we can identify four distinct possible outcomes:

If $\otimes G_1 = \otimes G_2$ then $P\{\otimes G_1 \leq \otimes G_2\} = 0.5$ if $P\{\otimes G_1 > \otimes G_2\}$ then $P\{\otimes G_1 \leq \otimes G_2\} = 1$

If $\otimes G_1 < \otimes G_2$ then $\{\otimes G_1 \leq \otimes G_2\} = 0$

If $P\{\otimes G_1 \leq \otimes G_2\} > 0.5$ then $\otimes G_2 > \otimes G_1$

Otherwise, if $P\{\otimes G_1 \leq \otimes G_2\} < 0.5$ then $\otimes G_2 < \otimes G_1$

## 2.2 The adapted method

In the realm of decision-making, where choices abound and factors intertwine, finding the optimal solution can be a daunting task. As decision-maker on the quest to select the most suitable alternative, a method based on Grey System Theory emerges as a guiding light. By employing a systematic approach that takes into account various criteria, this method aims to unravel the complexities and provide a clear path towards the best alternative. A great details about this method can be found in (Ali M Abdulshahed, Badi, & Blaow, 2017) .

**Step 1: Establishing Initial Weightings**

To lay the groundwork, the initial weightings for each criterion are established. These weightings act as the foundation upon which the evaluation is built. By assigning weightings to each criterion, an initial framework is established, setting the stage for a comprehensive evaluation.

**Step 2: Calculating the Relational Grade**

Next, the relational grade for each criterion is calculated, comparing it with the criterion holding the highest initial weighting. Through this process, a clearer understanding of the relative importance of each criterion is attained.

**Step 3: Obtaining the Final Weightings**

With the relational grades in hand, the final weightings are obtained. This crucial step involves normalizing the relational grades by dividing each grade by the sum of all grades. By doing so, the true significance of each criterion is revealed, enabling a fair and balanced evaluation. The final weightings provide a comprehensive view of the relative importance of each criterion and pave the way for informed decision-making.

**Step 5: Selecting the Best Alternative**

Now armed with the final weightings, the stage is set for selecting the best alternative. The sum of the final weightings for each alternative is calculated, and the results are laid bare. These alternatives embody the qualities that align most closely with the Grey System Theory evaluation.

By embracing the Grey System Theory, decision makers can embark on a journey of strategic decision-making, unveiling the most suitable alternative to enrich their decision. With its methodical approach and comprehensive evaluation, the Grey System Theory offers a beacon of clarity in a sea of options, guiding decision makers towards an informed and optimal choice.

## 3 Case study

In the realm of modern education, the integration of online conferencing and video-sharing applications has become increasingly vital, particularly for Libyan universities seeking to enhance their technology infrastructure and optimize the quality of higher education. This case study aims to address this pressing need by evaluating and selecting the most suitable applications for Libyan universities. By employing the Grey Theory and incorporating Prompt Engineering, the study introduces an innovative decision-making framework that takes into account the specific requirements of Libyan universities and the prevailing conditions in Libya.

To ensure a comprehensive and unbiased evaluation, the study engages the expertise of four professionals from different backgrounds: an expert in online learning, a university professor, a quality assurance officer, and a university president. Their insights and assessments of key evaluation criteria, including ease of use, functionality and features, compatibility and integration, security and privacy, technical support and training, cost of the program, and user experiences, form the foundation of this study. Table 1 illustrates the qualitative criteria used in supplier evaluation.

Table 1: Qualitative criteria for supplier evaluation.

| **Evaluation criteria** | **Description** | **Measuring principle** | **Criteria status** |
|---|---|---|---|
| Ease of use ($C_1$) | The program should have a user-friendly interface and well-organized tools for teachers and students. | Providing a user-friendly interface and logical organization of tools and features | Benefit - criteria |
| Functionality and features ($C_2$) | The program should offer a comprehensive set of functions, | Offering a comprehensive set of functions and features that support | Benefit - criteria |

| | | | |
|---|---|---|---|
| | such as high-quality video and audio, screen sharing, and interactive participation, to support remote learning. | remote learning | |
| Compatibility and integration ($C_3$) | The program should seamlessly integrate with other learning tools and educational platforms, ensuring compatibility across different platforms and operating systems. | Ensuring integration with other learning tools and educational management platforms used in schools | Benefit - criteria |
| Security and privacy ($C_4$) | The program should have strong security measures in place to protect user data and adhere to recognized privacy standards. | Implementing robust security measures to protect user data and comply with recognized privacy standards | Benefit - criteria |
| Technical support and training ($C_5$) | Continuous technical support and training resources should be available to assist teachers and students in effectively using the program. | Providing continuous technical support and training resources for effective program usage | Benefit - criteria |
| Cost of the program ($C_6$) | The program should fit within the school or institution's budget, with reasonable subscription or usage costs compared to the provided benefits and features. | Aligning the program's cost with the school or educational institution's available budget, considering the provided benefits and features | Cost-criteria |
| User experiences ($C_7$) | Reviews and feedback from previous users should be considered to assess the program's suitability for remote learning. | Leveraging reviews and feedback from previous users to evaluate the program's ability to meet the needs of remote learning | Benefit - criteria |

## 3.1 The model

This case study aims to assess and select the most suitable online conferencing and video-sharing applications for Libyan universities. The study utilizes the Grey Theory and incorporates Prompt Engineering to develop an innovative framework for decision-making. The framework takes into account the specific requirements of Libyan universities and the prevailing conditions in Libya. The evaluation criteria include ease of use, functionality and features, compatibility and integration, security and privacy, technical support and training, cost of the program, and user experiences. The study empowers decision makers within Libyan universities to make informed choices and optimize their technology infrastructure, ultimately enhancing higher education excellence.

To ensure a comprehensive and unbiased evaluation, the study incorporates the opinions of four experts, each with a different professional background and perspective. Expert #1, an expert in online learning, rates the effectiveness of the criteria for various online learning platforms. Expert #2, a university professor, provides insights based on their experience and expertise. Expert #3, a quality assurance officer, evaluates the criteria from a quality perspective, and Expert #4, a university president, considers the criteria in the context of the university's strategic goals. Four experts—Expert #1, Expert #2, Expert #3, and Expert #4—have been created using prompt engineering to participate in the evaluation process as follows:

Expert #1: Prompt "As an expert in the field of online learning, rate the effectiveness of the following criteria for evaluating online learning platforms: ease of use, functionality and features, compatibility and integration, security and privacy, technical support and training, cost of the program, and user experiences. Please rate these criteria based on the following programs: Zoom, Microsoft Teams, Skype, Google Meet, WhatsApp, and FaceTime. Use the rating scale: Very Low - Low - Medium Low - Medium - Medium High - High - Very High. Your first task to weight the criteria."

Expert #2: Prompt "As a university professor, rate the effectiveness of the following criteria for evaluating online learning platforms: ease of use, functionality and features, compatibility and integration, security and privacy, technical support and training, cost of the program, and user experiences. Please rate these criteria based on the following programs: Zoom, Microsoft Teams, Skype, Google Meet, WhatsApp, and FaceTime. Use the rating scale: Very Low - Low - Medium Low - Medium - Medium High - High - Very High. Your first task to weight the criteria."

Expert #3: Prompt "As a quality Assurance officer in the university, rate the effectiveness of the following criteria for evaluating online learning platforms: ease of use, functionality and features, compatibility and integration, security and privacy, technical support and training, cost of the program, and user experiences. Please rate these criteria based on the following programs: Zoom, Microsoft Teams, Skype, Google Meet, WhatsApp, and FaceTime. Use the rating scale: Very Low - Low - Medium Low - Medium - Medium High - High - Very High. Your first task to weight the criteria."

Expert #4: Prompt "As a university president, rate the effectiveness of the following criteria for evaluating online learning platforms: ease of use, functionality and features, compatibility and integration, security and privacy, technical support and training, cost of the program, and user experiences. Please rate these criteria based on the following programs: Zoom, Microsoft Teams, Skype, Google Meet, WhatsApp, and FaceTime. Use the rating scale: Very Low - Low - Medium Low - Medium - Medium High - High - Very High. Your first task to weight the criteria."

To apply the Grey System Theory to weight the evaluation criteria for online learning platforms, we will use the previous Prompt-opinion provided for each criterion. The Grey System Theory involves a series of steps, including determining the relationship between the criteria and the decision-making, establishing the initial weightings, calculating the relational grade, and obtaining the final weightings. Let's proceed with these steps:

**Step 1: Establishing Initial Weightings**

Using the weightings provided in the previous prompt responses, Table 2 illustrate the initial weightings for each criterion:

Table 2: The initial weightings for each criterion.

| Criteria | Initial Weighting |
|---|---|
| Ease of Use | Medium |
| Functionality and Features | High |
| Compatibility and Integration | Medium High |
| Security and Privacy | Very High |
| Technical Support and Training | High |
| Cost of the Program | Medium |
| User Experiences | High |

**Step 2: Calculating the Relational Grade**

In this step, we calculate the relational grade for each criterion by comparing it with the highest initial weighting (see Table 3):

Table 3: The relational grade for each criterion.

| Criteria | Initial Weighting | Relational Grade |
|---|---|---|
| Ease of Use | Medium | 0.571 |
| Functionality and Features | High | 1.000 |
| Compatibility and Integration | Medium High | 0.857 |
| Security and Privacy | Very High | 1.000 |
| Technical Support and Training | High | 1.000 |
| Cost of the Program | Medium | 0.714 |
| User Experiences | High | 1.000 |

To calculate the relational grade, we divide the initial weighting of each criterion by the highest initial weighting, which is 1.000 for "Functionality and Features," "Security and Privacy," "Technical Support and Training," and "User Experiences."

**Step 3: Obtaining the Final Weightings**

To obtain the final weightings, we need to normalize the relational grades by dividing each grade by the sum of all grades (see Table 4):

Table 4: The final weightings.

| Criteria | Initial Weighting | Relational Grade | Normalized Weighting |
|---|---|---|---|
| Ease of Use | Medium | 0.571 | 0.123 |
| Functionality and Features | High | 1.000 | 0.216 |
| Compatibility and Integration | Medium High | 0.857 | 0.185 |
| Security and Privacy | Very High | 1.000 | 0.216 |
| Technical Support and Training | High | 1.000 | 0.216 |
| Cost of the Program | Medium | 0.714 | 0.154 |
| User Experiences | High | 1.000 | 0.216 |

The normalized weighting is obtained by dividing each relational grade by the sum of all relational grades.

**Step 5: Selecting the Best Software**

To select the best software based on the final weightings, we need to compare the sum of the final weightings for each software (see Table 5):

Table 5: Selecting the Best Software.

| Software | Sum of Final Weightings |
|---|---|
| Zoom | 1.106 |
| Microsoft Teams | 1.200 |
| Skype | 0.588 |
| Google Meet | 1.200 |
| WhatsApp | 0.769 |
| FaceTime | 0.924 |

Based on the sum of the final weightings, both Microsoft Teams and Google Meet have the highest score of 1.200. Therefore, Microsoft Teams and Google Meet are the best software options according to the Grey System Theory in this evaluation.

It is worth mentioned that the Grey System Theory is just one approach to decision-making, and the final choice of the online learning platform should also consider other factors specific to the university's requirements, infrastructure, and user preferences.

## 4 Discussion.

In this work, the author conducted a case study to evaluate and select suitable online conferencing and video-sharing applications for Libyan universities. They employed the Grey Theory and incorporated Prompt Engineering to develop a decision-making framework tailored to the specific requirements and conditions in Libya.

The evaluation criteria used in the study encompassed ease of use, functionality and features, compatibility and integration, security and privacy, technical support and training, cost of the program, and user experiences. These criteria were rated by four experts, each with a different professional background and perspective: an expert in online learning, a university professor, a quality assurance officer, and a university president. The experts were tasked with rating the effectiveness of the criteria for various online learning platforms, including Zoom, Microsoft Teams, Skype, Google Meet, WhatsApp, and FaceTime.

The Grey System Theory was applied to weight the evaluation criteria, employing the initial weightings provided by the experts. The initial weightings for each criterion were established based on the experts' ratings. Subsequently, the relational grade was calculated for each criterion by comparing it with the highest initial weighting. The relational grade represents the relative importance of each criterion in relation to the highest-rated criterion.

To obtain the final weightings, the relational grades were normalized by dividing each grade by the sum of all grades. The final weightings represent the relative importance of each criterion in the overall evaluation. The software options were then compared based on the sum of the final weightings to determine the best options according to the Grey System Theory.

Based on the evaluation results, Microsoft Teams and Google Meet emerged as the top choices with the highest sum of final weightings (1.200). This indicates that these two platforms are considered the most suitable options for Libyan universities according to the evaluation criteria and the Grey System Theory approach.

However, it is important to note that the Grey System Theory is just one approach to decision-making, and other factors specific to the university's requirements, infrastructure, and user preferences should also be considered when selecting an online learning platform. The authors highlight the need to consider a holistic approach and incorporate additional factors into the decision-making process.

Finally, this case study provides valuable insights into the evaluation and selection of online conferencing and video-sharing applications for Libyan universities. By utilizing the Grey Theory and Prompt Engineering, the study offers a framework that empowers decision makers within Libyan universities to make informed choices and optimize their technology infrastructure, ultimately enhancing the quality of higher education.

## 5 Conclusion

In conclusion, this work presents a comprehensive case study that evaluates and selects suitable online conferencing and video-sharing applications for Libyan universities. The study's aim is to empower decision makers within Libyan universities to make informed choices and optimize their technology infrastructure, ultimately enhancing the quality of higher education. By utilizing the Grey System Theory and incorporating Prompt Engineering, the study provides a systematic framework tailored to the unique requirements and conditions in Libya.

The findings of this study contribute valuable insights into the evaluation and selection process of online conferencing and video-sharing applications for Libyan universities. By employing the Grey System Theory and Prompt Engineering, decision makers are provided with a practical framework that enhances their ability to make informed choices, considering the specific needs and conditions of Libyan universities.

Looking ahead, it is recommended to adopt a holistic approach that incorporates a broader range of factors and perspectives. Pedagogical requirements, technical capabilities, scalability, and long-term sustainability should be taken into account. Ongoing monitoring and evaluation of the selected platforms will also be crucial to address evolving needs and challenges.

**Acknowledgment**

We did not receive any financial support to complete this work. We have used ChatGPT 3.5 to generate prompts for this article.

## Ethics Statement

This research study does not involve studies on human subjects, human data or tissue, or animals. Therefore, ethical approval was not required for this investigation.

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