Journal of Accounting and Business Studies Vol. 7, No. 2, September 2022
p-ISSN # 2540-8275
e-ISSN # 2808-4705 Hal. 1-25

Correspondence Analysis of Mobile Phone Usage in a University

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ABSTRACT

This study aims to identify the preference patterns for mobile phone usage in a university, in terms of use cases, social media, and messaging applications, as well as to visually demonstrate differences in usage patterns by the lecturer/staff sub-segment from the student sub-segment using the Correspondence Analysis method. The results of the study show that the highest utilization of mobile phones is for communication, online learning, and social media. Meanwhile, the preferred social media applications are Instagram, TikTok, followed by Facebook. In addition, the three most widely used messaging applications are WhatsApp, Line, and email. This research also shows that there are differences in usage patterns between lecturers/staff and students both in terms of use cases, social media applications, and messaging applications. From a theoretical standpoint, this study shows that Correspondence Analysis has the advantage of easy to understand visualization of the relationship between variables, but also has a weakness in terms of potentially misleading interpretations, when not compared to some other visualization/analytical methods. Practically, the results of this research can be utilized by telecommunications operators and application developers for product development, as well as by digital marketers in selecting the most appropriate type of channel for the higher education segment.

Keywords: Correspondence Analysis, Dimension Reduction, Mobile Phone Usage, Social Media Applications, Messaging Applications

ABSTRAK

Studi ini bertujuan untuk mengidentifikasi pola preferensi penggunaan mobile phone khususnya use cases, media sosial, dan messaging application dalam sebuah perguruan tinggi, serta mendemonstrasikan secara visual perbedaan pola penggunaan oleh sub-segmen dosen/staff dari sub-segmen mahasiswa menggunakan metode Correspondence Analysis. Hasil penelitian menunjukkan bahwa pemanfaatan mobile phone tertinggi adalah untuk komunikasi, pembelajaran daring, dan media sosial. Sedangkan preferensi media sosial secara berurutan adalah Instagram, TikTok, dan diikuti oleh Facebook. Selain itu, tiga messaging application yang paling banyak dimanfaatkan adalah WhatsApp, Line, dan email. Penelitian ini juga menunjukkan bahwa terdapat perbedaan pola penggunaan di antara dosen/staff dengan mahasiswa baik dalam hal use case,

aplikasi media sosial, maupun messaging application. Dari sisi teoretis, penelitian ini menunjukkan bahwa Correspondence Analysis memiliki keunggulan dalam hal visualisasi relasi antar variabel yang relatif mudah dicerna, namun juga memiliki kelemahan dalam hal interpretasi yang berpotensi misleading, bila tidak dibandingkan dengan beberapa metode visualisasi/analisis lainnya. Secara praktikal, hasil penelitian ini dapat dimanfaatkan oleh operator telekomunikasi dan application developer untuk pengembangan produk, serta oleh digital marketer dalam memilih jenis channel yang paling sesuai untuk segmen perguruan tinggi.

INTRODUCTION

The presence of mobile phones has a significant effect on consumer lifestyles because it changes the way humans work, live and learn (Hamka, et al., 2014). This happens because mobile phones now have various functions that enable communication, social networking, multimedia entertainment, mobile commerce, mobile banking, photography, and many others. Of the 10 smartphone functions, De Canio, Pellegrini, and Muneta (2016) found 5 main user profiles: utility users, gamers, unfriendly users, moderator users, and super smartphones.

The development of information and communication technology has also led to the emergence of many new features and applications that have the potential to change user behavior dynamically. A use case and application can quickly become popular or be abandoned by users due to the emergence of new alternatives that are better to meet their needs. Users also have different adaptation abilities, so they have different preferences for using mobile phones.

One of the ways to answer the various needs of various users is segmentation, both demographically and psychographically, and usage patterns (behaviors). With segmentation, manufacturers can define specific and relatively unique (homogeneous) needs within a certain group of consumers, which are different (heterogeneous) from other segments. One of the demographic segments of mobile phone users is the higher education community, i.e. lecturers/staff and students.

Recent studies have not been found to provide sufficient information on the top use cases of mobile phones, especially in a higher-education setting. This research is a descriptive study to depict the behavioral patterns of the tertiary market segment, in terms of use cases, social media, and messaging applications. By understanding the behavior of this segment, mobile phone manufacturers, application developers, and cellular service operators can develop products that suit the needs of each sub-segment in the tertiary institution.

THEORETICAL FRAMEWORK AND HYPOTHESES

The concept of segmentation was introduced by Smith (1956). Heterogeneous markets need to be broken down into several small markets that are

p-ISSN # 2540-8275
e-ISSN # 2808-4705 Hal. 1-25

more homogeneous, so that producers can meet the needs and provide better satisfaction for the different desires of consumers. Smith emphasized the importance of homogeneity within groups, differences between groups, and reactions (similar responses to a marketing strategy, product, or service within a group).

There are 4 common segmentation methods (Kotler, 2012): geographic, demographic, psychographic, and behavioral. The college segment can be categorized as a demographic segment. Even though a college or university can be defined as one segment, there could be several subsegments in it that may have different behavioral patterns.

This study will examine differences in preferences for the use of mobile phones by two sub-segments in a higher education institution: lecturers/staff and students. The preferences for mobile phone use behavior that will be studied include use cases, social media applications, and messaging applications.

Use Cases

Most research in the mobile phone industry takes a behavioral perspective (Hamka, et al., 2014). One of the methods to obtain behavioral data is by self-report (Uronen, 2008; Jansen, 2007; Falaki, et al., 2010; and Sohn and Kim 2008). In addition, there is also an analysis of user behavior using data from call details collected from cellular operators.

Furthermore, most of the existing segmentation analyses study the use of mobile services in general, and only a few use detailed analysis per type of service that users want. Hamka and Bowman (2014) found that mobile user segments can actually be divided based on network usage (voice, SMS, and data) and service usage (such as URLs and applications). Division of a segment into such broad services might not be sufficient to help operators, application developers, or digital marketers in meeting the specific needs of mobile phone users.

Relevant segmentation variables will largely depend on the point of view of the actors who make use of the research results. By understanding the top use cases, mobile operators can ensure the most suitable product package (bundling). Seth, et al. (2008) found that responsiveness, reliability, network quality, convenience, and empathy are the most important dimensions for mobile phone users. By understanding the top use cases, cellular operators can design products (services) that are more in line with the specific needs of lecturers, staff, and students in the higher education segment.

This research will identify the most important mobile phone use cases for the academic community segment, both in terms of students and lecturers/staff of institutions. Use cases will be divided into 8 groups, namely: communication (verbal and text), online lectures, social media, entertainment (video/music player),

mobile banking, e-commerce, games, and cameras.

Research Question (RQ) 1: What are the top priorities of mobile phone usage by the university segment? Are there differences in the priority of mobile phone usage between lecturers/staff and students?

Social Media Apps

Social media is generally defined as an "Internet-based persistent communication channel for mass-personal that enables interaction between users, who derive value primarily from user-generated content" (Carr and Hayes, 2015, p. 49). Since the success of Facebook, which was founded in 2004, various other social media applications have emerged. Some applications that are gaining market share aggressively, include Twitter (2006), Instagram which is very popular in the segment 18-29 years old, Snapchat, TikTok, Linked In, and others, each with unique features.

According to the User and Gratifications (U&G) theory (Blumer and Khats, 1974), the preference for the choice of social media that a person uses will be determined by the motivation for using it. Whiting and Williams (2013) found 10 motivations for using social media: social interaction, seeking information, spending time, entertainment, relaxation, communication, comfort, expression of opinion, sharing information, and social surveillance. New applications have been developed to better meet these needs.

As a result of the emergence of various social media applications, the competition between applications has become very tight. Although Twitter was once very popular, newer social media such as Instagram and Snapchat are gaining the market rapidly (Stanley, 2015). Facebook remains popular among young adults but has been abandoned by teenagers migrating to Instagram and Snapchat (Duncan, 2016; Lang, 2015; Matthews, 2014). Jung and Sundar (2016) found that senior citizens (especially over 60 years) use social media, especially Facebook for social bonds, social bridges, and curiosity, as a means of responding to family. Studies by Alhabash and Ma (2017) and Stanley (2015) show that the most popular social media are Instagram and Snapchat, followed by Facebook and Twitter.

The dynamic nature of the trend in social media applications requires digital marketers to understand which media (applications) are most relevant to their target market. This research will identify which social media usage preference among users in university.

Research Question (RQ) 2: Which social media is the top choice of users in university? Does the lecturer/staff sub-segment have different social media preferences than the student sub-segment?

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Messaging Application

In accordance with its main function, mobile phones are used mainly for verbal and written communication. Versatile application such as WhatsApp not only dominates messaging applications but also dominates the use of mobile phones as a whole (Montag, et al., 2015). Montag found that 19.83% of mobile phone time was spent on WhatsApp (32.11 minutes per day), compared to Facebook's 9.38% (15.19 minutes). Other messaging alternatives include Line, SMS, and email, each with different features, advantages, and popularity among different user segments.

For example, Unuth (2020) found that applications such as Line can compete with WhatsApp because it has the advantages of video and voice calling quality, and allow users to call telephone numbers that do not use these applications at low costs.

By understanding the usage patterns of messaging applications, digital marketers can use the right media to communicate with the target market at the university segment, i.e. both lecturers/staff and students. This study will compare several messaging applications that are currently popular, namely: WhatsApp, Line, Telegram, e-mail, Facebook Direct Message (FB DM), and Short Messaging Service (SMS).

Research Question (RQ) 3: Which messaging application is the top choice of college users? Does the lecturer/staff sub-segment have a different preference for messaging application from the student sub-segment?

Correspondence Analysis

To show the relationship (association, relationship, correlation) between two or more categorical variables (e.g top use case variables and user sub segment variables), Bendixen (2003) identified four ways that can be used, as described below:

1. **Contingency Table (cross-tab)**. Frequency data for various levels of attributes (categorical variables) are presented in rows and columns. This method of presenting data is the simplest and most frequently used (Hoffman and Franke, 1986). This table produces information that is quite easy to interpret when the number of rows and columns is small, but becomes very difficult to interpret when the size of the table gets larger.

2. **Chi-square test of independence**. This statistical test shows whether the rows and columns in a contingency table are independent. The value of chi (χ) in a cell contained in a certain row and column in a contingency table, is the difference between the observed frequency and the expected frequency (the value that should be obtained if the row and column variables are truly independent). The greater the value of χ, it means that the higher the deviation from the expected value and the stronger the association between the level

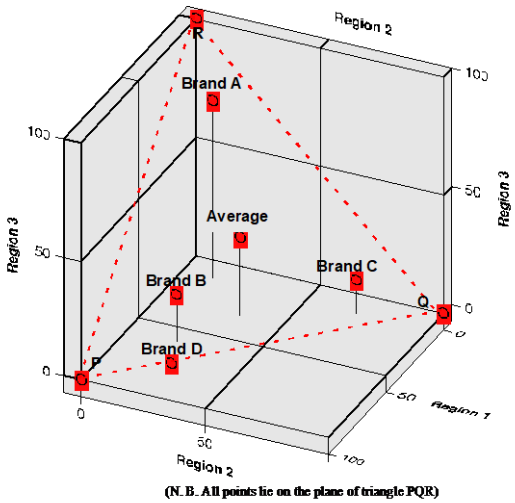
attributes of the row and column (the less independent). If the total χ^2 of all cells in the table is greater than the critical value χ^2 for a significance of 5% with (r-1) (c-1) degrees of freedom (r = number of rows, c = number of columns), then we can conclude that the rows and columns in the contingency table have a significant association.

3. **Graphical Representation**. Contingency tables with low dimensions can be presented easily in 2-dimensional (2D) plots. Data in tables with three rows (or columns), can also be represented in 3D maps. For example, if we have sales data for 4 Brands (A, B, C, D) in 3 Regions (1, 2, 3), then we have a contingency table measuring 4 rows (Brand) x 3 columns (Region). Sales data A, B, C, D in each region can be plotted on a 3D map using sales data for each Region (1, 2, 3) as coordinate points on the axes. This means that point A has the coordinates [x, y, z] that represent [Brand A sales in Region 1, Brand A sales in Region 2, and Brand A sales in Region 3]. Similarly, we can use such representation from other brands.

Furthermore, if we calculate the percentage of Brand A sales in a Region compared to the total sales of Brand A in all Regions, we know that the total sales of Brand A in all Regions will always be 100%. A sales percentage table where the total for each row is 100% is called a row profile. The same row profiles can be constructed for the other three Brands.

When we plot the abovementioned points in a 3D map with Region 1, Region 2, and Region 3 as the axes, the four Brands A, B, C, D will be in the same plane because $A_{R1} + A_{R2} + A_{R3} = 100\%$, $B_{R1} + B_{R2} + B_{R3} = 100\%$, and so on for Brand C dan D, as depicted in Figure 1.

Figure 1. **3D-Plot Example of a Contingency Table**



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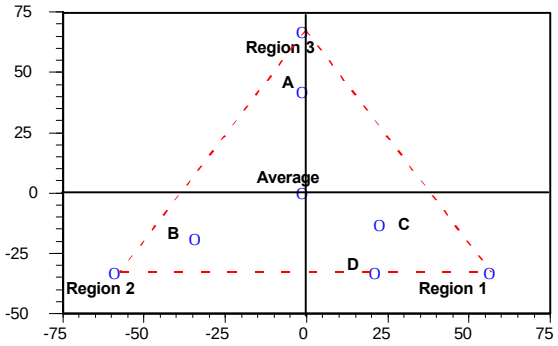
Then we can simplify the 3D plot into a perfect 2D map by shifting the origin and changing the point of view, without losing any information or data variation because every point is situated in the same plane, as shown in Figure 2.

4. **Correspondence Analysis (CA).** We can show that a contingency table that has 3 dimensions (3 columns) can be perfectly represented using a 2D plot as demonstrated in Figure 1 and Figure 2. In general, it can be shown that if a contingency table has *n* columns (or columns), then a perfect representation can be obtained in a map that has *n-1* dimensions (Bendixen, 2003). Of course, the transformation of a table into graphical form as exemplified above can only be done if the maximum number of rows or columns in the contingency table is 3.

CA is a data analysis technique that can be used to present the information contained in the rows and columns of a contingency table simultaneously into a low-dimensional graph (usually 2D), so that it is easier to interpret. With the CA method, we can reduce the number of dimensions in the data into 3 and even 2 dimensions by minimizing the missing details (variations) of the data. In order to determine the best two axes to use in a 2D map (which are called principal axis 1 and principal axis 2), CA uses the Singular Value Decomposition (SVD) method, as is the case with the dimension reduction method known as the Principal Component Analysis (PCA).

CA can be used for non-linear relationships and does not make any assumptions about the data distribution. CA is an exploratory method and is not appropriate for testing hypotheses because there are no hypotheses developed in this method of data presentation.

Figure 2. 2D-Plot Example of a Contingency Table



Quality of Data Representation in CA

To assess how well the final CA plot represents the initial data in the contingency table, we use the same metric as in other dimension reduction (PCA) methods, namely the eigenvalue. The eigenvalue (square of the singular value) of a

principal axis (axis) shows how much variation in the data is represented by that dimension (axis). The percentage of the eigenvalues of an axis to trace (the total eigenvalues of all principal axes) is called the inertia, and represents the number of chi-squares (χ^2) (i.e. the deviation from independence) represented by that axis. The higher the total inertia in the final plot (axis 1 and 2 in the 2-dimensional map), the better the plot describes the variation contained in the original data.

For example, with CA we can reduce the information in a 15x15 contingency table, to a 15x2 matrix (15 rows of data with 2 principal axes) by losing some of the details of the data variations. If the total inertia of the two axes (principal axis) reaches 75%, it means that we lose only 25% of detail (χ^2). In other words, the resulting data plot has a retention of 75%.

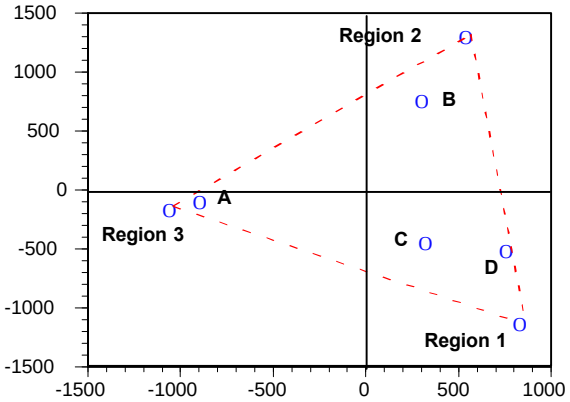
CA Data Plot Types

In the CA method, there are two types of the data plot:

a. **Symmetric plot** or French plot (row profile and column profile are both plotted using principal coordinates). The distance between the column points shows the similarity of the data in rows or columns. However, the distance between a row point and a column point cannot be interpreted easily.

b. **Asymmetric plot**. In this plot, the peak points (apices) of the row (or column) are plotted using standard coordinates, while the profile of the column (or row) is plotted using principle coordinates. Figure 3 is an example of an asymmetric plot generated by CA from the same data used in Figure 2, where the vertices of each axis are plotted using standard coordinates and depicting column Region 1, Region 2, Region 3, while the row profile (sales of each brand) is plotted using principle coordinates (using the principal axis). Apart from the orientation change, all distances between points are maintained in the asymmetric plot (see Figure 3).

Figure 3.
The Asymmetric Plot of Row Profiles and Column Vertices (Column Corner Points).



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e-ISSN # 2808-4705 Hal. 1-25

Interpretation of Data Plot in CA

To interpret a symmetric plot, we need to be careful because the distance between two points does not always show similarity or association (Bock, 2020). Below are some important things to note in interpretation:

a. The closer a row point is to another row point, the more similar the two-row points are. Likewise, the closer one column point is to the other column point, the more similar the two column points are.

b. The proximity between a row label point and a column point cannot be interpreted as a strong association between the row point and column point.

c. The further a row label or a column label is from the origin, the more discriminating the point is. Conversely, the closer a label to the origin, the smaller its difference from other row or column labels.

d. The strength of the association of a row point and column point can be perceived from the dot product of the two coordinates of the row point and column point, or from the multiplication of the row point vector from the origin and the column point vector from the origin. The product of the two vectors = (the length of the line between the point of the row and the origin) x (the length of the line between the point of the column and the origin) x the cosine of the angle between the two lines (vectors).

e. A narrow angle between the row point vector and the column point vector shows a stronger association than a wide angle. An angle of 90° indicates no association between row points and column points. A wide angle (90-180 degrees) shows a negative association between both row points and column points.

RESEARCH METHOD

Data collection was carried out by sending electronic questionnaires to two groups of the academic community of a private university in Indonesia. The first group consists of lecturers/staff and the second group of students. Out of a total of around 1,600 active students and 150 lecturers/staff at the college, 1,300 people received invitations to participate via the institution's official email. A total of 591 invitees (60 staff and lecturers, 531 students) responded, resulting in an overall response rate of 45%. This response rate is better than the average response rate for online surveys that are frequently cited, which is 33% (Lindemann, 2019).

Mobile phone usage ratings were conducted through self-reports. Each respondent was asked to answer the following three questions:

a. Mobile phone preference from the first to the fifth rank, for the following eight use cases: communication, online lectures, social media, entertainment, mobile banking, e-commerce, games, or cameras.

b. Social media preference from the first to the third rank, for the following options: Instagram, Facebook, TikTok, Linked In, and others.

c. Messaging application preference from the first to the third rank, for the following options: Whatsapp, Line, e-mail, FB-DM, SMS.

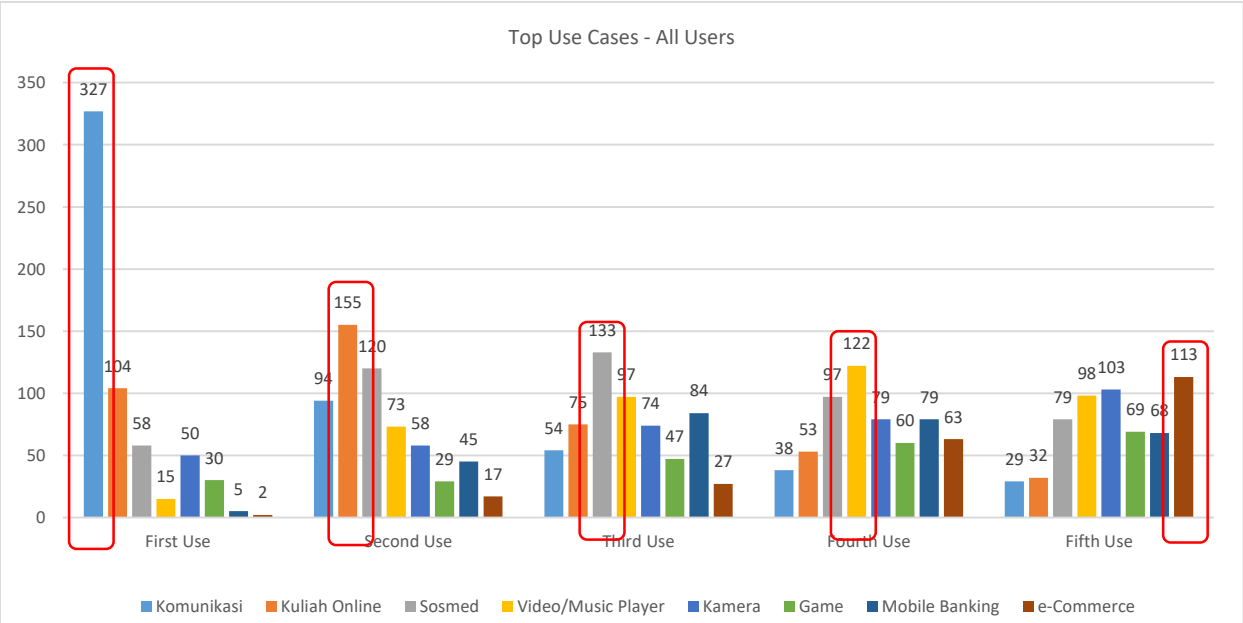
The collected data is filtered for completeness, compiled in a contingency table, and then presented in the form of a bar chart to provide a preliminary indication of the association between the usage ratings of each segment and each use case and application. Data in the contingency table were then analyzed using one of the data reduction methods available in SPSS software version 25.0, i.e. Correspondence Analysis. The data is then presented in a 2D graph using the Chi Square model parameters and the Symmetric Normalization plot parameters. The 2D plot results are then interpreted using the cross product principle between row and column point coordinates as suggested by Bock (2020).

DATA ANALYSIS AND DISCUSSION

1. Top Mobile Phone Use Cases

The results of this study indicate that the top 5 mobile phone use cases in the university (by lecturers/staff and students) in order of importance are as follows (1) communication (voice and text), (2) lectures, (3) social media, (4) entertainment (video/music player), and (5) e-commerce (see Figure 4).

Figure 4. Mobile Phone Top Use Cases for All Users



Mobile Phone Usage by Lecturer/Staff

The top use case data for the 60 university lecturers/staff who participated in this study are presented in the contingency table (Table 1). The data is also presented in the form of a bar chart (Figure 4), shows that the primary use of mobile phones among lecturers/staff is for communication in the form of voice or text (41 respondents). Next, the second use is for social media (17 respondents), the third use is still for social media (13 respondents) followed by m-banking (12 respondents), fourth use: social media (16 respondents) followed by entertainment (10 respondents), and fifth use is for e-commerce (20 respondents).

The fact that online lectures (teaching) are not included in the top 5 mobile phone use cases among lecturers/staff is not surprising because they tend to use laptops or PCs to teach online. Thus it can be concluded that the top use cases by lecturers/staff are as follows: (1) communication, (2) social media, (3) mobile banking, (4) entertainment, and (5) e-commerce. The data is also represented in the form of a bar chart in Figure 5.

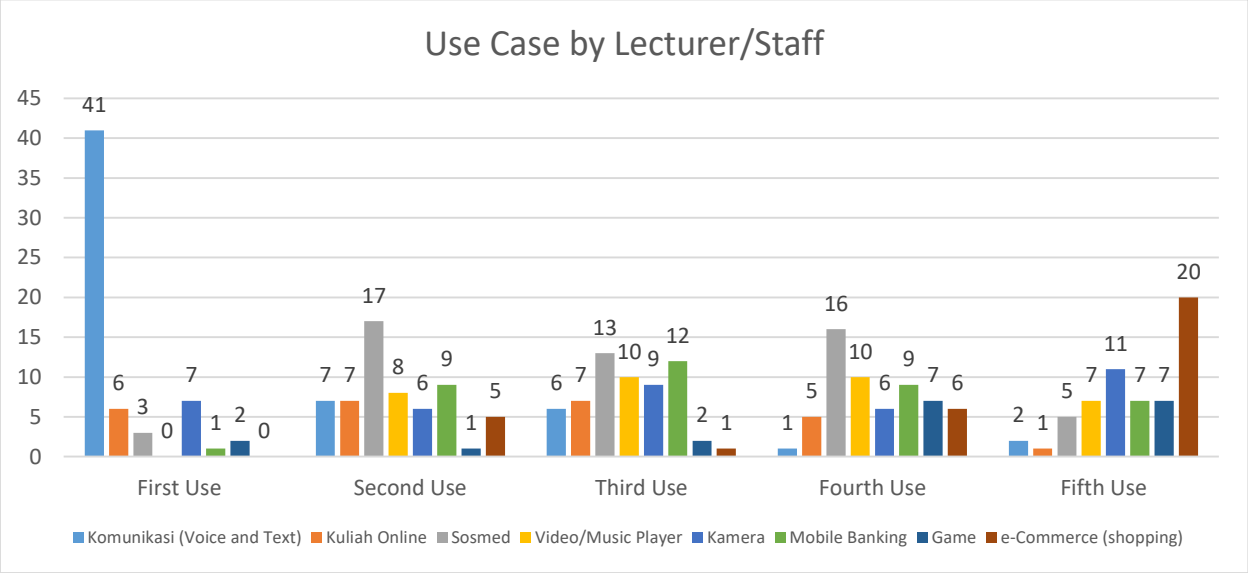
Next, correspondence analysis was carried out with the following results:

The value of $c^2 = 188.7$ with significance $p = 0.000$ (degree of freedom 28), indicates that there is strong association between Rating and Use Case among lecturers/staff. The results of the CA plot are shown in Figure 6. The inertia level of Dimension 1 is 70.8% and Dimension 2 is 25.0% so that the total retention reaches 95.8% which indicates that the quality of the representation plot compared to the initial data is very good.

Table 1. **Use Case Contingency Table by Lecturers/Staff**

	e-Commerce	**Game**	**Camera**	**Commu-nication**	**Online Course**	**m-Banking**	**Sosial Media**	**Entertainment**
Staff 1st	0	2	7	41	6	1	3	0
Staff 2nd	5	1	6	7	7	9	17	8
Staff 3rd	1	2	9	6	7	12	13	10
Staff 4th	6	7	6	1	5	9	16	10
Staff 5th	20	7	11	2	1	7	5	7
TOTAL	**32**	**19**	**39**	**57**	**26**	**38**	**54**	**35**

Figure 5. **Mobile Phone Top Use Cases by Lecturers/Staff**



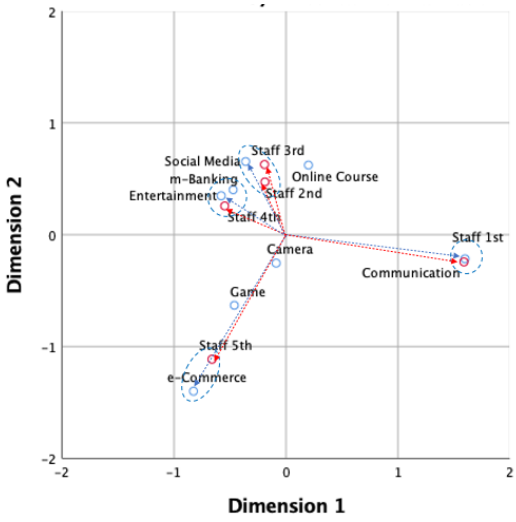
The visual inspection of CA results show that:

- The strongest relationship (association) is between the first use case–communication, and fifth e-commerce relationship. The two pairs of row and column points have the farthest distance from the origin and the narrowest angle between the two vectors.

- The weaker relationships can be seen between the 2nd (and 3rd use cases) with social media, as well between the 4th use case with entertainment and m-banking.

The CA interpretation results above generally are in accordance with the information obtained in the bar chart (Figure 5) and the contingency table (Table 1).

Figure 6. CA Row and Column Points Symmetrical Normalization For Mobile Phones Top Use Cases For Lecturers/Staff



Mobile Phone Usage by Students

Data from 531 university students who participated in this survey are presented in a contingency table (Table 2) and a bar chart (Figure 7). It appears that the main use of mobile phones is for communication (286 respondents). Next is for online lectures (148 respondents), third is for social media (120 respondents), fourth is for entertainment (112 respondents), and fifth is for e-commerce (93 respondents).

Next, correspondence analysis was carried out with the following results:

The value of $c^2 = 949.7$ and the significance of $p = 0.000$ (degree of freedom 28), demonstrates a strong association between Choice Rating and Use Cases for students. The CA plot results are shown in Figure 8. The inertia level of Dimension 1 is 80.3% and Dimension 2 is 15.8% so that the total retention reaches 96.2% which gives an indication that the quality of the representation plot compared to the initial data is very good (better than 95.8% for lecturers).

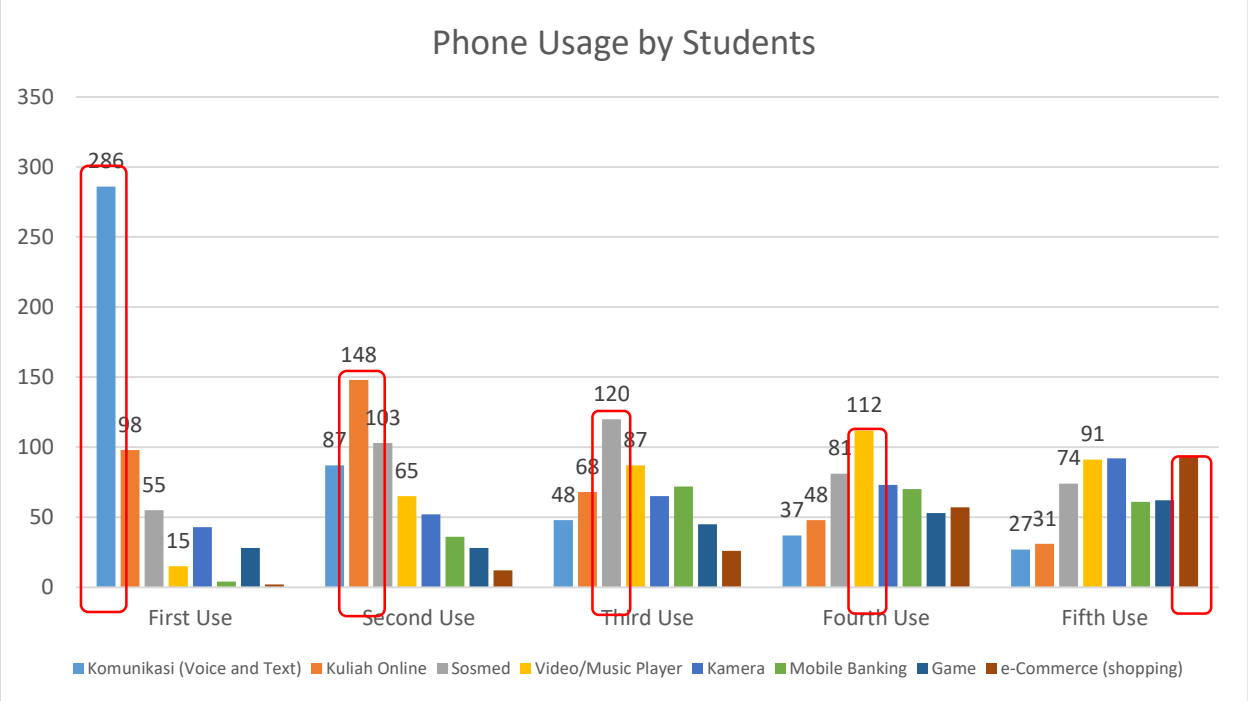
CA results can show visually that:

- The students' first priority is communication, the 2nd priority is online lectures, and the 5th priority is e-commerce. The three relationships have a very strong association (farthest distance from the origin, narrow angle between the two vectors).
- The 3rd priority for students is social media while the 4th is entertainment.
- Other observations, the patterns obtained for priorities 2 and 3 for students are more definitive (clearly separated) than the patterns for lecturer/staff.

Tabel 2. Contingency Table Phone Usage by Students

	e-Commerce	Game	Camera	Commu-nication	Online Course	m-Banking	Social Media	Entertainment
Student 1st	2	28	43	286	98	4	55	15
Student 2nd	12	28	52	87	148	36	103	65
Student 3rd	26	45	65	48	68	72	120	87
Student 4th	57	53	73	37	48	70	81	112
Student 5th	93	62	92	27	31	61	74	91

Figure 7. Mobile Phone Top Use Cases for Students



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- The 3rd priority for students is social media while the 4th is entertainment.
- Other observations, the patterns obtained for priorities 2 and 3 for students are more definitive (clearly separated) than the patterns for lecturer/staff.

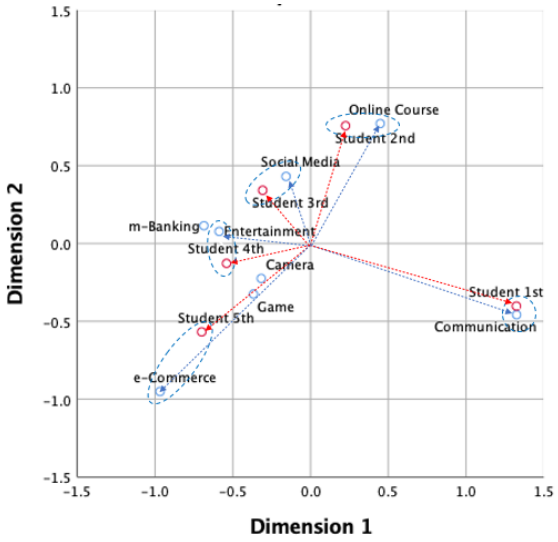
Difference between Lecturer/Staff and Students

The comparison in Table 3 shows that m-banking is one of the main use cases for lecturers/staff, but not for students. Gaming and camera functions are not within the top 5 use cases for both lecturers/staff and students.

2. Social Media Application

The data obtained for social media applications for both lecturers/staff and students are presented in Table 4 and Figure 8. Overall (lecturers/staff and students) the survey results show that the first application u sed for social media is Instagram (445 respondents), the second application is TikTok (125 respondents), and the third application is Facebook (101 respondents).

Figure 8. CA Row and Column Points Symmetrical Normalization for Mobile Phone Top Use Cases for Students



Differences in Social Media Preferences between Lecturers/Staff and Students

CA results also show that the top three social media applications for lecturers/staff and students have differences, as shown in Figure 9 and Figure 10. CA for both lecturers/staff and for students results in 100% retention because the contingency tables for the two segments have only three 3 rows (priority 1, 2, 3). As explained above, *n* dimensional data can be presented perfectly (100%) in *n-1* dimensional plots (3D data becomes 2D plots).

The value c^2 for lecturers/staff is 78.43 with a significance of p = 0.000

(degree of freedom = 8), while for students it is 597.99 with a significance of p = 0.000 (degree of freedom = 8). In other words, **priority ratings** (both by lecturers/staff and students) have a strong association with the choice of social media application.

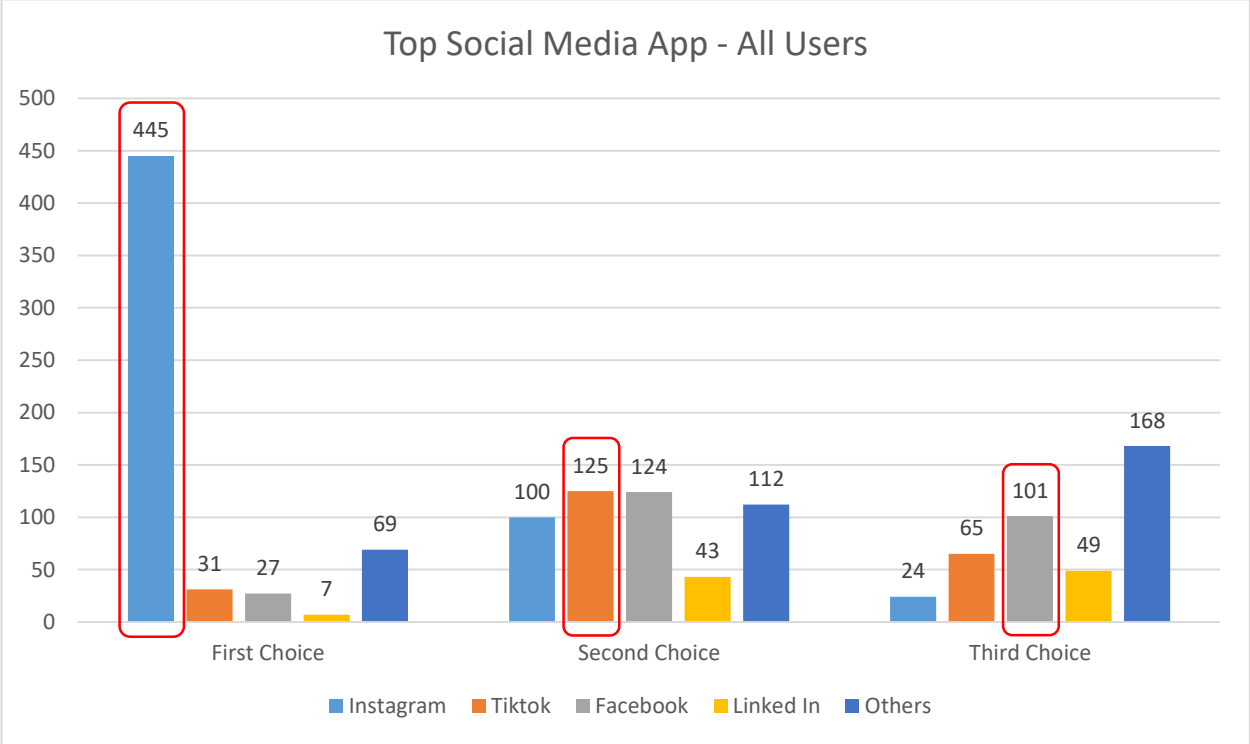
Table 3. Comparison of Usage Patterns of Lecturers/Staff and Students

	Lecturer/Staff	Students
First Use	Communication	Communication
Second Use	Social Media	Online Lecture
Third Use	Social Media, Mobile Banking	Social Media
Fourth Use	Social Media, Entertainment	Entertainment
Fifth Use	E-commerce	E-commerce

Table 4. Contingency Table for Social Media

	Instagram	TikTok	Facebook	Linked In	Others
Staff 1st	48	2	5	0	5
Staff 2nd	10	7	19	7	8
Staff 3rd	1	5	8	5	15
Student 1st	397	29	22	7	64
Student 2nd	90	118	105	36	104
Student 3rd	23	60	93	44	153

Figure 9. Top Social Media for University Lecturers/Staff and Students

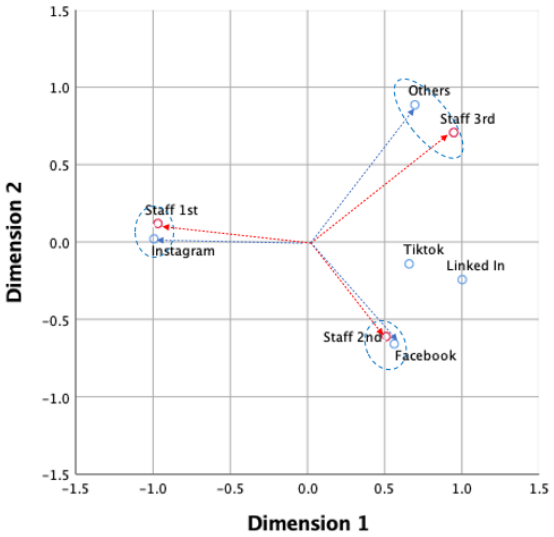


Secondly, the symmetric plots show that the first choice of lecturers/staff and students is Instagram. The second choice for lecturers/staff is Facebook, while for students it is TikTok.

Lecturers/staff do not have a tendency to use TikTok and LinkedIn, while students have a tendency to use LinkedIn. This result can be explained because students at this university are encouraged to use a LinkedIn account for their career development.

In general, plot results for both lecturers/staff and students are consistent with the pattern in the contingency table (Table 4) and the overall bar chart (Figure 9). The results of the CA plot (Figure 10 and Figure 11) for social media applications show a clearer (definitive) grouping of options 1, 2, and 3 than the plots in the previous mobile phone use cases.

Figure 10. Symmetric Normalization Social Media for Lecturer/Staff



3. Messaging Application

The contingency table (Table 5) and Figure 12 show that the top 3 messaging applications based on preference ranking are as follows: WhatsApp as the first preference (353 respondents), Line as the second (243 respondents), and e-mail as the third (320 respondents).

Next, Correspondence Analysis was carried out for the lecturer/staff and student segments. The value c^2 for lecturers/staff is 106.88 with significance p = 0.000 (degree of freedom = 10), while for students the c^2 is 922.8, and the significance p = 0.000 (degree of freedom = 10). This means that the priority rating for messaging application has a strong association with the choice of messaging application for both lecturers/staff and students. The 2D plots of CA are presented in Figure 13 and Figure 14.

Figure 11. **Symmetric Normalization of Social Media for Students**

p-ISSN # 2540-8275
e-ISSN # 2808-4705 Hal. 1-25

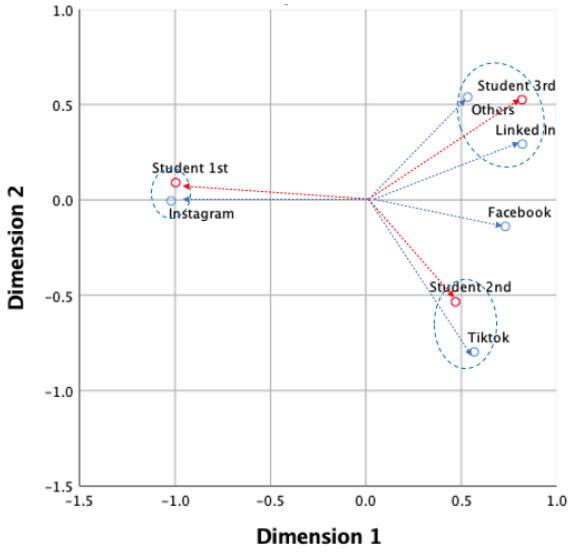


Table 5. Contingency Table for The Messaging Application

	WhatsApp	Line	e-mail	Telegram	FB DM	SMS
Staff 1st	48	12	0	0	0	0
Staff 2nd	12	17	21	5	1	1
Staff 3rd	0	9	18	3	5	8
Student 1st	305	213	8	1	1	2
Student 2nd	203	226	68	14	6	1
Student 3rd	16	47	302	50	23	36

Figure 12. Top Messaging Application in University

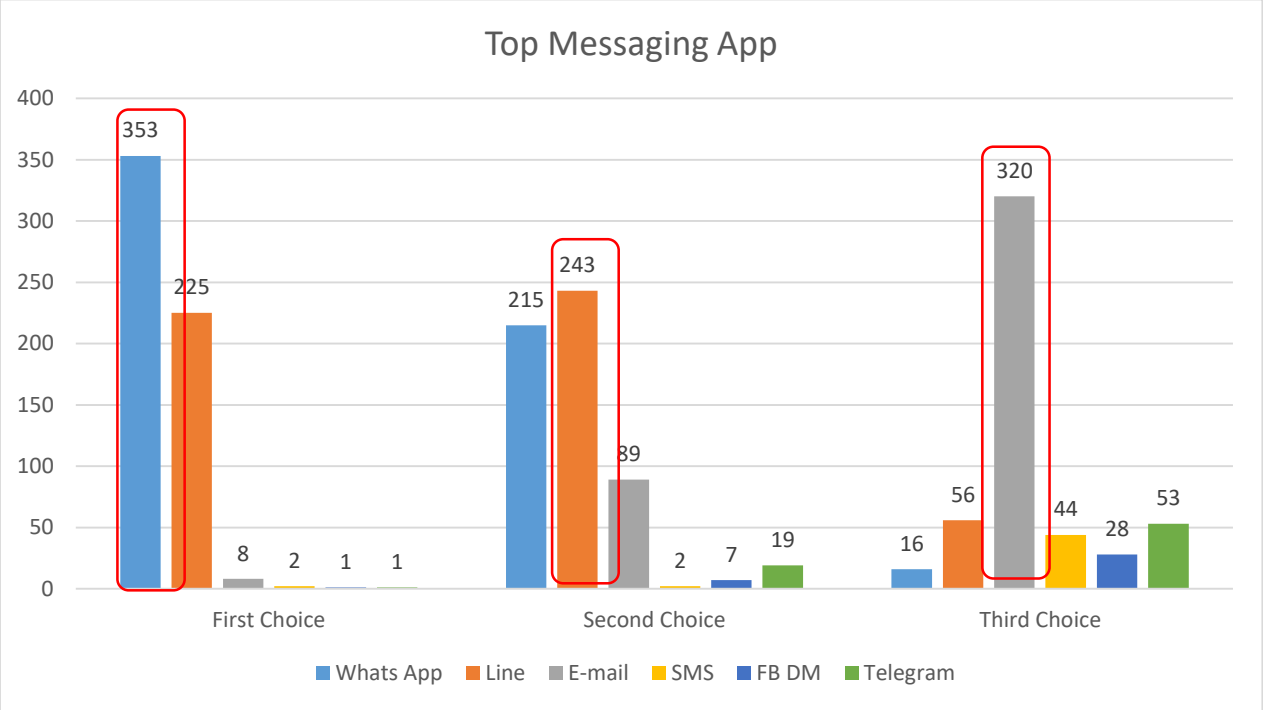
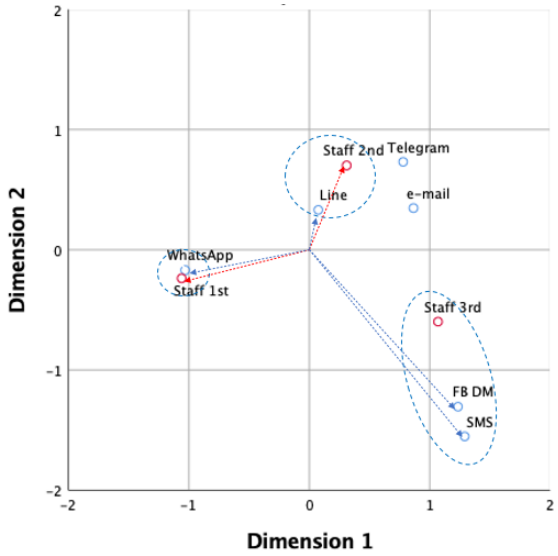


Figure 13. Symmetric Normalization Messaging Application for Staff

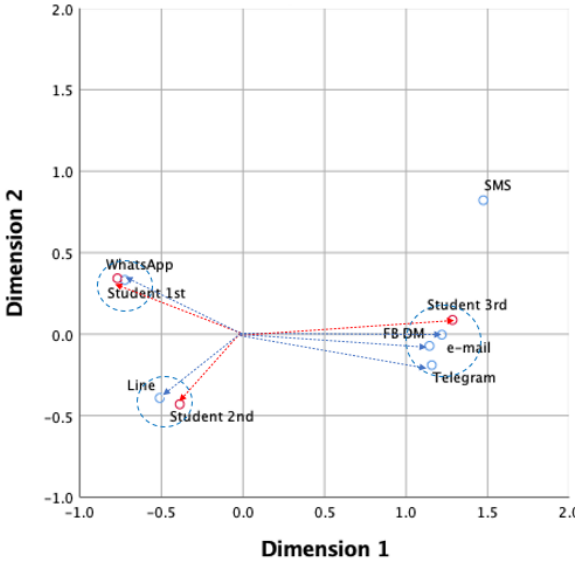


Similar to the previous social media analysis, the Correspondence Analysis for lecturers/staff, as well as for students produces 100% retention because the contingency tables for lecturers/staff and students have only 3 dimensions (priority 1, 2, 3).

The CA plots (Figure 13 and Figure 14), however, show slight differences between lecturer/staff priorities and students, especially for rank 3 as summarized

in Table 6.

Figure 14. Symmetric Normalization Messaging Application for Students

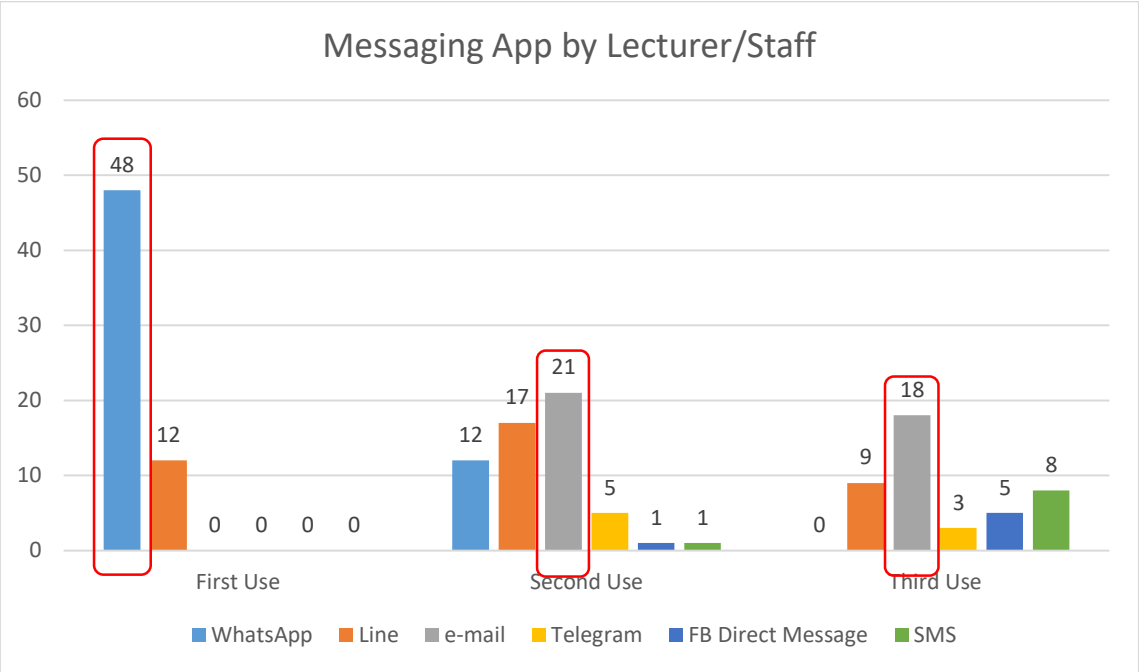


At first glance, the CA results in Table 6 seem to produce accurate results. These conclusions, however, are somewhat counterintuitive, because the Lecturer/Staff segment does not include e-mail as a top 3 priority, even though much daily professional communication among lecturers/staff utilizes e-mail, as presented in Figure 15.

Table 6. Differences In Messaging Application Preferences for Lecturers/Staff And Students

	Lecturer/Staff	Students
First Use	WhatsApp	WhatsApp
Second Use	Line	Line
Third Use	FB DM dan SMS	Email, FB-DM, dan Telegram

Figure 15. Messaging Application for Lecturer/Staff



These findings indicate that CA results can lead to erroneous conclusions (Bendixen, 2003 and Bock, 2020) when the procedure is isolated from other data representation methods. The findings corroborate Bock's (2020) recommendation that the interpretation of CA needs to be carried out in conjunction with the review of the initial data in the contingency table.

Figure 15 shows that for the lecturer/staff segment, email is the application of choice for both 2nd priorities (21 respondents) and 3rd priority (18 respondents). The somewhat ambiguous position places email in between the third choice in the CA plot (Figure 13). Lastly, SMS (8 respondents) and FB/DM (5 respondents) were found among the 3rd choice.

The results demonstrate that inaccurate interpretation of CA plots can lead to erroneous conclusions. The interpretation of CA plots needs to be compared with the original data in the contingency table or with other visual representations (e.g. bar charts), as suggested by Bock (2020).

CONCLUSION, IMPLICATION, SUGGESTION, AND LIMITATIONS

The results of this study indicate that the higher education segment has a faculty/staff subsegment that has different preferences in terms of use cases, social media applications, and messaging applications than the student subsegment. For

p-ISSN # 2540-8275
e-ISSN # 2808-4705 Hal. 1-25

lecturers/staff, the top 5 use cases are communication (voice and text), social media, mobile banking, entertainment (video and music player), and e-commerce, whereas the top uses for students were: communication, online lectures, social media, entertainment, and e-commerce.

In terms of social media, the top applications for lecturers/staff are Instagram and Facebook whereas for students: Instagram and TikTok. This shows that Snapchat's position has been overtaken by TikTok. For messaging applications, the lecturer/staff prefer WhatsApp, e-mail, and Line, while the students prefer WhatsApp, Line, and e-mail.

The Correspondence Analysis results confirm that the choice of use case, social media, and messaging application has a significant relationship (association) with the order of priority. This study also shows that Correspondence Analysis can produce a visual presentation of data quickly that is easier to read and more intuitive than a bar chart or contingency table, as long as the interpretation is carefully performed and complemented with other methods.

This exploratory study reveals many opportunities for further research on mobile phone usage, such as comparative studies with data from many institutions. Further research can include more variables (such as spending patterns) that are relevant for telecommunication operators, application developers, and digital marketers.

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