



Development and Evaluation of a Web Based Pharmacoinformatics Application for Excipients in Pharmaceutical Formulation: A Survey of Pharmacy Students Universitas Negeri Gorontalo

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ABSTRACT

The objective of this study was to assess the effectiveness and usability of the web based Pharmacoinformatics Application for Excipients designed to provide users with critical information on excipients used in pharmaceutical formulations. A total of 100 respondents participated in the study, completing a questionnaire assessing their experiences and opinions about the application. The reliability of the questionnaire was evaluated using Cronbach's Alpha, and Exploratory Factor Analysis (EFA) was conducted to ensure data suitability. Additionally, one-way ANOVA tests were performed to compare responses across gender, age, and semester level groups. The questionnaire demonstrated high reliability, with a Cronbach's Alpha value of 0.981. The EFA results indicated the data's suitability for further analysis. The one-way ANOVA tests showed no significant differences in responses across gender, age, or semester level, suggesting uniformity in participants' views. The average score for the application ranged between 4.25 and 4.44, indicating general satisfaction with its functionality, though slight variation was noted for question Q19. In conclusion, the web-based Pharmacoinformatics Application for Excipients application was well-received by the majority of respondents, with consistent positive feedback regarding its usability and effectiveness in aiding the understanding of excipients. The findings suggest that the application is a valuable tool for students and professionals in pharmaceutical education, though further development is planned to enhance its accessibility and features.

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1. Introduction

The advancement of science and technology in the field of pharmacy has had a significant impact on the way drugs are designed and developed. One of the key components in pharmaceutical formulation is the use of excipients, inactive substances that play a vital role in improving the stability, effectiveness, and usability of dosage forms. Excipients do not only serve as carriers for active pharmaceutical ingredients but also influence bioavailability, solubility, and absorption of drugs in the body. Therefore, a comprehensive understanding of the various excipients used in formulations is crucial for pharmacy students and professionals in the field [1].

In pharmaceutical education, it is important to integrate theory with practical applications to prepare students for real-world challenges. While the study of excipients is included in the curriculum, it is often considered secondary to the focus on active ingredients. However, in practice, the selection and appropriate use of excipients significantly impact the quality of pharmaceutical products. Hence, pharmacy education needs to introduce resources that allow students to thoroughly understand, access, and evaluate information related to excipients [2], [3], [4].

The development of information technology presents a significant opportunity for enhancing pharmacy education. Web-based applications have become an effective tool for providing comprehensive, easily accessible, and up-to-date information on various aspects of pharmacy. These applications offer the advantage of accessibility without the constraints of time and location, making them an ideal tool for enriching learning and training for pharmacy students. With the advancement of technology, such applications can facilitate teaching, research, and self-study on specific topics, including excipients in pharmaceutical formulations [5], [6], [7].

In this context, this study aims to develop and evaluate a web-based pharmacoinformatics application focused on excipients used in pharmaceutical formulations. This application is designed to provide comprehensive information on the chemical structures, physicochemical properties, benefits, applications in formulations, and incompatibilities of excipients. The information presented in this tool aims to help pharmacy students understand the characteristics of excipients and how they influence the quality and performance of pharmaceutical products. With this platform, students are expected to deepen their understanding of a topic that is often overlooked in traditional pharmaceutical education [8], [9], [10].

It is essential to note that, while web-based applications offer great potential, their effectiveness largely depends on how well students can utilize them in their learning processes. Therefore, this study also includes a survey to assess pharmacy students' understanding and perceptions of the application [11], [12]. The survey, conducted with 100 pharmacy students at varying academic levels, provides a representative sample of how effective this application is in enhancing students' knowledge of excipients. This evaluation is crucial to determine the success of the application in achieving its educational objectives [12], [13], [14].

This research not only focuses on the development of the application but also on evaluating its impact on students' knowledge. Through surveys completed by students, the study seeks to gain insights into the acceptance and usefulness of the tool, as well as how it aids students in understanding and applying knowledge about excipients in the context of pharmaceutical formulations. This evaluation is key to assessing the success of the application in fulfilling its educational goals.

Overall, this study aims to contribute to the use of information technology in pharmacy education, particularly in the teaching of excipients in pharmaceutical formulations. With this web-based application, it is hoped that pharmacy students will

be better prepared to meet the challenges of a rapidly evolving pharmaceutical industry. Additionally, the application can serve as a useful resource for pharmacy professionals in accessing information on excipients that can improve the quality and safety of pharmaceutical products.

2. Methods

Materials

This study aims to evaluate the effectiveness of a web-based pharmacoinformatics application, “**Pharmacoinformatics Application for Excipients**”, which was developed in collaboration with the Indonesian Pharmacists Association (Ikatan Apoteker Indonesia). The application provides comprehensive information about excipients used in pharmaceutical formulations. The study involved 100 pharmacy students from various universities negeri gorontalo, with students from different academic years participating in the survey. The methodology used to assess the impact of the application is outlined below.

Development of the Web-Based Application

The web based application, Pharmacoinformatics Application for Excipients, was designed to provide users with detailed information on pharmaceutical excipients, including their chemical structure, properties, solubility, benefits, usage in formulations, concentration guidelines, and incompatibilities. The application is accessible via the website <https://apotekergorontalo.com/farmasi-explore/> . It serves as an educational tool for pharmacy students, allowing them to search for excipient-related information efficiently and comprehensively

Survey Participants

The participants in this study were 100 pharmacy students from various universities across Indonesia. These students were at different academic levels, including freshmen, sophomores, juniors, and seniors. The sample was chosen to provide a diverse representation of pharmacy students’ perspectives on the usability and impact of the application.

Questionnaire Design

A structured questionnaire was developed to assess the participants' perceptions of the application’s usefulness, ease of use, and its impact on their learning. The questionnaire consists of six main sections.

1. Information: This section collects demographic data, including gender, age, academic year (semester), and university affiliation.
2. Perception of the Application's Usefulness: This section evaluates the perceived benefits of using the Pharmacoinformatics Application for Excipients application for finding excipient information. Can be seen in table 1.

Table 1. Perception of the Application's Usefulness

Number Of Question	Description
Q1	The Pharmacoinformatics Application for app helps me to more easily find information about excipients.
Q2	This app provides accurate and useful information in the context of learning pharmaceutical formulations.
Q3	I feel that this application can improve my understanding of the types of excipients in pharmaceutical preparations.
Q4	The app provides comprehensive and easy-to-understand information on excipients

3. **Ease of Use Application :** This section assesses the application's user interface and navigation. Can be seen table 2.

Table 2. Ease of Use Application

Number Of Question	Description
Q5	The interface of the Pharmacoinformatics Application for Excipients app is easy to use and navigation is clear.
Q6	The search feature in this application is effective for finding the required excipients
Q7	I feel this application is very user-friendly for pharmacy students to search for excipients.

4. **Impact on Learning:** This section explores the application's effect on students' understanding of excipients in pharmaceutical formulations. Can be seen table 3.

Table 3. Impact on Learning

Number Of Question	Description
Q8	The use of this app has helped me understand better the components of pharmaceutical formulations.
Q9	I feel more confident in choosing the right excipients for pharmaceutical formulations after using this app.
Q10	This application has accelerated my learning process related to the selection of excipients in the formulation of pharmaceutical preparations

5. **Perception of the Application:** This section assesses the overall satisfaction with the application. Can be seen table 4.

Table 4. Perception of the Application

Number Of Question	Description
Q11	The Structure Formulation feature on the app helps me to better understand the chemical structure of the excipient I am looking for.
Q12	The Excipient Description feature in the app provides clear and sufficient information on the properties of excipients.
Q13	The Solubility feature helps me to know how easily the excipients can dissolve in various commonly used solvents
Q14	The benefits of excipients provided in the app clarify the role of those excipients in pharmaceutical formulations
Q15	The information on Concentration of Use in the application is very helpful to me in determining the correct dosage for excipients in the formulation.
Q16	The Incompatibility feature helps me to avoid using excipients that may interact negatively with other active ingredients in the formulation

6. General evaluation of the application. Looking at the overall impact of the application on its users. Can be seen table 5.

Table 5. General evaluation of the application

Number Of Question	Description
Q17	Overall, I found the Pharmacoinformatics Application for Excipients app very useful in supporting my learning
Q18	I would recommend this app to my friends who are also pharmacy students
Q19	This application is better than other methods in finding excipients in literature or other sources.

Overall, I find the application “Pharmacoinformatics Application for Excipients” very useful in supporting my learning, I would recommend this application to my fellow pharmacy students and This application is superior to other methods of searching for excipient information in literature or other resources.”

Likert Scale

Each statement in the questionnaire is evaluated using a Likert scale, where participants rate their level of agreement with each statement on a scale from 1 to 5: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree.

Data Analysis

Data collected from the survey will be analyzed using **SPSS** (Statistical Package for the Social Sciences). The following statistical tests will be conducted:

1. Descriptive Statistics: Descriptive statistics, including mean, standard deviation, frequency distribution, and percentages, will be used to summarize the responses from the survey. These measures will provide an overview of the data and allow for an understanding of general trends in the participants' perceptions and experiences.

2. Validity and Reliability Testing: Cronbach's alpha will be calculated to assess the internal consistency and reliability of the questionnaire. This will ensure that the items in the survey consistently measure the intended constructs.
3. Exploratory Factor Analysis (EFA): EFA will be conducted to identify the underlying factors or dimensions that explain the variance in the participants' responses. This technique will help in understanding how different survey items group together and form meaningful factors (e.g., ease of use, usefulness, impact on learning). **Principal Component Analysis (PCA)** may be used as part of the factor extraction process to reduce the dimensionality of the data.
4. ANOVA (Analysis of Variance): ANOVA will be performed to evaluate whether there are significant differences in perceptions of the application based on participants' academic year (semester) and other demographic factors such as age, gender, and university affiliation.

3. Results

The web based pharmacoinformatics application is designed to facilitate easy access to information about excipients used in pharmaceutical formulations. Figure 1 the front interface of the application, showcasing two key features: A) the excipient list view, where users can search and select various excipients, and B) the detailed description view, which displays in-depth information about the selected excipient, including its chemical structure, physical properties, solubility, and role in formulations. Can be seen figure 1

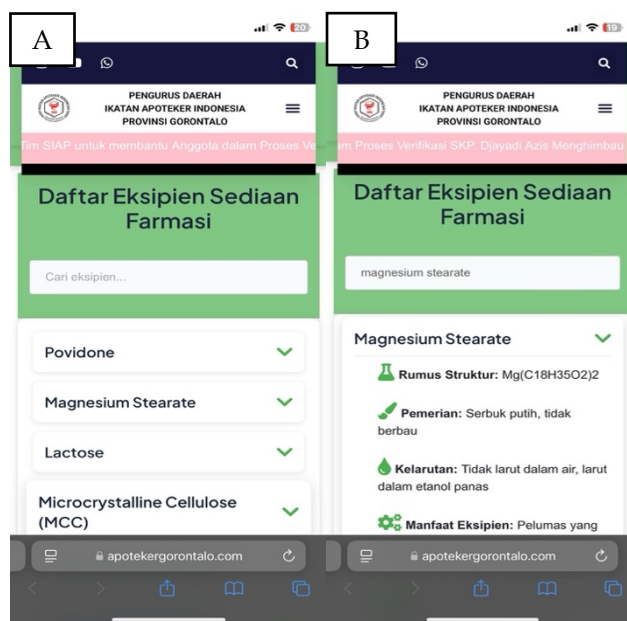


Figure 1. the front interface of the web-based application. A) Excipient list view, B) Description view of excipient information

The application is designed using WordPress as the base platform, with the Elementor add-on to simplify the HTML coding process in creating the layout and displaying excipient information. All excipient data used in the application are sourced from scientific literature, including journals and supporting research books. The application is freely accessible to everyone, including students and professionals who

require excipient data. Currently, the application is available in Indonesian and is being developed progressively.

The following table shows the demographic data of the respondents who completed the questionnaire in this study. The data includes information on the age, gender, and semester level of the respondents, which provides an overview of the characteristics of the sample involved in the study.

Table 6. Data Respondents filling out the questionnaire (n=100)

Factors	Frequency	Percentase (%)
Age (years)		
17-20	76	76
21-25	24	24
Total	100	100
Gender		
Male	15	15
Female	85	85
Total	100	100
Semester Level		
Level 1-2	38	38
Level 3-4	31	31
Level 5-6	21	21
Level 7-8	10	10
Total	100	100

This table presents the demographic data of the respondents who completed the questionnaires in this study. The table includes three main factors: **Age**, **Gender**, and **Semester Level**. Based on age, the majority of respondents were between 17 to 20 years old (76%), while the rest were between 21 to 25 years old (24%). For gender, the majority of respondents were female (85%) compared to male (15%). In terms of semester level, most respondents were from semester 1-2 (38%), followed by semester 3-4 (31%), semester 5-6 (21%), and semester 7-8 (10%). This data provides an overview of the diverse characteristics of the respondents in terms of their age, gender and education level. Can be seen table 6.

The following table shows the results of the reliability test using Cronbach's Alpha for the questionnaires used in this study. A high Cronbach's Alpha value indicates excellent internal consistency of the instrument used. The table also includes information regarding the number of items tested and the percentage of validity of the data used. Can be seen table 7.

Table 7. Reliability Statistics

Factors	Yield
Cronbach's Alpha	0.981
Cronbach's Alpha Based on Standardized Items	0.977
N of Items	22
Valid (%)	100

This table presents the reliability test results for the questionnaires used in this study. The **Cronbach's Alpha** value of **0.981** indicates an excellent level of internal consistency, which means that this questionnaire is highly reliable for measuring the

variables in question. The **Cronbach's Alpha Based on Standardized Items** value of **0.977** also supports the excellent results. The table also lists the number of **22** items tested, with all data used (**100% valid**) indicating that no data was excluded during the reliability analysis.

The following table shows the results of the Exploratory Factor Analysis (EFA) test involving the KMO and Bartlett's Test of Sphericity. The high KMO values and significant results of the Bartlett's Test support the eligibility of the data for further factor analysis, indicating that the data is eligible to conduct exploratory factor analysis. Can be seen table 8.

Table 8. Exploratory Factor Analysis (EFA) test

Factors	Yield
Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy	0.928
Barlett's Test Of Sphericity :	
- Approx. Chi-Square	3631.567
- df	231
- Sig.	<0.001

Note : df degrees of freedom Sig. significance

This table shows the results of the Exploratory Factor Analysis (EFA) test, which includes two main tests: Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity. The KMO value of 0.928 indicates that the data is very suitable for further analysis by factor analysis, because a high KMO value indicates a fairly strong correlation between the variables being analyzed. In addition, Bartlett's Test of Sphericity produces an Approx. Chi-Square = 3631.567, with df = 231, and a significance value <0.001. These results indicate that the correlation matrices between variables are significantly non-identical, which means the data has sufficient relationships between variables to proceed to the further stages of factor analysis. Overall, the results of these two tests support the appropriateness of the data for Exploratory Factor Analysis. Can be seen table 8.

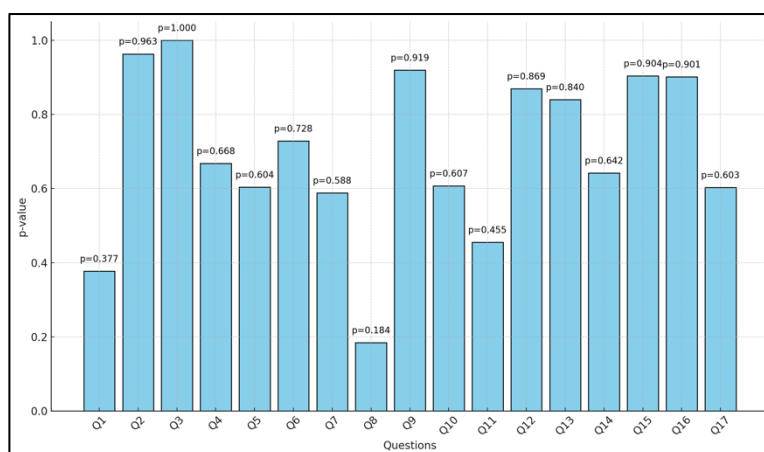


Figure 2. ANOVA test results by gender: P-Values for each question

Table 9. Anova One Way test with comparison of questionnaire data by gender

Question	Sum of Squares (Between Groups)	df	Mean Square	F	Sig. (p-value)
Q 1	0.637	1	0.637	0.789	0.377
Q 2	0.002	1	0.002	0.002	0.963
Q 3	0.0	1	0.0	0.0	1.0
Q 4	0.133	1	0.133	0.185	0.668
Q 5	0.214	1	0.214	0.271	0.604
Q 6	0.095	1	0.095	0.122	0.728
Q 7	0.227	1	0.227	0.295	0.588
Q 8	1.484	1	1.484	1.793	0.184
Q 9	0.01	1	0.01	0.01	0.919
Q 10	0.227	1	0.227	0.267	0.607
Q 11	0.452	1	0.452	0.563	0.455
Q 12	0.024	1	0.024	0.027	0.869
Q 13	0.038	1	0.038	0.041	0.84
Q 14	0.188	1	0.188	0.217	0.642
Q 15	0.754	1	0.754	0.904	0.344
Q 16	0.013	1	0.013	0.016	0.901
Q 17	0.254	1	0.254	0.272	0.603
Q 18	0.397	1	0.397	0.473	0.493
Q 19	0.044	1	0.044	0.044	0.835

Note : df degrees of freedom Sig. significance

The results of the one-way ANOVA test on the questionnaire data comparing differences in responses by gender showed that there were no significant differences between men and women on most questions. The p-value for almost all questions is greater than 0.05, which means that the null hypothesis of no difference between gender groups cannot be rejected. For example, in questions Q1 (p-value 0.377), Q2 (p-value 0.963), and Q19 (p-value 0.835), no significant difference was found between genders. Thus, it can be concluded that gender did not significantly influence respondents' answers to this questionnaire, indicating a uniformity of views between men and women in the context under study. Can be seen figure 2 and table 9.

Table 10. Anova One Way test with comparison of questionnaire data by age

Question	Sum of Squares (Between Groups)	df	Mean Square	F	Sig. (p-value)
Q 1	0.382	1	0.382	0.472	0.494
Q 2	0.101	1	0.101	0.125	0.725
Q 3	0.009	1	0.009	0.01	0.921
Q 4	0.046	1	0.046	0.065	0.8
Q 5	1.14	1	1.14	1.465	0.229
Q 6	0.039	1	0.039	0.05	0.824
Q 7	0.042	1	0.042	0.055	0.815
Q 8	0.228	1	0.228	0.271	0.604
Q 9	0.507	1	0.507	0.551	0.46

Q 10	0.825	1	0.825	0.978	0.325
Q 11	0.007	1	0.007	0.009	0.925
Q 12	0.534	1	0.534	0.617	0.434
Q 13	0.194	1	0.194	0.208	0.649
Q 14	0.246	1	0.246	0.284	0.595
Q 15	0.442	1	0.442	0.528	0.469
Q 16	0.011	1	0.011	0.013	0.909
Q 17	0.295	1	0.295	0.316	0.575
Q 18	0.711	1	0.711	0.849	0.359
Q 19	0.055	1	0.055	0.054	0.816

Note : df degrees of freedom Sig. significance

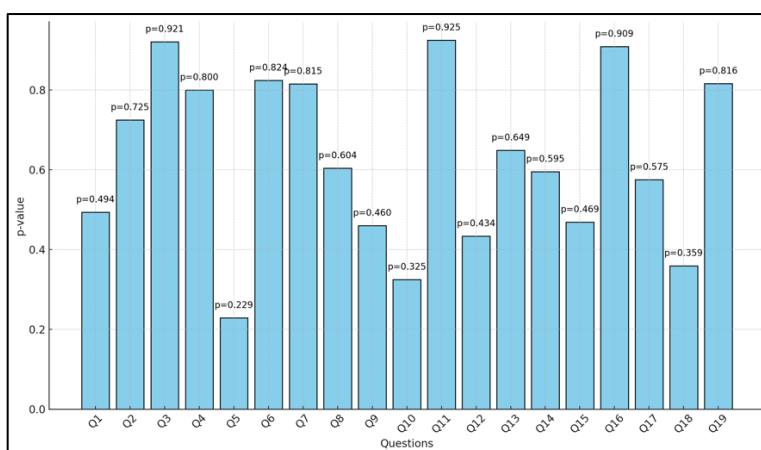


Figure 3. ANOVA Test Results By Age: P-Values For Each Question

results of the one-way ANOVA test on the questionnaire data comparing differences in responses by age showed that there were no significant differences between age groups on most questions, with p-values greater than 0.05 on almost all questions. For example, in questions Q1 (p-value 0.494), Q2 (p-value 0.725), and Q19 (p-value 0.816), no significant differences were found between age groups. This is also true for other questions such as Q8 (p-value 0.604), Q15 (p-value 0.469), and Q18 (p-value 0.849). Thus, it can be concluded that age did not significantly influence the responses to this questionnaire. Can be seen figure 3 and table 10.

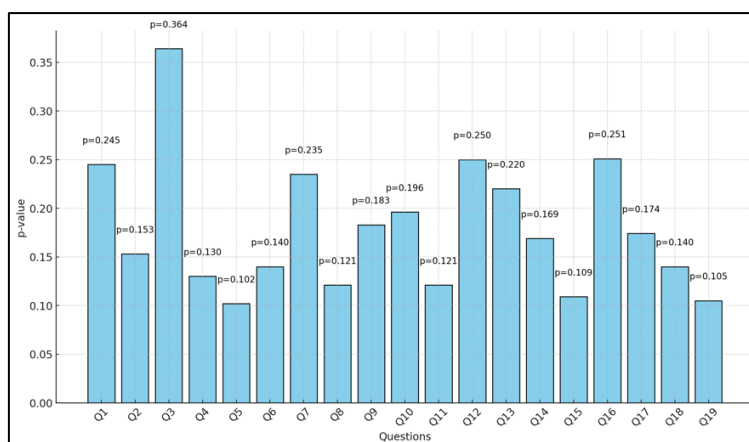


Figure 4. ANOVA Test Results By Semester level : P-Values For Each Question

Table 11. Anova One Way test with comparison of questionnaire data by semester level

Question	Sum of Squares (Between Groups)	df	Mean Square	F	Sig. value)	(p-
Q 1	3.362	3	1.121	1.408	0.245	
Q 2	4.245	3	1.415	1.798	0.153	
Q 3	2.791	3	0.93	1.073	0.364	
Q 4	4.004	3	1.335	1.931	0.13	
Q 5	4.813	3	1.604	2.122	0.102	
Q 6	4.219	3	1.406	1.869	0.14	
Q 7	3.258	3	1.086	1.442	0.235	
Q 8	6.063	3	2.021	2.535	0.061	
Q 9	4.439	3	1.48	1.649	0.183	
Q 10	3.967	3	1.322	1.595	0.196	
Q 11	4.627	3	1.542	1.99	0.121	
Q 12	3.555	3	1.185	1.391	0.25	
Q 13	4.09	3	1.363	1.496	0.22	
Q 14	4.337	3	1.446	1.714	0.169	
Q 15	5.02	3	1.673	2.075	0.109	
Q 16	3.27	3	1.09	1.388	0.251	
Q 17	4.602	3	1.534	1.69	0.174	
Q 18	4.567	3	1.522	1.869	0.14	
Q 19	6.088	3	2.029	2.102	0.105	

Note : df degrees of freedom Sig. significance

The results of the one-way ANOVA test on the questionnaire data comparing differences in responses by semester level showed that there were no significant differences between semester level groups on most questions, with p-values greater than 0.05 on almost all questions. For example, in questions Q1 (p-value 0.245), Q2 (p-value 0.153), and Q19 (p-value 0.105), no significant differences were found between semester levels. This is also true for other questions such as Q5 (p-value 0.102), Q6 (p-value 0.14), and Q15 (p-value 0.109). Although there are some questions with p-values close to 0.05, such as Q8 (p-value 0.061) and Q9 (p-value 0.061), overall, it can be concluded that semester level does not significantly affect the responses to this questionnaire. Can be seen figure 4 and table 11.

Table 12. Average score for all questionnaires

Question	Mean	Std. Deviation
Q 1	4.39	0.898
Q 2	4.39	0.898
Q 3	4.4	0.932
Q 4	4.42	0.843
Q 5	4.31	0.884
Q 6	4.34	0.879
Q 7	4.38	0.874
Q 8	4.29	0.913
Q 9	4.29	0.957

Q 10	4.38	0.919
Q 11	4.36	0.894
Q 12	4.37	0.928
Q 13	4.38	0.913
Q 14	4.37	0.962
Q 15	4.34	0.928
Q 16	4.44	0.913
Q 17	4.32	0.891
Q 18	4.35	0.963
Q 19	4.25	0.999

Mean : ¹ Strongly Disagree, ² Disagree, ³ Neutral, ⁴ = Agree and ⁵ = Strongly Agree.

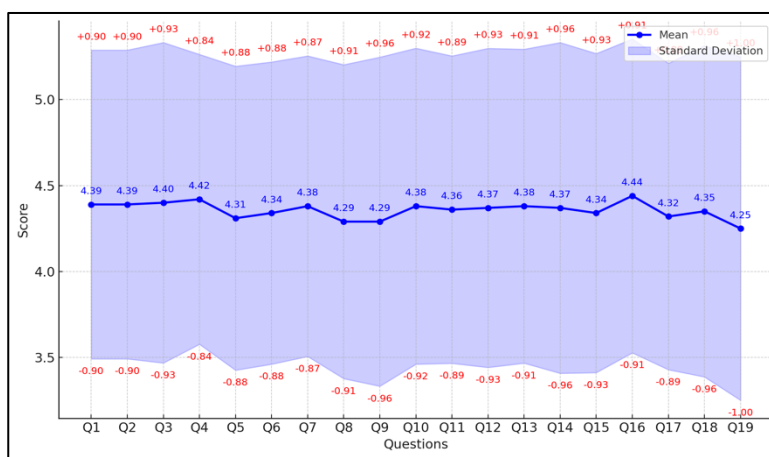


Figure 5. Average scores and standard deviation for each question

The results of the 100 respondents' assessment of the 19 questions in the questionnaire showed that the "Pharmacoinformatics Application for Excipients" application was generally well received, with most questions obtaining an average score between 4.25 and 4.44, meaning that respondents tended to agree or strongly agree with the statement. This suggests that the app is considered useful and effective in aiding understanding of excipients in pharmaceutical formulations. However, question Q19 had the lowest mean score of 4.25, indicating slightly greater disagreement among respondents. Standard deviations for most questions ranged from 0.84 to 0.96, indicating consistency in respondents' ratings, although Q19 had a higher standard deviation of 0.999, signaling greater variation in ratings for the question. Overall, this data shows that the app was very well received by the majority of respondents with relatively little variation in ratings. Can be seen figure 5 and table 12.

4. Discussion

The web based pharmacoinformatics application provides an efficient and accessible platform for users, particularly students and professionals, to obtain critical information about excipients used in pharmaceutical formulations. As shown in Figure 1, the interface is designed for ease of use, with two key views: the excipient list view (A) allows users to search for and select from a list of excipients, while the description view (B) presents detailed information about the selected excipient, including its chemical structure, physical properties, solubility, and role in formulations. This

design ensures that users can quickly navigate through the available data, making it a valuable tool for those involved in pharmaceutical practice and education. The application is developed using WordPress, with the Elementor add-on, to streamline the coding process, and all excipient data are sourced from authoritative scientific literature, ensuring accuracy and reliability. Although currently available only in Indonesian, the application is planned to be developed further, with additional features and language support to enhance its accessibility.

The demographic data of the respondents who completed the questionnaire reveals important insights about the characteristics of the sample population. As shown in Table 6, the majority of respondents were between 17 to 20 years old, comprising 76% of the sample, while the remaining 24% were aged 21 to 25 years. This age distribution suggests that the majority of respondents were likely university students, which aligns with the context of the study being related to pharmaceutical education and excipient knowledge. In terms of gender, there was a significant imbalance, with 85% of the respondents identifying as female compared to 15% male. This gender disparity could be a reflection of the demographic composition of the study population or the nature of the field, which may attract more female participants [15], [16].

Regarding the semester level, the distribution of respondents across different semester levels highlights the academic experience of the participants. Most of the respondents were from the 1st to 2nd semester (38%), followed by the 3rd to 4th semester (31%), and the 5th to 6th semester (21%). A smaller portion of respondents were from the 7th to 8th semester (10%). This distribution suggests that the study predominantly involved participants who were in the early stages of their academic journey, which may influence their level of familiarity with pharmaceutical excipients. The data provides a comprehensive overview of the respondents' age, gender, and semester level, offering valuable context for the analysis of their responses to the questionnaire and their familiarity with excipient information [17], [18], [19].

The reliability test results for the questionnaires used in this study demonstrate excellent internal consistency, as indicated by the Cronbach's Alpha value of 0.981. This high value suggests that the questionnaire is highly reliable for measuring the intended variables. Additionally, the Cronbach's Alpha Based on Standardized Items value of 0.977 further supports the robustness of the instrument, ensuring that it produces consistent results across different items. The data also show that all 22 items tested were valid, with a 100% validity rate, confirming that no data was excluded during the reliability analysis. These results underscore the high quality and reliability of the questionnaire used in this study [20], [21], [22].

The results of the Exploratory Factor Analysis (EFA) test, shown in Table 8, confirm the suitability of the data for further analysis. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy, with a value of 0.928, indicates that the data is highly suitable for factor analysis, as this high KMO value reflects a strong correlation between the variables being analyzed. Additionally, the Bartlett's Test of Sphericity produces a significant result with an Approximate Chi-Square value of 3631.567 (df = 231, $p < 0.001$), indicating that the correlation matrices between the variables are significantly non-identical. This result supports the conclusion that there are sufficient relationships between the variables to proceed with the subsequent stages of factor analysis. Overall, these tests validate the appropriateness of the data for conducting Exploratory Factor Analysis, confirming the robustness and reliability of the data for further statistical examination [23], [24].

The results of the one-way ANOVA test comparing responses by gender revealed no significant differences between men and women on most questions, as shown in Table 9 and Figure 2. The p-value for almost all questions is greater than 0.05, meaning that the null hypothesis of no difference between gender groups cannot be rejected. Specifically, for questions Q1 ($p = 0.377$), Q2 ($p = 0.963$), Q10 ($p = 0.607$), Q12 ($p = 0.869$), Q13 ($p = 0.041$), Q14 ($p = 0.642$), Q15 ($p = 0.344$), and Q19 ($p = 0.835$), no significant difference was found between male and female respondents. This indicates a uniformity of responses between genders in the context of the study, supporting the idea that gender does not significantly influence the participants' answers to the questionnaire. These findings suggest that both male and female participants have similar views and attitudes toward the issues addressed in the survey [25], [26].

The results of the one-way ANOVA test comparing responses by age, presented in Table 10 and Figure 3, indicate no significant differences between the age groups for most questions, as the p-values for nearly all questions exceed the 0.05 threshold. For example, questions Q1 ($p = 0.494$), Q2 ($p = 0.725$), and Q19 ($p = 0.816$) showed no significant differences between age groups. This finding is consistent across other questions, including Q8 ($p = 0.604$), Q15 ($p = 0.469$), and Q18 ($p = 0.849$), where age did not significantly influence responses. The lack of significant variation suggests that the age of the respondents did not notably affect their answers to the survey, supporting the idea that the factors addressed in the questionnaire are not age-dependent. These findings emphasize the uniformity in responses regardless of age, as shown in Figures 3 and Table 5.

The results of the one-way ANOVA test comparing responses by semester level, presented in Table 11 and Figure 4, show that there were no significant differences between semester level groups for most of the questions, as the p-values for nearly all questions exceed the 0.05 threshold. For instance, questions Q1 ($p = 0.245$), Q2 ($p = 0.153$), and Q19 ($p = 0.105$) did not reveal any significant differences between the semester levels. This pattern holds true for several other questions, including Q5 ($p = 0.102$), Q6 ($p = 0.14$), and Q15 ($p = 0.109$), indicating that semester level did not significantly influence the responses to the questionnaire. However, a few questions approached statistical significance, such as Q8 ($p = 0.061$) and Q9 ($p = 0.061$). Despite these near-significant findings, it can be concluded that semester level does not significantly affect respondents' answers to this questionnaire, further confirming the consistency of the participants' responses across different academic stages.

The results from the 100 respondents' assessment of the 19 questions in the questionnaire reveal that the Pharmacoinformatics Application for Excipients application was generally well-received by the participants. With most of the questions yielding average scores between 4.25 and 4.44, it indicates that respondents mostly agreed or strongly agreed with the statements provided. These findings suggest that the application is considered effective in aiding the understanding of excipients in pharmaceutical formulations. The highest average score was observed for questions related to the application's usefulness and ease of use, which aligns with the positive reception of the tool for educational purposes. However, question Q19, with the lowest mean score of 4.25, indicated slightly more disagreement among respondents [4], [9], [27]. Despite this, the standard deviations for most questions ranged from 0.84 to 0.96, demonstrating a relatively high level of consistency in the respondents' ratings. Question Q19, however, had a slightly higher standard deviation of 0.999, suggesting greater variation in responses, potentially reflecting differing individual experiences with the application. Overall, the data shows that the app was well-received by the majority of respondents with only slight variation in responses, as seen in Figure 5 and

Table 12, indicating its reliability and effectiveness as a tool for learning about excipients [1], [28].

Conclusion

In conclusion, the web-based Pharmacoinformatics Application for Excipients has been well-received by the majority of respondents, as evidenced by the high average scores and consistency in responses. The application, developed using WordPress and Elementor, provides an accessible and efficient platform for obtaining critical information about pharmaceutical excipients. The study's demographic data reveals a predominantly young, female student population, with a strong representation from early-semester students. Reliability tests confirmed the robustness of the questionnaire used, with excellent internal consistency and validity. The results of the Exploratory Factor Analysis (EFA) test also support the appropriateness of the data for further analysis. Additionally, the one-way ANOVA tests comparing responses by gender, age, and semester level showed no significant differences, suggesting that the responses were consistent across these demographic groups. Overall, the application is an effective tool for enhancing the understanding of excipients, with future plans for further development and expansion.

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References

- [1] S. P. Chaudhari and P. S. Patil, "Pharmaceutical Excipients: A review," *Int. J. Adv. Pharmacy, Biol. Chem.*, vol. 1, no. 1, pp. 21-34, 2012.
- [2] Z. Li, "On the role of excipients and their future development," *BIO Web Conf.*, vol. 61, 2023, <https://doi.org/10.1051/bioconf/20236101029>
- [3] S. Narasimha Murthy and M. A. Repka, "Excipient Stability: a Critical Aspect in Stability of Pharmaceuticals," *AAPS PharmSciTech*, vol. 19, no. 1, p. 11, 2018, <https://doi.org/10.1208/s12249-017-0902-2>
- [4] N. Fathima, T. Mamatha, H. K. Qureshi, N. Anitha, and J. Venkateswara Rao, "Drug-excipient interaction and its importance in dosage form development," *J. Appl. Pharm. Sci.*, vol. 1, no. 6, pp. 66-71, 2011.
- [5] J. Jeffries, P. Jeffries, J. Hertig, and K. Hultgren, "Embracing Pharmacy E-Learning: Models of Success," *Pharmacy*, vol. 1, no. 1, pp. 43-52, 2013, <https://doi.org/10.3390/pharmacy1010043>
- [6] C. D. Kebodeaux and V. Mak, "Using Technology to Enhance Teaching and

- Learning in Pharmacy Education," *Pharmacy*, vol. 9, no. 3, p. 150, 2021, <https://doi.org/10.3390/pharmacy9030150>
- [7] C. O'hare and B. Girvin, "A Narrative Overview of the Effectiveness of E-Learning in Pharmacy Education Journal of Pharmacy Practice and Pharmaceutical Sciences," pp. 9-23, 2018.
- [8] V. S. Dave, R. V Haware, N. A. Sangave, M. Sayles, and M. Popielarczyk, "Drug-Excipient Compatibility Studies in Formulation Development: Current Trends and Techniques," *Am. Assoc. Pharm. Sci.*, vol. 1-2015, pp. 9-15, 2015.
- [9] V. Saluja and B. S. Sekhon, "The regulation of pharmaceutical excipients," *J. Excipients Food Chem.*, vol. 4, no. 3, pp. 95-106, 2014.
- [10] S. S. Bharate, S. B. Bharate, and A. N. Bajaj, "Interactions and incompatibilities of pharmaceutical excipients with active pharmaceutical ingredients: A comprehensive review," *J. Excipients Food Chem.*, vol. 1, no. 3, pp. 3-26, 2010.
- [11] K. J. Suda, A. B. Guirguis, J. L. Easterling, and A. S. Franks, "Online education: Student pharmacist exposure and perceptions.," *Pharm. Educ. An Int. J. Pharm. Educ.*, vol. 13, no. 1, pp. 172-176, 2013.
- [12] O. O. Vlashyn, O. A. Adeoye-Olatunde, K. S. Illingworth Plake, J. L. Woodyard, Z. A. Weber, and A. L. Russ-Jara, "Pharmacy students' perspectives on the initial implementation of a teaching electronic medical record: Results from a mixed-methods assessment," *BMC Med. Educ.*, vol. 20, no. 1, pp. 1-14, 2020, <https://doi.org/10.1186/s12909-020-02091-8>
- [13] H. Abdel-Halim, "Enhancing medicinal chemistry knowledge and student interest: Incorporating pharmacy practice related case studies and active-learning strategies," *Pharm. Educ.*, vol. 20, pp. 168-178, 2020, <https://doi.org/10.46542/pe.2020.201.168178>
- [14] A. E. Johnson, J. Barrack, J. M. Fitzgerald, D. M. Sobieraj, and L. M. Holle, "Integration of a Virtual Dispensing Simulator 'MyDispense' in an Experiential Education Program to Prepare Students for Community Introductory Pharmacy Practice Experience," *Pharmacy*, vol. 9, no. 1, p. 48, 2021, <https://doi.org/10.3390/pharmacy9010048>
- [15] R. Kaur, T. Singh, D. Basu, and R. Kumar, "Prevalence and pattern of psychoactive substance use among female students aged 18-25 years in universities of North India," *Int. J. Community Med. Public Heal.*, vol. 6, no. 2, p. 602, 2019, <https://doi.org/10.18203/2394-6040.ijcmph20190176>
- [16] L. Gonsalves, K. Wyss, J. A. Cresswell, M. Waithaka, P. Gichangi, and A. Martin Hilber, "Mixed-methods study on pharmacies as contraception providers to Kenyan young people: Who uses them and why?," *BMJ Open*, vol. 10, no. 7, 2020, <https://doi.org/10.1136/bmjopen-2019-034769>
- [17] S. A. Jacob and A. C. Boyter, "Survey of undergraduates' perceptions of experiential learning in the mpharm programme: The tell project," *Pharm. Pract. (Granada)*, vol. 18, no. 2, pp. 1-11, 2020, <https://doi.org/10.18549/PharmPract.2020.2.1856>
- [18] I. Södervik, L. Hanski, and N. Katajavuori, "First-year pharmacy students' prior knowledge correlates with study progress and reveals different dynamics of misconceptions," *Pharm. Educ.*, vol. 20, no. 1, pp. 94-102, 2020, <https://doi.org/10.46542/pe.2020.201.94102>
- [19] I. Paper and R. Noll, "The Three Studies," vol. 8, 2010.
- [20] N. Ismail, S. Azhar Shah, N. Safian, And S. Nor Mat, "Internal Consistency Study of EORTC QLQ-C30 and QLQ-PR25 Questionnaires for Quality of Life Assessment among Prostate," *Int. J. Public Health*, vol. 10, no. 1, pp. 1158-1165,

- 2019.
- [21] S. J. Wafudu, Y. Bin Kamin, and D. Marcel, "Validity and reliability of a questionnaire developed to explore quality assurance components for teaching and learning in vocational and technical education," *Humanit. Soc. Sci. Commun.*, vol. 9, no. 1, pp. 1-10, 2022, <https://doi.org/10.1057/s41599-022-01306-1>
- [22] M. Siyoum, W. Teklesilasie, R. Nardos, B. Sirak, and A. Astatkie, "Reliability and validity of the Sidaamu Afoo version of the pelvic organ prolapse symptom score questionnaire," *BMC Womens. Health*, vol. 23, no. 1, pp. 1-10, 2023, <https://doi.org/10.1186/s12905-023-02478-x>
- [23] B. K. Nkansah, "On the Kaiser-Meier-Olkin's Measure of Sampling Adequacy," *Math. Theory Model.*, vol. 8, no. 7, pp. 52-76, 2018, [Online]. Available: www.iiste.org
- [24] M. W. Watkins, "Exploratory Factor Analysis: A Guide to Best Practice," *J. Black Psychol.*, vol. 44, no. 3, pp. 219-246, 2018, <https://doi.org/10.1177/0095798418771807>
- [25] B. Dahl, "Lack of Gender Differences in Engineering Students' Assessment of Group-Based Project Exams," *SEFI 2022 - 50th Annu. Conf. Eur. Soc. Eng. Educ. Proc.*, pp. 225-233, 2022, <https://doi.org/10.5821/conference-9788412322262.1128>
- [26] G. Kaiser and Y. Zhu, "Gender differences in mathematics achievement: A secondary analysis of Programme for International Student Assessment data from Shanghai," *Asian J. Math. Educ.*, vol. 1, no. 1, pp. 115-130, 2022, <https://doi.org/10.1177/27527263221091373>
- [27] S. P. Apte, "Excipients and food chemicals: More than merely coincidental bedfellows," *J. Excipients Food Chem.*, vol. 1, no. 2, pp. 1-2, 2010.
- [28] E. Vrania, "Drug- Excipients Interactions," pp. 56-58, 2004. <https://doi.org/10.17305/bjbms.2004.3421>