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Development of an interactive pharmacology themed card game to enhance health science students' knowledge

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Abstract

Background: Health science students often find pharmacology difficult because of the large number of scientific terms, drug names, drug classes, indications, and side effects they must understand. Therefore, interactive and engaging learning materials are needed to enhance health science students' knowledge. This study developed a pharmacology-themed card game containing drug names, drug classifications based on indications, drug indications, drug side effects, and drug safety levels to facilitate basic pharmacology learning.
Method: This study is a research and development (R&D) project that employs the ADDIE development model with a quasi-experimental approach and a pre-test and post-test control group design. The study sample consisted of 98 students, divided into an intervention group and a control group of 49 students each, using cluster sampling. Data were collected from pre-test and post-test results, as well as a user satisfaction questionnaire.
Results: An interactive media card game was successfully developed using the ADDIE model. The results of the Wilcoxon test showed a significant difference between the pre-test and post-test scores in each group ($p < 0.05$). However, the Mann–Whitney test showed no significant difference in the increase in knowledge between the two groups ($p > 0.05$). The intervention group had a higher average increase in knowledge scores, and most students reported being very satisfied with the use of the media.
Conclusion: An interactive pharmacology-themed card game can be used as an engaging learning tool and has been shown to improve health students' knowledge, although this improvement was not significantly different from that achieved through conventional learning methods.

Keywords: Card Game; Pharmacology; Educational Media

INTRODUCTION

Scientific progress in the modern era is supported by advancements in education, particularly in the use of technology-based learning media (1). Pharmacology education plays a vital role in Indonesia's educational system, where universities are expected to produce graduates capable of understanding medications accurately and safely (2). However, the abundance of scientific terminology and drug classifications which health science students find challenging leads to low motivation and poor learning outcomes among students (3). Furthermore, the use of conventional learning media is considered ineffective and has not been able to engage students in an enjoyable learning experience (4).

A study on game-based learning in France found that a "pharmacotrophy" group game tournament in a pharmacy program was shown to improve students' exam scores (5). The international card game "What The Pharma?" was also effective in simplifying basic pharmacology material, making it more concise and easier to understand (2). A study in Palangka Raya on the use of multimedia-based instructional videos had a positive impact on students' pharmacology learning outcomes (6). Additionally, a nutrition card game in Mataram was shown to improve students' nutrition knowledge. The

development of an Android-based antibiotic identification app and the Med-Pharm app was also deemed effective in supporting the evaluation of pharmacy coursework (1,7).

Although innovations in card games for pharmacology have advanced abroad, pharmaceutical education media in Indonesia are currently still dominated by individual-based digital platforms, which can limit direct social interaction among students during the learning process (1,7). The use of card games in Indonesia has actually been proven effective in improving knowledge, but their application has been limited to teaching balanced nutrition to elementary school students (6). This situation indicates that there is currently no concise card game specifically designed to support basic pharmacology courses for students in Indonesia.

Based on these conditions, this study developed an interactive pharmacology-themed card game to be used in lectures as an engaging and user-friendly learning tool. This interactive pharmacology-themed card game includes content on drug names, drug classes based on indications, drug side effects, and drug classes based on safety levels. This study aims to develop an interactive pharmacology-themed card game and to determine the effectiveness of its use in improving the knowledge of health science students.

METHOD

This study employed the ADDIE research and development (R&D) model with a quasi-experimental approach using a pre-test and post-test control group design. The ADDIE model consists of five stages: analysis, design, development, implementation, and evaluation. This study was conducted in the Department of Health Analysts, Three-Year Pharmacy Diploma Program, Bengkulu Public Health Polytechnic under the Ministry of Health.

The study sample consisted of first-year students in the Three-Year Pharmacy Diploma Program who met the inclusion criteria, totaling 98 respondents: 49 students in the intervention group (Class A) and 49 students in the control group (Class B). The intervention group received instruction in the form of pharmacology handouts and an interactive pharmacology-themed card game, while the control group received instruction in the form of pharmacology handouts.

Inclusion criteria included first-year students in the Three-Year Pharmacy Diploma Program who had taken or were currently taking a course in basic pharmacology, were willing to participate as subjects, and participated in the entire research process; subjects who were present at the time of the study. Exclusion criteria included students in the Three-Year Pharmacy Diploma Program; students who had not taken a course in basic pharmacology; subjects who did not participate in the entire research process; subjects who were unwilling to participate; and subjects who were not present at the time of the study.

The research instrument consisted of 20 multiple-choice pre-test and post-test items based on basic pharmacology material. The Guttman scale was used, with correct answers scored as 1 and incorrect answers scored as 0. The results were obtained from the total score of correct answers, which was then converted into a score ranging from 0 to 100 (8). Before use, the pre-test and post-test instruments were pilot-tested on 30 respondents with characteristics similar to those of the research sample. The results of the validity test using Pearson's Product-Moment correlation indicated that the 20 items were valid after revisions were made, while the reliability test using Cronbach's Alpha yielded a value of 0.692, confirming that the instruments were reliable and suitable for use in the study.

Knowledge was assessed using pre-tests and post-tests. The data were analyzed using IBM SPSS Statistics. The Shapiro-Wilk test was used to assess normality. If the data were normally distributed, the pre-test and post-test scores for each group were analyzed using

a parametric test, namely the Paired Samples t-test; whereas if the data were not normally distributed, the Wilcoxon test was used to compare the pre-test and post-test scores for each group, and the Mann-Whitney test was used to compare the increase in knowledge between the intervention group and the control group. This study was reviewed and received ethical approval from the Health Research Ethics Committee (KEPK) of the Bengkulu Ministry of Health Polytechnic (Poltekkes Kemenkes Bengkulu) prior to its implementation, under No. KEPK.BKL/542/06/2026.

RESULTS

This study involved 98 first-year students in the Three-Year Pharmacy Diploma Program at the Bengkulu Ministry of Health Polytechnic who met the inclusion criteria. The respondents consisted of 49 students in the intervention group and 49 students in the control group. The study results covered the respondents' characteristics and the development of an interactive card game.

Respondent Characteristics

Table 1. Respondent Characteristics

Characteristics	Intervention (n=49)	Control (n=49)	Number of Categories	Persentase
Gender				
Men	1	0	1	1%
Women	48	49	97	99%
Age				
17 years old	0	1	1	1%
18 years old	20	20	40	41%
19 years old	24	26	50	51%
20 years old	4	2	6	6%
21 years old	0	0	0	0%
22 years old	1	0	1	1%

Table 1 shows the characteristics of the respondents in this study. Based on gender, the majority of respondents were female (99%). Based on age, most were between 18 and 19 years old (92%). Respondents aged 17 accounted for 1% of the total.

Development of an Interactive Card Game

a. Media Production Process

The interactive card game was developed using the Canva application. During this phase, the designs for the cards, leaflets, and storage box were created in accordance with the predetermined pharmacology material (Figure 1).



Figure 1. Creating Media Using the Canva Pro® App

b. Final Media Design

Following revisions, the final design of the interactive card game was finalized, consisting of a card box, medication name cards, medication cards, action cards, and a game instruction leaflet (Figure 2, Figure 3, Figure 4, Figure 5, Figure 6).



Figure 2. Card Box



Figure 3. Drug Information Card



Figure 4. Medication Card



Figure 6. Game Rules Information Sheet

Overview of Knowledge Scores for Respondents in the Intervention and Control Groups Before and After the Intervention

Table 2. Overview of Knowledge Scores

Group	n	Mean	Std. Deviation	Minimum	Maximum
Intervention	49				
Pre-Test		67.35	22.82	15	100
Post-Test		93.47	5.79	80	100
Control	49				
Pre-Test		69.49	23.05	15	100
Post-Test		87.76	15.58	20	100

After being provided with learning materials in the form of handouts and an interactive pharmacology-themed card game, the respondents took a post-test (Table 2). The pre-test results showed an average knowledge score of 67.35 with a standard deviation of 22.82, a minimum score of 15, and a maximum score of 100. After being provided with learning materials in the form of handouts and an interactive

pharmacology-themed card game, the respondents took a post-test, and their average knowledge score increased to 93.47 with a standard deviation of 5.79, a minimum score of 80, and a maximum score of 100.

In the control group, before being provided with the learning material in the form of handouts, the respondents took a pre-test with an average knowledge score of 69.49, a standard deviation of 23.05, a minimum score of 15, and a maximum score of 100. After being provided with the learning material in the form of handouts, the respondents took a post-test. The post-test results showed that the average knowledge score increased to 87.76 with a standard deviation of 15.58, a minimum score of 20, and a maximum score of 100.

Normality Test for Respondents' Knowledge Scores

Table 3. Normality Test Results

Group	n	Shapiro-Wilk Test (*p*-Value)	Description
Intervention	49		
Pre-Test		0.002	Abnormal
Post-Test		0.000	
Control	49		
Pre-Test		0.000	Abnormal
Post-Test		0.000	

The Shapiro-Wilk test showed (Table 3) that the p-values were 0.002 for the intervention group's pre-test, 0.000 for the intervention group's post-test, 0.000 for the control group's pre-test, and 0.000 for the control group's post-test. All significance values were less than 0.05 ($p < 0.05$), so it can be concluded that the respondents' knowledge scores across all groups were not normally distributed. The normality test included the Shapiro-Wilk test (*p*-value) and the results are presented in (Table 4).

5. The Test of the Effect of Knowledge Scores

Table 4. Test of the Effect of Knowledge Scores

Group	Good (76-100)	Fair (56-75)	Poor (<55)	Mann-Witney Test (*p*-Value)
Intervetion				
Pre-Test	22 (44.90%)	12 (24.29%)	15 (30.61%)	
Post-Test	49 (100%)	0 (0%)	0 (0%)	0.109
Control				
Pre-Test	23 (46.94%)	15 (30.61%)	11 (22.45%)	
Post-Test	41 (83.67%)	6 (12.24%)	2 (4.08%)	

The pre-test results for the intervention group showed (Table 4) that 22 students (44.90%) had a "good" level of knowledge, 12 students (24.49%) had a "fair" level, and 15 students (30.61%) had a "poor" level. After the intervention, the post-test results showed that all 49 students (100%) were in the "good" knowledge category, meaning there were no longer any students in the "fair" or "poor" knowledge categories.

In the control group, the pre-test results showed that there were 23 students (46.94%) in the "good" knowledge category, 15 students (30.61%) in the "adequate"

knowledge category, and 11 students (22.45%) in the "poor" knowledge category. In the post-test results, the number of students in the "good" knowledge category increased to 41 students (83.67%), while the number of students in the "adequate" knowledge category decreased to 6 students (12.24%) and the number in the "poor" knowledge category decreased to 2 students (4.08%).

The results of the Wilcoxon Signed-Rank Test showed a *p*-value of 0.000 for both the intervention and control groups ($p < 0.05$), indicating a significant difference between the pre-test and post-test knowledge scores in each group. Furthermore, the results of the Mann Whitney test showed a *p*-value of 0.109 ($p > 0.05$), indicating that there was no statistically significant difference in knowledge improvement between the intervention group, which received instruction using handouts and an interactive card game, and the control group, which received instruction using handouts. The analysis of the effect of knowledge scores included the categories of good, fair, and poor, as well as the Wilcoxon test (*p*-value) and the Mann–Whitney test (*p*-value).

Card Game User Satisfaction Survey

Table 5. Survey Results

Category	n	Percentage (%)
Very Satisfied	41	83.67
Satisfied	8	16.33
Neutral	0	0
Dissatisfied	0	0
Very Dissatisfied	0	0

The results of the satisfaction survey regarding the use of interactive card games (Table 5) show that the majority of respondents fell into the "very satisfied" category, namely 41 respondents (83.67%). Furthermore, 8 respondents (16.33%) fell into the "satisfied" category. No respondents fell into the "neutral," "dissatisfied," or "very dissatisfied" categories.

DISCUSSION

Based on the study, the majority of respondents in this study were women (99%). Another study involving pharmacy students was also dominated by women (87.2%) (9). In terms of age, 92% of the respondents in this study were between the ages of 18 and 19. A study conducted on first-year pharmacy students also showed similar results, with respondents ranging in age from 18 to 22 years(10).

This research project to develop an interactive card game on pharmacology employs the ADDIE research and development (R&D) model. This model consists of the following stages: analysis, design, development, implementation, and evaluation.

Analysis

The analysis phase involved analyzing the learning needs for the basic pharmacology course, which covers drug names, drug classes based on indications, drug indications, drug side effects, and drug classes based on safety levels—all of which students need to understand. The abundance of scientific terms and drug classifications, which students find difficult, leads to low motivation to learn (3).

A study on game-based learning in Jepara showed that the application of this method can increase students' active engagement (11). Furthermore, a study on game-based learning in Yogyakarta also indicated that this medium develops students' thinking skills, creativity, communication, and collaboration through interactive learning activities (12).

At this stage, an analysis of basic pharmacology materials was also conducted. The results yielded an interactive card game consisting of drug names, drug classes based

on indications, drug indications, drug side effects, and drug classes based on safety levels. Additionally, this analysis utilized the Specialty Practicum and Health Terminology Module as well as the book *Pharmacology of Important Drugs in the Study of Pharmacy and the Health Sciences*. An analysis was also conducted to determine the support needed for developing the card game media using the Canva Pro application.

Design

During this design phase, the initial design and layout of the product are developed, consisting of a card box, a game instruction leaflet, medication name cards, medication class cards based on indications, medication indication cards, medication side effect cards, medication class cards based on safety levels, and action cards.

This card game can be played in groups using a scoring system. The game continues for several rounds until one player reaches a loss score of 50 points. The game ends when one player reaches that score, and the player with the lowest remaining score is declared the winner. The game system is designed so that students can play the game multiple times, allowing them to memorize, understand, and reinforce their mastery of pharmacology material through a process of repeated learning.

The design of these card game materials was created with careful consideration of visual presentation, color selection, font size, and information layout to ensure the content is easy to read and understand. The color selection for these card game materials was chosen to distinguish between card categories, making it easier for students to recognize the information presented. In addition to serving as a distinguishing feature, the use of different colors for each card category also helps increase students' attention and engagement during the learning process. The results of a study on visual design (color and typography) in Padang indicate that the use of bright, attractive, consistent, and theme-appropriate colors can assist students in the learning process (13).

The selection of font type and size on the cards was also adjusted to ensure the information is easily readable by students. The use of clear fonts in appropriate sizes aims to improve the readability of the information so that students can understand the card content more easily. Research findings on visual design (color and typography) in Padang also indicate that the use of simple, consistent fonts with a minimum size of 12 pt is considered ideal, as it helps students better understand the material (13).

Development

Based on the research findings, the development phase involved creating educational materials using the Canva Pro app, which resulted in a set of Pharma Edu Cards. Each set consists of 1 box of cards, 1 game instruction leaflet, 15 drug name cards, 15 drug class cards based on indications, 15 drug indication cards, 15 drug side effect cards, 15 drug class cards based on safety levels, and 12 action cards consisting of 4 reverse cards, 4 plus cards, and 4 block cards.

The game, which has been completed and developed, has undergone improvements to several components, namely the card box, the game instruction leaflet, and the addition of explanatory information at the top of the cards. The size of the box was adjusted to include a slit, making it easier to remove the cards. Additionally, the game instruction leaflet was revised to clarify the sequence of play, helping players better understand the flow of the card game. The final improvement was made to the game cards themselves: descriptive information was added to the top of each card, including drug class based on indication, drug

indication, side effects, and drug class based on safety level, so that players can identify the type of card they hold. The results of the interactive card game study in Yogyakarta indicate that the media design has become a ready-to-use educational product through refinements to the media's appearance, content, and functionality (14).

Implementation

Based on the research findings, the implementation phase involved using the interactive card game that had been developed and providing instructional materials in the form of handouts to 98 first-year students in the Three-Year Pharmacy Diploma Program at the Bengkulu Public Health Polytechnic (Poltekkes Kemenkes Bengkulu) who met the inclusion criteria. This study was conducted to determine the effectiveness of an interactive pharmacology-themed card game in improving the knowledge of health science students after they were provided with instructional materials in the form of handouts and the interactive pharmacology-themed card game.

This study began by dividing the students into two groups: the intervention group (Class A) and the control group (Class B). Both groups took a pre-test to assess their initial level of knowledge before being provided with the instructional materials. The intervention group (Class A) received instruction in the form of pharmacology handouts and an interactive pharmacology-themed card game, while the control group (Class B) received only the pharmacology handouts. After the instruction, both groups took a post-test to assess their knowledge levels following the use of the learning materials. The intervention group also completed a satisfaction survey to gauge their satisfaction with the interactive pharmacology-themed card game.

The pre-test results for the intervention group showed that 22 students (44.90%) had a "good" level of knowledge, 12 students (24.49%) had a "fair" level, and 15 students (30.61%) had a "poor" level. After the intervention, the post-test results showed that all 49 students (100%) were in the "good" knowledge category, meaning there were no longer any students in the "fair" or "poor" knowledge categories.

In the control group, the pre-test results showed that 23 students (46.94%) were in the "good" knowledge category, 15 students (30.61%) were in the "adequate" category, and 11 students (22.45%) were in the "poor" category. In the post-test results, the number of students in the "good" knowledge category increased to 41 students (83.67%), while the number of students in the "adequate" knowledge category decreased to 6 students (12.24%) and the number in the "poor" knowledge category decreased to 2 students (4.08%).

Based on the research results, the average knowledge scores of both the intervention and control groups increased. The increase in scores in both groups indicates that the instruction provided was effective in enhancing students' knowledge of basic pharmacology. Findings from a study on the impact of a nutrition card game in Jakarta suggest that the increase in average scores may be attributed to the influence of the instructional medium used. Additionally, this improvement may also have been influenced by the discussions that took place during the game (15).

The increase in the average knowledge score in the intervention group occurred not only because students received learning materials in the form of handouts but also because they gained a more active learning experience through an interactive pharmacology-themed card game. Through this interactive card game, students were required to recall and name medications, drug

classes based on indications, drug indications, side effects, and drug classes based on safety levels.

The Shapiro-Wilk normality test was conducted to determine the distribution of the research data. Based on the results of the normality test, the p-values for all data groups were less than 0.05 ($p < 0.05$), indicating that the data were not normally distributed. Consequently, further statistical analysis was conducted using the nonparametric Mann-Whitney test to analyze differences in the increase in knowledge scores between the intervention group and the control group.

The absence of a statistically significant difference between the intervention and control groups may be influenced by several factors. Although the intervention group received additional learning activities through the interactive card game, both groups received the same pharmacology handout containing the main learning materials. The availability of comprehensive written materials may have provided sufficient information for students in the control group to improve their knowledge, thereby reducing the additional measurable contribution of the card game. Furthermore, the duration and frequency of card game implementation may have influenced its effectiveness. Game-based learning activities may require repeated exposure and integration into structured learning sessions to produce a clearer impact on cognitive outcomes. Therefore, the card game developed in this study should be considered a complementary learning medium rather than a replacement for conventional learning materials. Future studies may evaluate longer intervention periods, repeated gameplay sessions, and broader pharmacology topics to determine its educational effectiveness more comprehensively.

The results of the Wilcoxon Signed-Rank Test showed a p-value of 0.000 for both the intervention and control groups ($p < 0.05$), indicating a significant difference between pre-test and post-test knowledge scores in each group. Furthermore, the results of the Mann–Whitney test showed a p-value of 0.109 ($p > 0.05$), indicating that there was no significant difference in the increase in knowledge between the intervention group which received instruction using handouts and an interactive card game and the control group which received instruction using handouts alone. Additionally, the control group also received the same handout materials, which could be used as a learning resource, allowing them to still experience an increase in knowledge after the instruction took place.

The results of a study on nutrition card games in Malang show that the use of card-game-based learning media can increase student engagement during the learning process because it combines educational and game elements in a single medium (6). In addition, the results of a study on interactive games in Riau show that game-based learning can increase motivation to learn and help students understand the material through a more interactive learning experience (16).

Evaluation

Instructional media are useful tools for conveying information more effectively. With interactive instructional media, an engaging learning process can foster interest and enjoyment in the learning process (17).

The results of the satisfaction survey regarding the use of interactive card games showed that the majority of respondents fell into the "very satisfied" category, namely 41 respondents (83.67%). Furthermore, 8 respondents (16.33%) fell into the "satisfied" category. No respondents fell into the

"neutral," "dissatisfied," or "very dissatisfied" categories.

Based on the research findings, the evaluation phase was conducted to determine students' responses to the interactive card game used during the learning process. The evaluation was carried out by distributing a satisfaction survey to students after the entire learning sequence was completed. The majority of students rated the interactive card game as "very satisfied" or "satisfied." These results indicate that the developed medium received positive feedback from students, both in terms of its appearance, ease of use, presentation of material, and the learning experience gained while using the medium.

The results of a study on interactive games in Riau show that game-based learning media can create a more enjoyable learning experience, thereby increasing students' motivation, engagement, and satisfaction during the learning process (16). Additionally, the results of a study on a nutrition card game in Malang indicate that the use of card games not only enhances students' knowledge but also provides a more interactive learning experience, leading students to respond positively to the media used (6).

Furthermore, based on the evaluation results for the card game used, the quality of the card materials should be improved in the future, or more durable materials should be used. Long-term use can cause the cards to become damaged due to friction during gameplay, resulting in the images and text on the cards becoming damaged and difficult to read.

The high level of student satisfaction in this study indicates that the interactive card game has an attractive design, is easy to use, and effectively supports the learning process in Basic Pharmacology. Nevertheless, this medium still has several limitations, such as a scope of material that is still limited to a few topics in basic pharmacology and the fact that its use requires guidance at the beginning of the game. Therefore, future development of this medium is expected to increase the variety of material, refine the game mechanics, and expand its application

CONCLUSIONS

An interactive pharmacology-themed card game can improve health students' knowledge, although statistically, it did not show a significant difference. However, based on the actual data, the study results indicate a difference in the average increase in scores between the intervention group and the control group, as measured by the difference between pre-test and post-test scores.

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